Initial Environmental Examination for Representative Subprojects

November 2017

People's Republic of China: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility:

1. Advanced Biogas and Organic Fertilizer Subproject
2. Industrial By-product Gas Utilization Subproject
3. Smart Industrial Zone Development Subproject
4. Deep-well Geothermal District Heating Subproject
5. Super ESCO Subproject

Prepared by China Energy Conservation and Environmental Protection Group for the Asian Development Bank

Initial Environmental Examination (Draft)

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People's Republic of China: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility (Advanced Biogas and Organic Fertilizer Subproject)

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CURRENCY EQUIVALENTS

(as of 7 November 2017)

Currency unit	–	yuan (CNY)		
CNY1.00	=	$0.1514	or	€0.1299
$1.00	=	CNY6.6045	or	€0.8578
€1.00	=	CNY7.6995	or	$1.1658

ABBREVIATIONS

ADB	Asian Development Bank
AP	Affected People
AQI	Air Quality Index
CECEP	China Energy Conservation and Environmental Protection Group
CNG	Compressed Natural Gas
EA	Executing Agency
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EPB	Environmental Protection Bureau
ESMS	Environment and Social Management System
FIL	Financial intermediation loan
FSR	Feasibility Study Report
GDP	Gross Domestic Product
GHG	Green House Gas
GIP	Good International Practice
GRM	Grievance Redress Mechanism
IA	Implementing Agency
IEE	Initial Environmental Examination
IT	Interim Target
LAR	Land Aquisation and Resettlement
MAC	Maximum Acceptable Concentration
MEP	Ministry of Environmental Protection
MSDS	Material Safety Data Sheet
NG	Natural Gas
PCR	Physical Cultural Resources
PPE	Personnel Protective Equipment
PPTA	Project Preparatory Technical Assistance
PRC	People's Republic of China
SPS	Safeguard Policy Statement, ADB

TA	Technical Assistance
THC	Total Hydro Carbon
TSP	Total Suspended Particulates
VOCs	Volatile Organic Compunds
WB	World Bank
WHO	World Health Organization

WEIGHTS AND MEASURES

BOD_5	Biochemical Oxygen Demand, five days
$CaCO_3$	Calcium Carbonate
cm	Centimeter
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
dB(A)	A-weighted sound pressure level in decibels
DO	Dissolved Oxygen
kg	Kilogram
km	Kilometer
kWh	Kilowatt Hour
Leq	Equivalent Continuous Noise Level
m	Meter
m/s	Meters per Second
m^2	Square Meters
m^3	Cubic Meters
mg/l	Milligrams per Liter
mg/m^3	Milligrams per Cubic Meter
$\mu g/m^3$	Micrograms per Cubic Meter
NO_x	Nitrogen Oxides
^oC	Degrees Celsius
O_3	Ozone
pH	A measure of the acidity or alkalinity of a solution
PM	Particulate Matter
PM_{10}	Particulate Matter with diameter less than 10 micrometers
$PM_{2.5}$	Particulate Matter with diameter less than 2.5 micrometers
SO_2	Sulfur Dioxide
t/h	Tons per Hour

NOTES

(i) In this report, "$" refers to US dollars.

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EXECUTIVE SUMMARY

A. Introduction

1. This is the Initial Environmental Examination (IEE) report for the Advanced Biogas and Organic Fertilizer Subproject of proposed People's Republic of China (PRC): Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility.

2. The subproject uses anaerobic fermentation technology for biogas production. The produced biogas is then purified and compressed. The compressed bio-natural gas is sold to consumers to replace gasoline and diesel for transport in the gas station. The biogas residue and slurry is used to produce organic fertilizer in replacement of chemical fertilizer.

B. Policy, Legal, and Administrative Framework for Environmental Impact Assessment

3. Environmental impact assessment (EIA) procedures have been established in the PRC for over 20 years. Domestic EIA studies are required to be undertaken by relevant PRC environmental laws and regulations. National and local legal and institutional frameworks for EIA review and approval ensure that proposed projects are environmentally sound, designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environmental, health, social, or safety hazards.

4. Following ADB's Safeguard Policy Statement (SPS 2009), an Environmental and Social Management System (ESMS) for the financial intermediation loan (FIL) has been formulated to provide the screening, categorization, and review procedures for subproject selection. In implementing this FIL, subprojects should follow the screening and categorization procedures set out in the ESMS. The subproject has been classified as environment category B following SPS 2009 and the ESMS, and an IEE is required.

C. Implementation Arrangements

5. China Energy Conservation and Environmental Protection Group (CECEP) Green Carbon Environmental Protection Company will be the subborrower and responsible for day-to-day management during subproject preparation and implementation. CECEP will be the executing agency (EA) and responsible for overall guidance during project preparation and implementation.

D. Description of the Environment

1. Location and Topography

6. The subproject will be implemented at Yingju Town, Fengqiu County, located southeast of Xinxiang, a prefecture-level city. Xinxiang City is located in northeast Henan Province at the North China Plain. Xinxiang City's total jurisdiction area occupies 8,249 square kilometers (km^2). About 10% of Xinxiang is hilly, 12% is mountainous, and 78% is plains. The subproject site is located near the urban core of Yingju Town, Fengqiu County, Xinxiang City, and topography in this area is generally flat.

2. Meteorology and Climate

7. Xinxiang City has a continental monsoon climate with four distinct seasons. Autumn is

cool and Spring usually comes early. Xinxiang has a humid subtropical hot summer climate that is mild with dry winters, hot humid summers and moderate seasonality (Köppen-Geiger classification: Cwa). According to the Holdridge life zones system of bioclimatic classification, Xinxiang is situated in or near the warm temperate thorn steppe biome.

8. The average annual temperature at Xinxiang is 14.5°C, with the highest monthly average temperature occurring in July (32°C) and the lowest in January (-5°C). Over the last 50 years the highest daily temperature was 43°C, recorded in June 1951, and the lowest was -21°C, recorded in January 1951.

9. **Precipitation**. Annual precipitation in Xinxiang from 1950–2011 was 581 millimeter (mm), of which 72.3% occurs in the June to August period. The lowest recorded annual precipitation was 241.8 mm in 1997 and the highest was 1168.4 mm in 1963.

3. Water Resources

10. Xinxiang rides on the water systems of the Yellow River and Haihe River. The plains take up 78% of its whole area. At present, the capacity of the reservoir is 199 million cubic meter (m^3). The Yellow River runs about 170 kilometer (km) and cover an area of 4,558 km^2 in Xinxiang. In 2016, Xinxiang city has 2.005 billion m^3 of water resources and 349.05 m^3 per capita.

11. The main groundwater sources for Xinxiang are from Yellow River and Haihe River. Total groundwater resource in Xinxiang is 1.123 billion m^3, while 559 million m^3 is in Yellow River basin, and 564 million m^3 is in Haihe River basin.

4. Ecological and Sensitive Resources

12. The subproject site is within city limits in a highly developed and modified agricultural and urban environment. Surrounding land uses include agricultural, mixed commercial, and residential. Original vegetation cover has been previously removed, and existing site vegetation is completely absent as they are developed agricultural sites, or disturbed dirt with little or no vegetation cover. There are no known rare or endangered flora or fauna, parks, nature reserves or areas with special national, regional or local ecological significance within or adjacent to the subproject site.

5. Socioeconomic Conditions

13. Xinxiang is rich in mineral resources. Coal reserve in Xinxiang is 8.4 billion tons; cement limestone reserve is 10 billion tons; and granite reserve is 2 billion m^3.

14. Xinxiang is one of the important high-quality wheat, grain, and cotton production bases in the PRC. It is also one of livestock production and processing bases in Henan Province. In 2016, the city's gross domestic product (GDP) was CNY214.073 billion, of which the primary sector accounted for 10.4% or CNY22.26 billion; the secondary sector accounted for 49.1% or CNY105.10 billion; and the tertiary sector accounted for 40.5% or CNY86.70 billion.

6. Physical Cultural Resources

15. Xinxiang has a rich history. Xinxiang was site of the Battle of Muye where the Shang Dynasty was overthrown by the Zhou Dynasty. However, the project activities are all on long developed sites within city limits in highly developed and modified industrial and urban environments. There are no known physical cultural resources (PCR) in the subproject site.

E. Anticipated Impacts and Mitigation Measures

16. Anticipated positive and negative environmental impacts of the proposed subproject were assessed based on (i) the Feasibility Study Report (FSR) prepared in 2014, (ii) a technical due diligence review of the FSR undertaken by ADB project preparatory technical assistance (PPTA) consultants, (iii) a domestic EIA report prepared by Xinxiang Environmental Protection Science and Technology Design and Research Institute (XEPSTDRI), (iv) public consultations led by the subborrower and assisted by ADB PPTA consultants, and (v) site visits, surveys, and consultations undertaken by ADB PPTA consultants.

17. Environmental impacts during pre-construction, construction, and operation phases were each considered separately. The results of the assessment indicate that during the pre-construction phase environmental issues are very limited, and are mostly associated with ensuring appropriate incorporation of mitigation measures into the subproject design.

18. Potential negative environmental impacts during construction phase are short-term and localized, and are associated with soil erosion, construction noise, fugitive dust, disruption of traffic and community services, and risks to worker health and safety. These can be effectively mitigated through good construction and health and safety practices.

19. Potential negative impacts during operation phase are associated with waste and wastewater, noise, odor, boiler emissions, and health and safety risks to workers and the community. These can be effectively mitigated through good operation and health and safety practices.

20. Potential positive impacts during operation phase are significant and long-term, and are associated with emissions and pollution reductions from open burning of straws, chemical fertilizer, and untreated livestock and poultry manure.

21. This subproject adopts a proven and best available technology for agricultural waste treatment and produces 4,200,000 m^3 biogas per year from agricultural waste. It will save 4,715 tons of coal equivalent (tce) of energy per annum and reduce carbon dixode (CO_2), sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter (PM), carbon minoxide (CO), and hydrocarbon/volatile oraganic compounds (VOCs) emission by 15,499 tons, 19.3 tons, 192.7 tons, 514.1 tons, 2,393.2 tons, and 453.3 tons, respectively.

F. Alternative Analysis

22. Xinxiang City is one of the important high-quality wheat, grain, and cotton production bases in the PRC. It is also one of the livestock production and processing bases in Henan Province. Straw and manure treatment is a problem in rural area of Xinxiang City. In the purpose of saving time and convenient treatment, main straw treatment methods in rural area of Xinxiang City are to throw away or open burning which result in air pollution. The main manure treatment method is directly discharged which also result in air pollution and odor gas. Energy regeneration ratio of biomass in rural area of Xinxiang City is less than 30% which results in a waste of energy and environmental pollution.

23. Besides, a common challenge for many biogas projects in the PRC is how to make effective utilization of generated biogas. The subproject has identified a new way to solve the problem.

24. Implementation of the subproject will: (i) significantly reduce fossil oil consumption; (ii) improve air quality; (iii) reduce greenhouse gas (GHG) emissions; and (iv) effective utilization of generated biogas.

G. Information Disclosure and Public Consultations

25. During the domestic EIA preparation, Xinxiang Environmental Protection Bureau (EPB) posted the domestic EIA report on its website in March 2014.

26. The subborrower organized a public consultation meeting in May 2017 in which information was presented on the subproject scope, potential environmental impacts, and proposed mitigation measures. Participants were asked to complete a questionnaire. A total of 15 questionnaires were distributed. Most of the respondents work and live within a 3-km radius of the subproject; 66.7% of respondents knew about subproject either from other person, newspapers or information signs; and 73.3% of respondents indicated that they were already familiar with the subproject benefits after the introduction of the subproject. The top three environmental issues identified by the respondents in their neighborhoods are air quality (53.5%), noise (46.7%), and solid waste pollution (33.3%). Surface water quality and noise were identified as the top two issues during both subproject construction phase and operation phase. However, most participants also indicated that potential air, waste water, solid waste, and noise impacts can be appropriately mitigated.

27. Overall support for the subproject is very strong; 100% of the respondents indicated that the subproject will improve local economic development; 86.7% indicated that the subproject will improve quality of life; and 100% of respondents indicated that they support the subproject.

H. Grievance Redress Mechanism

28. A subproject-level grievance redress mechanism (GRM) has been established to receive and facilitate resolution of complaints about the subproject during the construction and operation phases. The GRM includes procedures for receiving grievances, recording/ documenting key information, and evaluating and responding to the complainants in a reasonable timeframe. Any concerns raised through the GRM will be addressed quickly and transparently, and without retribution to the affected person (AP).

I. Environmental Management Plan

29. A comprehensive environmental management plan (EMP) has been developed to ensure: (i) implementation of identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of environmental monitoring plan (EMoP) against the performance indicators; and (iii) compliance with the PRC's relevant environmental laws, standards and regulations and the ADB's SPS 2009. The EMP includes an EMoP to monitor the environmental impacts of the project and assess the effectiveness of mitigation measures, and a capacity building and training program focused on health, safety, and environment. Organizational responsibilities and budgets are clearly identified for execution, monitoring and reporting. The EMP is presented in Appendix I.

J. Conclusion

30. Through the environmental assessment process, it is concluded that the subproject has: (i) selected appropriate technologies to produce biogas and reduce the emission of pollutants; (ii)

identified potential negative environment impacts and appropriately established mitigation measures; (iii) received public support from the project beneficiaries and AP; (iv) established subproject GRM procedures; and (v) prepared a comprehensive EMP including environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

31. Overall, any minimal adverse environmental impacts associated with the subproject can be prevented, reduced, or minimized through the appropriate application of mitigation measures. It is therefore recommended that: (i) the subproject is classified as environment category B; and (ii) the subproject will be supported by ADB, subject to the implementation of the commitments contained in the EMP and allocation of appropriate technical, financial, and human resources by the subborrower to ensure these commitments are effectively and expediently implemented.

I. INTRODUCTION

A. The Subproject

1. TheAdvanced Biogas and Organic Fertilizer Subproject is located in Fengqiu County, Xinxiang City, Henan Province, PRC. The subproject uses anaerobic fermentation technology for biogas production. The produced biogas is then purified and compressed. The compressed bio-natural gas is sold to consumers to replace gasoline and diesel in compressed natural gas (CNG) stations. The subproject site is located in the Yingju Agriculture Industry Park, it is in the north of Province Road S227, northwest to Yingju Village and South to Nanfan Village, covers an area of about 115.73 mu (77,157 square meters [m^2]).[1]

2. CECEP Green Carbon Environmental Protection Company is the subborrower which is responsible for daily operation and equipment maintenance of the subproject.

B. Introduction of the Subborrower

3. CECEP Green Carbon Environmental Protection Company is a wholly-owned subsidiary of CECEP with a registered capital of CNY700 million. Its main business focus is the utilization of organic waste resources. The company builds overall industrial chain integrating consultancy, planning and design, technology research and development, construction investment, product marketing, operation management, equipment manufacturing, financial services, and provides comprehensive solutions for regions at county-level in organic waste treatment, distributed energy and agriculture waste utilization. It aims to promote environmental protection, resource utilization, eco-organic agriculture, and clean energy. The company aims to become (i) the largest organic fertilizer supplier, (ii) the largest biogas supplier, (iii) the largest integrator, and (iv) the largest operational service provider in biomass utilization in the PRC.

4. CECEP Fengqiu Biomass Environmental Protection Co., Ltd. is a is a wholly-owned subsidiary of CECEP Green Carbon Environmental Protection Company and is responsible for the daily operation and equipment maintenance of the subproject. The company was founded in Fengqiu County in December 2014 with a registered capital of CNY34.52 million. Main business of the company is production of organic fertilizer and biogas from agricultural wastes like straw and livestock manure.

C. Report Purpose

5. Asian Development Bank's (ADB) environmental safeguard requirements are specified in Safeguard Policy Statement (SPS) 2009. Following SPS 2009 and the environmental and social management system (ESMS), the subproject has been screened and classified by as Environment Category B, requiring the preparation of an initial environment examination (IEE) including an environmental management plan (EMP).

D. Approach to report Preparation

6. This report has been prepared based on a domestic feasibility study report (FSR); a technical due diligence review of the FSR undertaken by Asian Development Bank (ADB) project

[1] mu is a Chinese unit for area, 1 mu = 666.67 m^2.

preparatory technical assistance (PPTA) consultants; approved domestic tabular environment impact assessment (EIA) report; public consultations with key stakeholders and affected person (AP); and site visits, surveys and consultations undertaken by ADB PPTA environmental consultants.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

7. This IEE has been prepared in accordance with both the PRC's national and local environmental legal and institutional framework and environmental assessment requirements, and applicable ADB policies, requirements, and procedures.

A. PRC Environmental Legal Framework

8. The environmental protection and management system in the PRC consists of a well-defined hierarchy of regulatory, administrative, and technical institutions. At the top level, the People's Congress of the PRC has the authority to pass and revise national environmental laws; the Ministry of Environmental Protection (MEP) under the State Council promulgates national environmental regulations; and the MEP either separately or jointly with the Administration of Quality Supervision, Inspection and Quarantine issues national environmental standards. Provincial and local governments can also issue provincial and local environmental regulations and guidelines in accordance with the national ones. In addition, national and local five-year environmental protection plans form an important part of the legal framework.

9. Key applicable PRC environmental laws are listed in **Table 1**. The implementation of environmental laws is supported by a series of associated regulations summarized in **Table 2**.

Table 1: Applicable PRC environmental laws

No.	Title of the Law	Year Issued/Updated
1	Environmental Protection Law	2015
2	Environmental Impact Assessment Law	2016
3	Water Law	2016
4	Water Pollution Prevention and Control Law	2008
5	Air Pollution Prevention and Control Law	2015
6	Noise Pollution Prevention and Control Law	1999
7	Solid Waste Pollution Prevention and Control Law	2016
8	Water and Soil Conservation Law	2011
9	Land Administration Law	2004
10	Flood Control Law	1998
11	Forest Law	1998
12	Grassland Law	2013
13	Prevention and Control of Desertification	2002
14	Wild Fauna Protection Law	2004
15	Wild Flora Protection Law	1996
16	Agricultural Law	2003
17	Urban and Rural Planning Law	2008
18	Energy Conservation Law	2016

Source: ADB PPTA consultants.

10. In addition to environmental laws and regulations, there are occupational health and safety laws and regulations the subproject must comply with, including the *PRC Safety Production Law* (2014), *State Administrative Regulations of Safety Production* (2003), and *PRC Prevention and Control of Occupational Diseases Law* (2011).

Table 2: National Administrative Regulations

No.	Regulation	Year Issued/Updated
1	Environmental Protection Management Regulations on Construction Project	2015
2	The PRC Basic Farmland Protection Ordinance	1998
3	The PRC Air Pollution Prevention and Control Law Implementation Rules	1997
4	The PRC Water Pollution Prevention and Control Law Implementation Rules	2000
5	The PRC Forestry Law Implementation Rules	2000
6	The PRC Water and Soil Conservation Law Implementation Rules	1993
7	The PRC Land Management Regulations Implementation Rules	1999
8	The PRC Wild Plant Protection Ordinance	1997
9	Notification of National Key Function Zoning Issued by the State Council	2010
10	The PRC River Management Ordinance	1988
11	The Decision on Several Environmental Protection Issues	1996
12	The National Ecological and Environmental Protection Platform	2000
13	The State Council Decision on Deepening Reform and Strict Land Management	2004

PRC = People's Republic of China.
Source: ADB PPTA consultants.

B. PRC Environmental Impact Assessment Framework

11. EIA procedures have been established in the PRC for over 20 years. Article 16 of the PRC *Law on Environmental Impact Assessment* (2003)[2] stipulates that an EIA document is required for any capital construction project producing significant environmental impacts. Projects are classified into three categories for environment impact:

Category A: projects with significant adverse environmental impacts, for which a full EIA report is required;

Category B: projects with adverse environmental impacts which are of a lesser degree and/or significance than those of Category A, for which a simplified tabular EIA report is required; and

Category C: projects unlikely to have adverse environmental impacts, for which an EIA registration form is required.

12. A full EIA report for category A project and a simplified tabular EIA report for category B project are similar to ADB's EIA and IEE reports, respectively. The registration form of an EIA is similar to an ADB Category C project.

13. Applicable PRC environmental management and assessment guidelines are summarized in **Table 3**. In 2008, MEP issued "Management Guideline on EIA Categories of Construction Projects" (revised 2015). MEP guidelines provide detailed EIA requirements for 23 sectors and 199 subsectors based on the project's size, type (e.g., water resources development, agriculture, energy, waste management, etc.), and site environmental sensitivity (e.g., protected nature reserves and cultural heritage sites).

14. MEP's "Guidelines on Jurisdictional Division of Review and Approval of EIAs for Construction Projects" (2009) defines which construction project EIAs require MEP review and

[2] *National Environmental Impact Assessment Law*, published on Oct 28 2002 and implemented in Sep 1, 2003.

approval, and which EIAs are delegated to the provincial EPBs.

Table 3: Applicable PRC environmental management and assessment guidelines

No.	Guideline	Code and/or Year Issued/Updated
1	Guideline for Technical Review of EIA on Construction Projects	HJ 616-2011
2	Management Guideline on EIA Categories of Construction Projects	2008
3	Further Enhance the Management of EIA and Preventing Environmental Risks	2012
4	Guideline on Jurisdictional Division of Review and Approval of EIAs for Construction Projects	2009
5	Guideline on EIA Categories of Construction Projects	2015
6	Interim Guideline on Public Consultation for EIA	2006
7	Technical Guidelines for EIA – General Program	HJ 2.1-2011
8	Technical Guideline for EIA – Atmospheric Environment	HJ 2.2-2008
9	Technical Guideline for EIA – Surface Water	HJ/T 2.3-1993
10	Technical Guideline for EIA – Acoustic Environment	HJ 2.4-2009
11	Technical Guideline for EIA – Groundwater Environment	HJ 610-2016
12	Technical Guideline for EIA – Ecological Impact	HJ 19-2011
13	Technical Guidelines for Environmental Risk Assessment for Construction Projects	HJ/T 169-2004

EIA = environmental impact assessment.
Source: ADB PPTA consultants.

C. Project Domestic EIA Report

15. The proposed subproject was categorized as B under the PRC National EIA Law and Fengqiu EPB requirements. A tabular EIA Report was prepared by XEPSTDRI and submitted to the Xinxiang EPB for approval.

16. The domestic EIA was reviewed by the Xinxiang EPB. The Xinxiang EPB formed a Technical Expert Group (TEG) who reviewed the draft tabular EIA and required additional data collection and other revisions. The tabular EIA report was revised according to the comments and the TEG made a formal recommendation to the Xinxiang EPB for approval. Xinxiang EPB approved the EIA report on 9 May 2014 and a copy of the approval is presented in Appendix II.

D. Relevant International Agreements

17. The PRC has signed a number of international agreements regarding environmental and biological protection. Those which have potential application to the project are listed in **Table 4**.

Table 4: Applicable international agreements

No.	Agreement	Year	Purpose
1	Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat	1975	Preventing the progressive encroachment on and loss of wetlands for now and the future
2	Convention Concerning the Protection of the World Cultural and Natural Heritage	1986	Conserving cultural and natural heritage sites.
3	Convention on Biological Diversity	1993	Conservation and sustainable use of biodiversity.

No.	Agreement	Year	Purpose
4	UN Framework Convention on Climate Change	1994	Stabilizing GHG concentrations in the atmosphere at a level that will prevent anthropogenic induced climate change.
5	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification	1996	Fighting against desertification and mitigating the effects of drought.
6	Kyoto Protocol	2002	Controlling emissions of anthropogenic GHGs in ways that reflect underlying national. differences in GHG emissions, wealth, and capacity to make the reductions.
7	Stockholm Convention on Persistent Organic Pollutants	2004	Safeguarding human health and the environment from POPs, ascertaining sound management of stockpiles and wastes that contain POPs, and taking measures to reduce or eradicate releases from intentional production and use of POPs.
8	Paris climate agreement	2015	Dealing with greenhouse gas emissions mitigation, adaptation and finance starting in the year 2020.

GHG = greenhouse gas, POP = persistent organic pollutants.
Source: ADB PPTA consultants.

E. Applicable PRC Environmental Quality Standards

18. The environmental quality standard system that supports the implementation of the environmental protection laws and regulations in the PRC is classified into two categories by function: ambient environmental standards and pollutant emission/discharge standards. Standards applicable to the subproject are presented in **Table 5**, and key standards are further elaborated below.

1. Ambient Air Quality

19. Ambient air quality limits are intended to indicate safe exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Limits are given for one or more specific averaging periods, typically one-hour average, 24-hour average, and/or annual average. The PRC's recently updated *Ambient Air Quality Standards (*GB3095-2012) has two classes of limit values; Class 1 standards apply to special areas such as natural reserves and environmentally sensitive areas, and Class 2 standards apply to all other areas, including urban and industrial areas. The PRC standards for Class 2 areas are applicable for the subproject.[3]

[3] On 29 February 2012, the PRC State Council passed the roadmap for ambient air quality standards with the aim of improving the living environment and protecting human health. The Ambient Air Quality Standards (GB 3095-2012)

Table 5: Applicable PRC environmental standards

No.	Standard	Code/Date
1	Ambient Air Quality Standards	GB 3095-2012
2	Groundwater Quality Standard	GB/T 14848-93
3	Surface Water Quality Standards	GB 3838-2002
4	Environmental Quality Standards for Noise	GB 3096-2008
5	Soil Quality Standard	GB15618-1995
6	Noise Standards for Construction Site Boundary	GB 12523-2011
7	Noise Standards for Industrial Enterprises at Site Boundary	GB 12348-2008
8	Standard for Flood Control	GB 50210-94
9	Emission standard of air pollutants for boiler	GB 13271-2014
10	Emission standards for odor pollutants	GB 14554-93

Source: ADB PPTA Consultants.

20. The World Health Organization (WHO) Air Quality Guidelines are recognized as international standards and are adopted by the *World Bank Group's Environment, Health and Safety Guidelines* (*EHS Guidelines)*. In addition to guideline values, interim targets (IT) are given for each pollutant by the WHO as incremental targets in a progressive reduction of air pollution. The WHO guidelines and corresponding PRC standards are presented in **Table 6**.

21. From a review of **Table 6** it can be observed that:

- For total suspended particulates (TSP), there are PRC standards but no corresponding WHO guidelines.
- For particulate matter with diameter less than 10 micrometers (PM_{10}), PRC Class 2 annual average and 24-hour average standards meet WHO IT-1 guidelines (there are no 1-hour average standards or guidelines for either PRC or WHO).
- For particulate matter with diameter less than 2.5 micrometers ($PM_{2.5}$) PRC Class 2 annual and 24-hour standards meet WHO IT-1 guidelines (there are no 1-hour standards or guidelines for either PRC or WHO).

prescribes the first-ever limits for $PM_{2.5}$. It also modified the previous area classifications by combining Class III (special industrial areas) with Class II (residential, mixed use areas).

Table 6: PRC ambient Air Quality Standards and WHO ambient air quality guidelines mg/m^3

Standard	TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	O_3	CO
WHO Ambient Air Quality Guidelines							
Annual mean	--	0.020	0.010	--	0.040	--	--
Annual mean IT-1	--	0.070	0.035	--	--	--	--
24-hr mean	--	0.050	0.025	0.020	--	--	--
24-hr mean IT-1	--	0.150	0.075	0.125	--	--	--
8-hr mean	--	--	--	--		0.100	--
8-hr mean IT-1	--	--	--	--		0.160	--
1-hr mean	--	--	--	--	0.200		0.030
1-hr mean IT-1	--	--	--	--	--		--
PRC Ambient Air Quality Standard (Class 2)							
Annual mean	0.200	0.070	0.035	0.060	0.040	--	--
24-hr mean	0.300	0.150	0.075	0.150	0.100	--	0.004
8-hr mean	--	--	--	--	--	0.160	--
1-hr mean	--	--	--	0.500	0.200	0.200	0.010

CO = carbon minoxide, NO_2 =nitrogen dioxide, O_3= ozone, PM_{10} = particulate matter with diameter less than 10 micrometers, $PM_{2.5}$ = particulate matter with diameter less than 2.5 micrometers, SO_2 = sulfur dioxide, TSP = total suspended particulates

Source: WHO Air Quality Guidelines (2006) in IFC *EHS Guidelines* (2007), and PRC GB 3095-2012.

- For SO_2, WHO only has a 24-hour average guideline (0.125 mg/m^3), which is slightly lower than the PRC standard (0.150 mg/m^3). However, SO_2 levels are low in the subproject area, and the subproject will only contribute extremely low levels of SO_2, so the very minor difference is inconsequential.
- For nitrogen dioxide (NO_2) the PRC standard is equivalent to the WHO annual average guidelines, there is no WHO 24-hour average guideline; and the 1-hour average PRC standard is equivalent to the WHO guideline.

22. Overall the PRC standards show a high degree of equivalency to the WHO guidelines or IT-1 values, and they are adopted for use in this IEE report.

2. Boiler Emissions

23. **Table 7** presents relevant PRC national gas boiler emission standards compared with relevant international standards (EHS Guidelines). The PRC standards exceed the EHS Guidelines, and the most stringent of the national and provincial standards are applicable to the subproject.

Table 7: **Relevant PRC Natural Gas Fired and/or Fueled Boiler, Turbine and Engine Emission Standards and Relevant International Guidelines**

Parameter	***Emission Standards of Air Pollutants from Coal-Burning, Oil-Burning and Gas-Fired Boilers*** (Table 2 of GB 13271-2014) (Applies to newly built natural gas boilers less than 65 t/h)	**EHS Guidelines for Boilers**	**Comparison**
Stack Height	Stack height is determined according to the requirements in the approved EIA, and must be > 8 m	Design stack height according to GIP to avoid excessive ground level concentrations and minimize impacts.	PRC standard meets GIP
PM	20 mg/Nm^3	NA	No EHS guideline.
SO_2	50 mg/Nm^3	NA	No EHS guideline.
NO_x	200 mg/Nm^3	240 mg/Nm^3	PRC standard is more stringent than the EHS guidelines

EIA = environmental impact assessment, GIP = Good International Practice, m = meter, mg/Nm^3 = milligrams per normal cubic meter, NA = not applicable, NO_x =nitrogen oxides, PM = particulate matter, PRC = People's Republic of China, SO_2 = sulfur dioxide, t/h = ton per hour.
Source: Unofficial translation of Chinese original standards by the ADB PPTA consultant, and World Bank 2007.

3. Odor pollutant

24. Odor pollutant generated from the subproject operation is regulated under the PRC's *Emission standards for odor pollutants* (GB 14554-93). The PRC standards for Class 2 areas are applicable for all subprojects.

Table 8: **Applicable odor pollutant standard**

No.	Parameter	**Category II Standard at the site boundary** (mg/m^3, Odor concentration excluded)
1	Ammonia	2.0
2	Trimethylamine	0.15
3	H_2S	0.10
4	Methyl mercaptan	0.01
5	Dimethyl sulfide	0.15
6	Dimethyl disulfide	0.13
7	Carbon disulfide	5.0
8	Styrene	7.0
9	Odor concentration	30

mg/m^3 = milligram per cubic meter.
Source: class II, GB 14554-93 *Emission Standards for Odor Pollutants*

4. Fugitive Particulate Matter Emission

25. Fugitive emission of PM such as dust from construction sites is regulated under PRC's *Air Pollutant Integrated Emission Standard* (GB 16297-1996), which sets 120 mg/m^3 as the maximum allowable emission concentration and ≤1.0 mg/m^3 as the concentration limit at the boundary of construction sites, with no specification on the PM's particle diameter. There is no equivalent standard recommended in the *EHS Guidelines,* and the PRC standard is adopted for use in this IEE report.

5. Surface Water

26. PRC's *Surface Water Ambient Quality Standard* (GB3838-2002) defines five water quality categories for different environmental functions. For example, Category I is the best, such as water at sources of rivers and National Nature Reserves. Category V is the worst quality, suitable only for agricultural and scenic water uses. Based on site visit, the surface water near the subproject area is Sandou Canal which is used for agricultural irrigation and the Category V water quality standard is applicable (see **Table 9**). There are no applicable *EHS Guidelines* or target for water quality in this context, and the PRC standard is adopted for use in this IEE report.

Table 9: Applicable surface water standard

No.	Parameter	Category V Standard (mg/l, pH excluded)
1	pH	6-9
2	Dissolved Oxygen	2
3	COD_{Mn}	15
4	COD_{Cr}	40
5	BOD_5	10
6	NH_3-N	2.0
7	TP	0.4
8	TN	2.0
9	Copper	1.0
10	Zinc	2.0
11	Fluoride	1.5
12	Selenium	0.02
13	Arsenic	0.1
14	Total Mercury	0.001
15	Cadmium	0.01
16	Hexavalent Chromium	0.1
17	Lead	0.1
18	Cyanide	0.2
19	Volatile Phenol	0.1
20	Sulfide	1.0
21	Petroleum	1.0
22	Anionic surfactant	0.3
23	Coliforms	40000

COD_{Mn} = permanganate index; CODcr = chemical oxygen demand; BOD_5 = 5-day biochemical oxygen demand; NH_3-N= ammonia nitrogen; TP = Total Phosphorus; TN = Total Nitrogen.
Source: Class V, GB3838-2002 Surface Water Ambient Quality Standards.

6. Groundwater

27. PRC's *Groundwater Water Ambient Quality Standards* (GB/T14848-93) also defines a number of water quality categories for different environmental functions. As groundwater is primarily used for irrigation, the Category III standard is applicable (**Table 10**). There is no

equivalent standard recommended in the *EHS Guidelines,* and the PRC standard is adopted for use in this IEE report.

Table 10: Applicable groundwater standard

No	Parameter	Unit	Category III Standard
1	pH	-	6.5–8.5
2	CODMn	mg/l	3.0
3	Sulfate	mg/l	250
4	Chloride	mg/l	250
5	Volatile Phenols	mg/l	0.002
6	Total hardness ($CaCO_3$)	mg/l	450
7	Nitrate NO_{3-}	mg/l	20
8	Nitrite NO_{2-}	mg/l	0.02
9	NH_3-N	mg/l	0.2
10	Molybdenum	mg/l	0.1
1	Cyanide	mg/l	0.05
12	Cadmium	mg/l	0.01
13	Chromium VI	mg/l	0.05
14	Arsenic	mg/l	0.05
15	Zinc	mg/l	1.0
16	Fluoride	mg/l	1.0
17	Lead	mg/l	0.05
18	Iron	mg/l	0.3
19	Manganese	mg/l	0.1
20	Copper	mg/l	1.0
21	Selenium	mg/l	0.01
22	Total coliforms	/L	3.0

BOD_5 = 5-day biochemical oxygen demand; CODcr = chemical oxygen demand; COD_{Mn} = permanganate index; /L = per liter, mg/l = milligram per liter, NO_3- = Nitrate; NO_2- = Nitrite; NH_3-N= ammonia nitrogen; pH = potential of Hydrogen, TP = Total Phosphorus; TN = total nitrogen.
Source: Class III, GB/T14848-93 Quality Standard for Ground Water.

7. Wastewater Discharge

28. **Table 11** presents relevant PRC wastewater discharge standards. The *EHS Guidelines* indicate that wastewater discharged to public or private wastewater treatment systems should: (i) meet the pretreatment and monitoring requirements of the sewer treatment system into which it discharges; (ii) not interfere, directly or indirectly, with the operation and maintenance of the collection and treatment systems, or pose a risk to worker health and safety, or adversely impact characteristics of residuals from wastewater treatment operations; and (iii) be discharged into municipal or centralized wastewater treatment systems that have adequate capacity to meet local regulatory requirements for treatment of wastewater generated from the subproject.

29. Sanitary wastewater discharged during construction will be treated in an underground septic system. The treated effluent should comply with Class II of the PRC *Integrated Sewage Discharge Standard* (GB8978-1996). The wastewater generated during operation will be used for organic fertilizer production. No wastewater will be discharged during operation.

Table 11: PRC *Integrated Sewage Discharge Standards*

No.	Parameter	Class II Standard (mg/l except pH)
1	pH	6–9
2	Suspended Solids	150
3	BOD^5	30
4	COD_{cr}	150
5	Petroleum	10
6	Ammonia Nitrogen (NH_3-N)	25
7	Anionic Surfactants	10

BOD_5 = 5-day biochemical oxygen demand; CODcr = chemical oxygen demand; mg/l = milligram per liter, pH = potential of Hydrogen.
Source: ADB PPTA Consultants and domestic EIA, 2017.

8. Noise

30. **Table 12** presents relevant PRC *Urban Noise Standards* compared with relevant international guidelines from the WHO (as presented in the *EHS Guidelines*). Category I and II standards are applicable to the project area. The classes within the standards are not directly comparable, but the PRC Category I standards are equivalent to WHO Class I standards. Category II is utilized in this IEE report.

Table 12: PRC *Environmental Quality Standards for Noise* (GB3096-2008) and relevant international guidelines

PRC Standards Leq dB(A)			**International Standards One Hour Leq dB(a)**		**Comparison**
Category	**Day** 06-22h	**Night** 22-06h	**Day** 07-22h	**Night** 22-07h	
0: Areas needing extreme quiet, such as special health zones	50	40	WHO Class I: residential, institutional, educational: 55 WHO Class II: industrial, commercial: 70	WHO Class I: Residential, institutional, educational: 45 WHO Class II: Industrial, Commercial: 70	Classes are not directly comparable, but PRC Class II standards exceed WHO Class II standards. PRC standards are utilized in this report.
I: Mainly residential; and cultural and educational institutions	55	45			
II: Mixed residential, commercial and industrial areas	60	50			
III: Industrial areas	65	55			
IV: Area on both sides of urban trunk roads	70	55			

dB(a) = A-weighted decibels, Leq = equivalent continuous noise level, PRC = People's Republic of China, WHO = World Health Organization.
Source: GB3096-2008 and ADB PPTA consultant.

31.

32. **Table 13** presents relevant PRC and international standards (US EPA, there are no WHO or *EHS Guidelines* standards) for on-site construction noise. The PRC standards are more stringent than international guidelines, and are utilized in this IEE report.

Table 13: PRC *Noise Emission Standards for Construction Site Boundary* and relevant international guidelines

Day Leq dB(A)	Night Leq dB(A)	International Standards Leq dB(a)	Comparison
70	55	US EPA: 85 (day, 8hour exposure)	PRC standards meet or are more stringent than international standards

dB(a) = A-weighted decibels, Leq = equivalent continuous noise level, PRC = People's Republic of China, US Environmental Protection Agency.
Source: GB12523-2011 and ADB PPTA consultant.

33. During operation noise at site boundaries should comply with Class II of the PRC *Industrial Enterprise Boundary Noise Emission Standard* (GB12348-2008) (**Table 14**).

Table 14: PRC *Noise Emission Standard for Construction Site Boundary* and relevant international guidelines

Standard Type	Standard Value Leq dB(A)	
	Day	Night
Class 2	60	50

dB(a) = A-weighted decibels, Leq = equivalent continuous noise level.
Source: GB12348-2008 and domestic EIA, 2017(2017)

F. Applicable ADB Policies and Requirements

34. The major applicable ADB policies, requirements and procedures for EIA are the SPS 2009 and the *Environmental Safeguards—A Good Practice Sourcebook* (2012), which jointly provide the basis for this IEE. The SPS promotes good international practice as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*. The policy is underpinned by the *ADB Operations Manual* for the SPS (OM Section F1, 2013).

35. The SPS establishes an environmental review process to ensure that projects undertaken as part of programs funded through ADB loans are environmentally sound, are designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environmental, health, social, or safety hazards.

36. At an early stage in the project cycle, typically the project identification stage, ADB screens and categorizes proposed projects based on the significance of potential project impacts and risks. A project's environment category is determined by the category of its most environmentally sensitive component, including direct, indirect, induced, and cumulative impacts. Project screening and categorization are undertaken to:

(i) reflect the significance of the project's potential environmental impacts;
(ii) identify the type and level of environmental assessment and institutional resources required for the safeguard measures proportionate to the nature, scale, magnitude and sensitivity of the proposed project's potential impacts; and,
(iii) determine consultation and disclosure requirements.

37. ADB assigns a proposed project to one of the following categories:

(i) **Category A.** Proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented; impacts may affect an area larger than the sites or facilities subject to physical works. A full-scale EIA

including an EMP, is required.

(ii) **Category B**. Proposed project's potential environmental impacts are less adverse and fewer in number than those of category A projects; impacts are site-specific, few if any of them are irreversible, and impacts can be readily addressed through mitigation measures. An IEE, including an EMP, is required.

(iii) **Category C**. Proposed project is likely to have minimal or no adverse environmental impacts. No EIA or IEE is required although environmental implications need to be reviewed.

(iv) **Category FI**. Proposed project involves the investment of ADB funds to, or through, a financial intermediary.

38. Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility was categorized by ADB as FI. Following the screening and categorization procedures set out in the ESMS, the subproject has been classified as environment category B and thus an IEE is required.

39. The SPS 2009 requires a number of additional considerations, including: (i) project risk and respective mitigation measures and project assurances; (ii) project-level grievance redress mechanism; (iii) definition of the project area of influence; (iv) physical cultural resources damage prevention analysis; (v) climate change mitigation and adaptation; (vi) occupational and community health and safety requirements (including emergency preparedness and response); (vii) economic displacement that is not part of land acquisition; (viii) biodiversity conservation and natural resources management requirements; (ix) provision of sufficient justification if local standards are used; (x) assurance of adequate consultation and participation; and (xi) assurance that the EMP includes an implementation schedule and measurable performance indicators. These requirements, which may not be covered in the domestic EIA, have been considered, and all applicable environmental requirements in the SPS 2009 are covered in this IEE.

40. During the design, construction, and operation phases of a project, SPS 2009 also requires the borrower to follow environmental standards consistent with good international practice (GIP), as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*.[4] The *EHS Guideline*s contain discharge effluent, air emissions, and other numerical guidelines and performance indicators as well as prevention and control approaches that are normally acceptable to ADB and are generally considered to be achievable at reasonable costs by existing technology. When host country regulations differ from these levels and measures, the borrower/subborrower is to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower/subborrower is required to provide justification for any proposed alternatives.

[4] *World Bank Group, Environmental, Health, and Safety Guidelines*, April 30, 2007, Washington, USA. http://www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

III. PROJECT DESCRIPTION

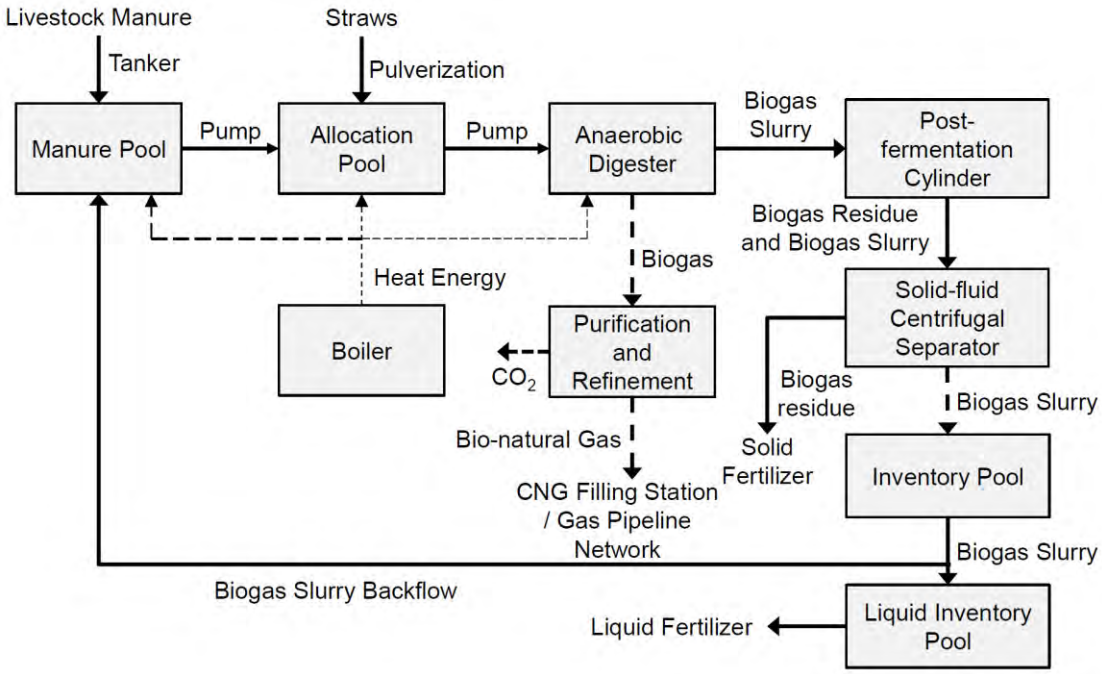
A. The Subproject

41. The subproject will be implemented at the Fengqiu County, located southeast of Xinxiang, a prefecture-level city. Xinxiang is located in northern Henan Province.

42. Various types of mixed organic waste will be anaerobically digested to generate biogas, which in turn will be used to produce bio-natural gas as a replacement for conventional natural gas in transport, and organic fertilizer as a replacement for chemical fertilizer. This would have multiple economic, ecological and environmental benefits.

43. The subproject uses anaerobic fermentation technology for biogas production. The produced biogas is then purified and compressed. The compressed bio-natural gas is sold to consumers to replace gasoline and diesel for transport in the filling station. The biogas residue and slurry is used to produce organic fertilizer in replacement of chemical fertilizer (see **Figure 1**).

Figure 1: Flow chart diagram of the advanced biogas and organic fertilizer subproject



CNG = compressed natural gas, CO_2 = carbon dioxide.

B. Project Rational

44. In the PRC, the organic waste production from straws, livestock manure and agricultural waste amounts to over 3.5 billion tons per year. Based on statistics from the Ministry of Agriculture, the annual applicable waste resource for biogas production amounts to 1.4 billion tons (among which straw resource amounts to 180 million tons, livestock manure 1.06 billion tons, and other organic waste 164 million tons). The potential for raw biogas production is up to 122.7 billion cubic meters (m^3) and compressed bio-natural gas production is 84.4 billion m^3.

45. Air pollution caused by the open burning of straw is a serious problem and the government has been trying to resolve it. Despite more rigorous enforcement of the "no burning" policy, some farmers still burn the straws. This is because they are concerned that straw returned to the field will bring germs and insects from crops to underground and affect the crops to be planted next; if there are too much straw buried back to the field, the slow corrosion will lead to decreased crop yield.

46. Direct use of livestock manure brings serious adverse impact to the environment. Untreated livestock sewage that goes directly into lakes and rivers contributes to eutrophication. When done continuously, the waterbody will become black and smelly, causing permanent organic contamination and becoming very difficult to treat or recover. With the chemical reaction of microbes, livestock manure will emit harmful and smelly gases such as ammonia and sulfur dioxide, affecting the air quality around livestock farm, and consequently the health of livestock keepers and residents nearby. A great deal of pathogenic microbes, parasite ovum and fly's eggs from livestock waste may cause the spreading of zoonosis. In the worst-case scenario, zoonosis can lead to human and livestock epidemics. If highly concentrated livestock sewage is directly used for irrigation, it will block soil pores, decrease soil's penetrability of air and water, harden the soil, and negatively impact soil quality.

47. Attempting to increase crop yields has resulted in over-application of chemical fertilizers in the PRC. Such over-fertilization not only harms the crops and wastes resources, but also seriously contaminates the soil and underground water, endangering biological balance and human health. For instance, if ammonia fertilizer is applied to the soil, part of it may react through denitrification and produce nitrogen and nitrous oxide that diffuse from the soil and spread to the air. When the nitrous oxide reaches the ozone layer, it reacts to produce nitric oxide and reduce the amount of ozone. The application of ammonia fertilizer and phosphate fertilizer generates nutrients containing a great amount of nitrogen and phosphorus that may enter the waterbody. Thus, eutrophication of the waterbody takes place, leading to excessive algae reproduction (and cyclical demise), and the dissolved oxygen is greatly consumed. The lack of oxygen in the water causes the death of fish and shrimps. Long-term application of ammonia fertilizer, especially ammonium fertilizer in large amounts, will also gradually acidize and harden the soil and will make the soil no longer suitable for planting.

48. The replacement of chemical fertilizer with organic fertilizer could improve soil quality, increase crop yields and quality, and avoid negative impacts caused by chemical fertilizers. There is a great potential in the replacement of chemical fertilizer with organic fertilizer in the PRC. According to a recent study, the organic fertilizer generated from livestock manure could replace 11.87 million tons of ammonia fertilizer, 8.06 million tons of phosphate fertilizer, and 11.69 million tons of potash fertilizer, taking up 38%, 52%, and 87% of actual chemical fertilizer consumption in 2014, respectively.[5] In livestock solid-fluid manure in Beijing suburbs, nutrients of nitrogen, phosphate and potash take up 58,700, 21,300, and 29,800 tons, respectively, which equals to 99.3%, 185.2%, and 62.7% of crops field nutrient demand.[6]

C. Key Project Features

49. The subproject has the potential to resolve the environmental problems described above

[5] Lu, G.B. and Wang X.Z. (2016) Potential Estimation of Organic Fertilizer Replacing Chemical Fertilizer Based on Nutrient Balance. China Swine Industry, 11(11), pp. 15–18.

[6] Jia W., Li Y.H., Chen Q. and Chadwick D (2014) Analysis on Livestock Manure Resource Status Quo and Its Replacement Potential of Chemical Fertilizer in Beijing Suburb. Transactions of the Chinese Society of Agricultural Engineering, 30(8), pp. 156–167.

and is strongly supported by the government. In the past 2 to 3 decades, central financial institutions have invested nearly CNY 40 billion to support biogas development in rural areas, but the actual operation results are far below expectations. The biogas industry needs a new business model with an industrialized, scaled-up, and a market and growth-oriented approach.

50. Key issues that affect the development of the biogas industry include (i) lack of sustainable supply of fermentation materials, (ii) limited market penetration of organic fertilizer, (iii) large amounts of biogas slurry production, (iv) limited grid connection of biogas-generated electricity, and (v) poor economic returns of biogas projects. Based on the existing issues in organic waste treatment and the barriers to biogas industry development, this subproject adopts a new business model, and incorporates an innovative technology and technique, aiming to provide a replicable example for the development of organic waste treatment and resource utilization in the future. Special features of the subproject included:

(i) **Suitable technology.** The subproject adopts Continuous Stirred Tank Reactor (CSTR) technology for biomass generation which is a proven and best available technology for treating mixed feedstock (manure and biomass). The CSTR is a vertical cylinder shaped digester with a massive roof and height/diameter ratio of close to 1:1. Its contents are perfectly mixed by a vertical, ultra-low speed turbine mixer with extremely high pumping capacity, being placed in the central axis of the tank. The low rotational speed results in a gentle treatment of the anaerobic biomass. At the same time, the permanent mixing produces optimum mass transfer rates for the bacterial conversion of the organic material into biogas. CSTR is particularly suitable for the treatment of organic waste and slurries with high solids concentrations and for materials with a high propensity for scum production. Sediments can easily be removed during operation.

(ii) **Mixed fermentation.** The subproject uses straw and livestock manure for mixed fermentation. In the fermentation cylinder, the percentage of dry material could amount to 11%. Based on the sales performance of liquid fertilizer, the output quantity of biogas slurry could be controlled by increasing straw input quantity or increasing the capacity of returns of biogas slurry and digestive fluid.

(iii) **High production efficiency.** Carbon excipients such as corncob are added into raw material. By keeping balance of nutrient elements, carbon nitrogen ratio (C/N ratio) and potential of hydrogen (pH) value in the fermentation substrate, the fermentation technology could enhance the buffering ability of fermentation broth, improve the synergistic effect of microbes, increase the hydrolysis efficiency of straws and reduce the constraints to fermentation process caused by harmful substances, therefore increase biogas production efficiency. The subproject uses straw and livestock manure as mixed raw material, among those corncob is the main carbon source while livestock manure is the main nitrogen source. The mixed feeding of these two kinds of raw materials is favourable for the adjustment of C/N ratio in the fermentation system, so that the C/N ratio is within the best range of 15–20:1. The mixed feeding of raw materials helps solve the issue of low production efficiency of methane bacteria and the system's acidification incurred by imbalanced C/N ratio of single raw material.

(iv) **Sufficient resources**. Based on the statistics provided by the Agricultural Bureau of Fengqiu County, the cultivated area of main crops in Fengqiu County such as wheat, corns, and rice took up 1,795,000 mu and the straw production yield was 858,500 tons in 2013. The subproject's annual corn straw consumption was 43,000 tons, 17.2% of available corn straw resource in Fengqiu. Per the statistics provided by the Animal Husbandry Bureau of Fengqiu County, in 2012, the number of animals were 532,000 pigs, 75,000 cows, 405,000 sheep and 6 million poultries,

respectively, which can produce 1.571 million tons of livestock manure. The subproject can treat 30,000 tons of pig manure per annum, 9.4% of annual pig manure production in Fengqiu. Yingju Town, where the subproject is located, is on the boundaries of Yuanyang County, Yanjin County and Fengqiu County that are all major agricultural counties in the PRC.

(v) **Well-designed collection system.** To ensure abundant supply of raw materials, the subproject adopts an "active collection" approach on raw material collection. The raw materials will be collected by the following ways: (i) through specialised straw purchasers; (ii) by the facility operator; and (iii) through harvester manufacturers. The straw collection radius is within 12 km from Fengqiu County, and it can be expanded to include Yuanyang County and Yanjin County. In the collection of livestock manure, the subproject uses self-collection mode and outsourcing mode where the company will outsource the collection and transportation of livestock manure to several professional companies. The subproject company is only responsible for quality checking at the facility. At the same time, the subproject company will also purchase manure collection freight vehicles, and will rent out some of the vehicles to collection staff hired externally as a backup source. To ensure the raw material collection, the subproject company has signed an exclusive agreement with the local government, which guarantees that no more organic agricultural waste treatment projects or alike will be approved in Fengqiu County, therefor to secure the raw material supply.

(vi) **Energy efficient devices**. Energy conservation measures will be used in the subproject including: (i) overflow device is installed between the first plate and second plate of anaerobic fermentation cylinder, so that the energy consumption of material delivery pump is reduced; (ii) all energy-consuming equipment including mixer, fan, water pump and lighting devices will use energy-saving products; (iii) the captive well is equipped with deep-well energy efficient submersible pump with variable frequency drive to control the operation of the water pump based on the water demand; (iv) in adoption of dry-type transformer that is self-equipped with a forced air cooling device: when one transformer is in default or under maintenance, the forced air cooling device will start to raise the transformer's rated capacity by around 50%; (v) reactive power self-compensation device is used on the transformer in the load centre; and (vi) optimise the logistics route of production and operation based on the principle of reasonable technical process, clear functioning division, concise pipeline and compact layout, therefore shorten the route and save energy.

(vii) **Better purification**. Biogas purification and refinement unit utilizes pressure swing adsorption equipment (PSA) that could refine the methane with a concentration of more than 99%, thereby enhancing the calorific value of bio-nature gas and increasing the market competitiveness of bio-nature gas. Per the gas quality test report of similar reports, the methane concentration is as high as 99.99% and the high calorific value reaches 37.11 megajoule per cubic meter (MJ/m^3) (10.31 kilowatt hour per cubic meter [kWh/m^3]) which is equivalent to the first-class standard of natural gas (GB 17820-2012).

(viii) **Various organic fertilizers.** The production process of solid organic fertilizer could produce not only primary powdery organic fertilizer of low cost, but also particle bio-organic fertilizer of high value to respond various market demands; and two kinds of liquid organic fertilizer could also be produced. By mixing and allocating the liquid organic fertilizer with solid organic fertilizer, complete product structure will be formed and market competitiveness of the organic fertilizer product can be enhanced.

(ix) **Flexible selling methods.** The subproject allows various selling modes and sales channels for organic fertilizers: (i) for users with large demand, the subproject plans to use “company + farmer” direct selling mode; (ii) for users near the subproject site (within 100 km) with small demand, the subproject plans to establish CECEP brand stores to sell to users directly; (iii) for users with a distance between 100 to 500 kilometres from the subproject site, the subproject plans to adopt traditional agricultural supply agent system, (i.e., to sell the products via wholesalers); and (iv) for users with a distance of more than 500 kilometres, the company is to establish sales offices, build warehouses and stock inventories for sales activity.

(x) **Use of biogas.** Unlike the traditional biogas utilization in electricity generation, the subproject produces natural gas and uses it in transport to replace gasoline and diesel, which can not only reduce the air pollutant but also improve the financial viability of the subproject. Meanwhile, to ensure the sales of natural gas, the subproject company has obtained the approval of compressed natural gas (CNG) filling station from the local government and will construct a CNG filling station as one component of the subproject. The station will be located on the southwest of the subproject site. Connected by high-pressure pipeline, the station is adjacent to the main site of the subproject, thus saving the cost of tanker transportation and achieving higher return.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Location

51. The subproject will be implemented at Yingju Town, Fengqiu County, located southeast of Xinxiang, a prefecture-level city. Xinxiang is located in northeast Henan Province at the North China Plain. It borders the provincial capital of Zhengzhou to its southwest, Kaifeng to its southeast, Hebi and Anyang to its north, Jiaozuo to its west, and the provinces of Shanxi and Shandong to its northwest and east respectively.

Figure 2: Subproject site location

Source: https://en.wikipedia.org/wiki/China

B. Henan Province Overview

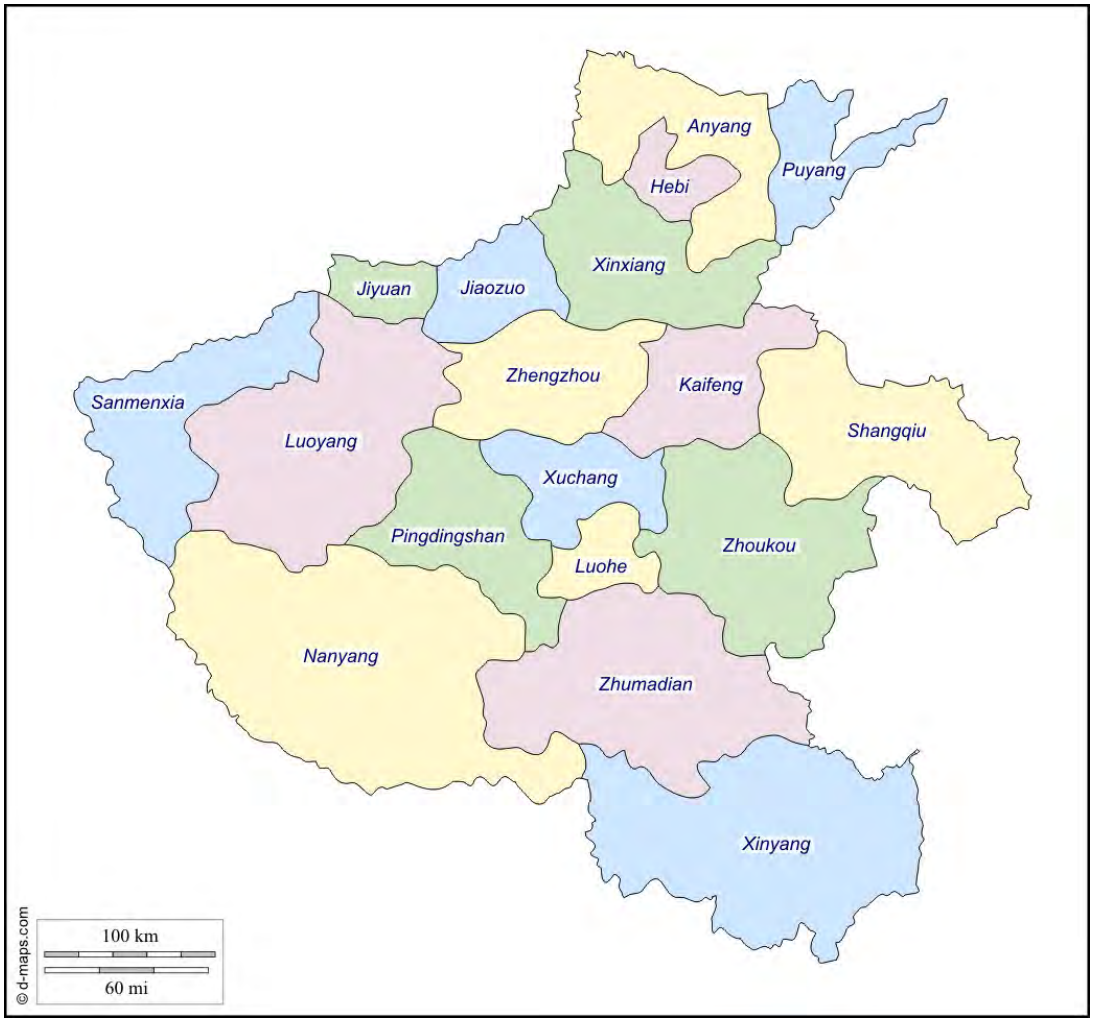
52. Henan Province is located in the central part of the PRC. With an area of 167,000 square kilometers (km^2), Henan covers a large part of the fertile and densely populated North China Plain. Neighboring provinces are Anhui, Hebei, Hubei, Shaanxi, Shandong, and Shanxi. Henan is the PRC's third most populous province with a population of over 107.88 million at the end of 2016. It is the 5th largest provincial economy of the PRC and the largest of inland provinces. Per capita GDP is low compared to eastern provinces. The economy largely depends on dwindling aluminum and coal reserves, as well as agriculture, heavy industry, tourism, and retail.

Figure 3: Henan Province in China

Source: https://en.wikipedia.org/wiki/Henan.

53. Henan Province is divided into 17 prefecture-level cities and one directly administered county-level city (Jiyuan) (**Figure 4**). These cities are subdivided into 159 county-level divisions (50 districts, 21 county-level cities, and 88 counties; Jiyuan is counted as a county-level city here). Those are in turn divided into 2,399 township-level divisions (1,014 towns, 827 townships, and 558 subdistricts).

Figure 4: Map of Henan Province administrative divisions



Source: http://d-maps.com

54. In Henan, the principal religions are Chinese Buddhism and Taoism. It is also home to one of the largest Christian populations in East Asia, most being either Protestant or Catholic. Henan Province has the largest Protestant Christian population in the PRC, nearly 4 million. In addition, Henan has the largest Muslim Hui population in the eastern PRC, which constitutes approximately 1% of the population.

55. Henan has a temperate climate that is humid subtropical to the south of the Yellow River and bordering on humid continental to the north. It has a distinct seasonal climate characterized by hot, humid summers due to the East Asian monsoon; and generally cool to cold, windy, dry winters that reflect the influence of the vast Siberiananti cyclone. Temperatures average around the freezing mark in January and from 27°C to 28°C in July. A great majority of the annual rainfall occurs during the summer.

56. Four major river systems—Haihe River, Huaihe River, Yangtze River, and Yellow River—go through Henan Province. One of Chinese mother rivers, Yellow River, runs through the middle Henan with a main stream of 711 km and a drainage area of 36,200 km^2 in the province, which

accounts for 1/5 of the total province. The Huaihe River goes through middle and south Henan with a main stream of 340 km and a drainage area of 88,300 km^2, half the area of Henan Province. The Weihe and Zhanghe rivers in north Henan drain into Hai River. Danjiang, Tangbai, and Tuan rivers in the southwest drain into the Han River. More than 1,500 rivers interweave with each other in Henan, of which 493 rivers have a drainage area above 100 km^2.

57. The province has 41.3 billion m^3 of water resources and 440 m^3 per capita in 2015. The groundwater resources of Henan are large, but are being exploited at an unsustainable rate. Data provided by the provincial Water Resource Department for the Henan Year Book show that total groundwater resources have decreased by almost 40% since 2009. The demand for groundwater resources will continue to increase in the future with rising population and higher temperatures predicted in climate change scenarios.

C. Site Physical Resources

58. **Xinxiang City.** Xinxiang is a prefecture-level city in northern Henan province. Xinxiang is an important manufacturing and farm production base of Henan province, separated from the provincial capital of Zhengzhou and Kaifeng by the Yellow River in the south. It borders Hebi and Anyang to its north, Jiaozuo to its west, and the provinces of Shanxi and Shandong, to its northwest and east respectively.

59. **Geology and Topography**. Xinxiang City is located at the North China Plain. Xinxiang City's total jurisdiction area occupies 8,249 km^2. About 10% of Xinxiang is hilly, 12% is mountainous and 78% is plains. The subproject site is located near the urban core of Yingju Town, Fengqiu County, Xinxiang City, and topography in this area is generally flat (**Figure 5**).

Figure 5: Xinxiang Topography

Source: Google map, 2017

60. **Soil.** Soils of Xinxiang City comprise six groups, 11 subgroups and 21 soil genera. Main categories are aeolian sandy soil, fluvial soil, cinnamon soil, swamp soil, and paddy soil. Wetlands support “cinnamon” and “swamp” soils.

61. **Meteorology and Climate.** The Xinxiang City has a continental monsoon climate with four distinct seasons. The autumn is cool and the spring usually comes early. Xinxiang has a humid subtropical hot summer climate that is mild with dry winters, hot humid summers and moderate seasonality (Köppen-Geiger classification: Cwa). According to the Holdridge life zones system of bioclimatic classification, Xinxiang is situated in or near the warm temperate thorn steppe biome.

62. **Temperature**. The average annual temperature at Xinxiang is 14.5 ºC, with the highest monthly average temperature occurring in July (32ºC) and the lowest in January (-5ºC). Over the last 50 years the highest daily temperature was 43ºC, recorded in June 1951, and the lowest was -21ºC, recorded in January 1951.

63. **Precipitation.** Annual precipitation in Xinxiang from 1950–2011 was 581 mm, of which 72.3% occurs in the June to August period. The lowest recorded annual precipitation was 241.8 mm in 1997 and the highest was 1168.4 mm in 1963.

Table 15: Average Climatic conditions in Xinxiang (1950–2011)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high, °C	5	8	14	22	27	32	32	31	27	21	14	7	20
Average low, °C	−5	-2	3	10	15	20	23	22	16	10	3	-3	9
Average precipitation, mm	5	7	19	29	43	72	161	128	59	33	19	6	581

Source: http://www.tianqihoubao.com/qihou/xinxiang.htm

64. **Humidity and sunshine.** Sunshine hours of Xinxiang in 2016 were 1,992.6 hours, or 45.1% of the annual daytime hours. Annual average humidity of Xinxiang is 68%.

65. **Frost-free Days.** There is an average of 220 frost free days per year. The first frost typically occurs in the first 10 days of November, and typically ends in the first 10 days of March.

66. **Wind.** The Xinxiang city has a continental monsoon climate. The southwest monsoon occurs in summer, while the northeast monsoon occurs in winter. The dominant wind direction of the area is east-northeast, accounting for 17.49% of the total windy days per year (based on data from 1950-2011) and the secondary wind direction is northeast, accounting for 12.3%. Annual average wind speed is 2.5 m/s.

67. **Water Resources.** Xinxiang rides on the water systems of the Yellow River and Haihe River. The plains take up 78% of its whole area. At present, the capacity of the reservoir is 199 million m^3. The Yellow River runs about 170 km and cover an area of 4,558 km^2 in Xinxiang. In 2016, Xinxiang city has 2.005 billion m^3 of water resources and 349.05 m^3 per capita.

68. **Groundwater Resources.** The main groundwater sources for Xinxiang are from Yellow River and Haihe River. Total groundwater resource in Xinxiang is 1.123 billion m^3, while 559 million m^3 is in Yellow River basin and 564 million m^3 is in Haihe River basin.

69. **South-to-north water transfer project**. The Xinxiang suffers from an acute shortage of surface and groundwater. The middle route project of South-to-North water transfer project has 77.7 km main canal in Xinxiang city and has four water diversion intakes in Xinxiang. Xinxiang can benefit around 400 million m^3 water per year from this subproject.

D. Environmental Monitoring

70. During the preparation of the domestic EIA, environmental quality assessment of the subproject site was undertaken by XEPSTDRI.

1. Air Quality Monitoring

71. Air quality monitoring data from Xinxiang EPB's continuous air quality monitoring station was collected over a 7-day period in early April 2014. Monitoring was undertaken for a minimum of 18 hours per day, allowing 24 hour averaging periods for SO_2, nitrogen dioxide (NO_2), $PM_{2.5}$, and PM_{10}. Besides, air quality monitoring data from Xinxiang EPB air quality monitoring station was collected over a 7-day period in April 2017 was also collected by PPTA consultant. The results are presented in **Table 16**. The data show that all parameters except 24-hr mean $PM_{2.5}$ on 1 April 2014 were in compliance with Class II of *Ambient Air Quality Standards (*GB3095-2012).

Table 16: Air quality monitoring results (ug/m^3)

Date	24-hr mean PM_{10}	24-hr mean $PM_{2.5}$	24-hr mean SO_2	24-hr mean NO_2
April 1, 2014	146	78	0	53
April 2, 2014	110	60	0	0
April 3, 2014	133	52	46	43
April 4, 2014	146	72	74	51
April 5, 2014	122	40	39	41
April 6, 2014	122	52	37	48
April 7, 2014	138	64	67	47
April 16, 2017	68	42	34	44
April 17, 2017	142	42	30	36
April 18, 2017	110	31	17	38
April 19, 2017	124	41	22	48
April 20, 2017	134	35	23	37
April 21, 2017	72	23	16	27
April 22, 2017	94	38	26	48
Standard	**150**	**75**	**150**	**80**

NO_2 = nitrogen dioxide, $PM_{2.5}$ = particulate matter with diameter less than 2.5 micrometers, PM_{10} = particulate matter with diameter less than 10 micrometers, SO_2 = sulphur dioxide, ug/m^3 = microgram per cubic meter.
Source: Domestic EIA and PPTA consultant

2. Surface Water

72. The surface water body near the subproject site is: Sandou Canal (**Figure 6**), which is 15 m away from the subproject in east direction.

Figure 6: Surface water near the subproject site

Source: Google map, 2017

73. Sandou Canal is used for agricultural irrigation and is part of Wenyan Canal. Surface water quality of Sandou Canal was not undertaken in domestic EIA. Based on information from *Henan Environmental Quality Bulletin in 2016,*[7] surface water quality of Sandou Canal in Fengqiu city can meet the Class IV of Environmental Quality Standards for Surface Water (GB 3838-2002) and is 100% compliance with the standard in 2016. Because Category V water quality standard is applicable for Sandou Canal and Class IV is more stringent than Class V, Sandou Canal's water quality is in compliance with the standard.

3. Noise

74. Daytime and nigh-time noise monitoring was not conducted at the subproject site. But environmental noise quality assessment of the subproject site was undertaken by Xinxiang Environmental Protection Science and Technology Design and Research Institute (XEPSTDRI). Based on the domestic tabular EIA, noise levels near the subproject site were in compliance with

[7] http://www.hnep.gov.cn/tabid/324/InfoID/24529/Default.aspx

relevant PRC standard, Category II of *Environmental Quality Standards for Noise* (GB3096-2008). The PPTA consultants visited the subproject site in March 2017 and observed that main noise activities near the subproject site are agricultural activities and vehicles and there is no other industrial facility near the subproject site. Noise levels will be monitored during the subproject implementation.

E. Ecological Resources

75. Based on site survey undertaken during the preparation for the domestic EIA, there are no known ecological and/or sensitive resources near the subproject site.

76. The subproject area has been subject to human activity for agricultural activities and habitats are highly modified and mostly degraded. Virtually no original habitat remains. Habitats are rated as Ecological Impact Grade III (the lowest level) under the PRC's Technical Guideline on EIA Regarding Ecological Impact (HJ 19-2011). Overall, biodiversity value of the areas is low.

1. Flora

77. The original vegetation of Xinxiang City is classified as temperate deciduous broad-leaved forest by the Vegetation Regionalization of China (1980). Due to human activities, the original vegetation has been replaced by secondary vegetation. Common shrub species include Vitex negundol and Zizyphus jujube. Cultivated trees along the river banks, roads and villages include Sophora japonica, Anthus altissima, Salix matsudana, Populus tomentosa, Robinia pseudoacacia, Ulmus pumila, and Morus alba. Lands along the river support maize, rape, potato and beans and planted trees. Weeds include Imperata cylindrica var, major, Setaria viridis, Xanthium sibiricum, Artemisia argyi, Tribulus terrestris, Vitex negundo, Humulus scandens and Plantago asiatica.

2. Fauna

78. According to the Fauna Regionalization of China (1959), Xinxiang City belongs to the Huabei (North China) Region. For birds, at least 188 species from 39 families have been recorded near the subproject area, including about 129 migratory species, 84 wetland species, 45 of conservation interest (i.e., listed on the International Union for Conservation of Nature (IUCN) Red List, Grade I or II National Protected Species Status, or provincial protected species in Henan). For mammals, 20 species have been recorded, comprising over 50% rodents (rats and mice). There are few records for larger mammals. One species, Hog Badger (Arctonyx collaris) is IUCN Near Threatened, yet the date and accuracy of the record is unclear. Leopard Cat (Felis bengalensis) is listed as the Grade II in the state key protection wildlife list, and two species (Rock Squirrel Sciurotamias davidianus; Cape Hare Lepus capensis) are included under the "Three Have" list of SFA (2000).[8]

3. Flora and Fauna at Subproject Site

79. The subproject site is within city limits in highly developed and modified agricultural and urban environments. Surrounding land uses include agricultural, mixed commercial, and residential. Original vegetation cover has been previously removed, and existing site vegetation is typically completely absent as they are developed agricultural sites, or disturbed dirt with little or no vegetation cover (**Figure 7**). There are no known rare or endangered flora or fauna, parks, nature reserves or areas with special national, regional or local ecological significance within or

[8] A designation by the SFA on whether a species has three categories of values: ecological, scientific and economic.

adjacent to the subproject site.

Figure 7: Subproject site conditions

(i) Northern part of the subproject site

(ii) Western part of subproject site

4. Parks and Protected Areas

80. There are no parks or protected areas in or near the subproject site.

5. Sensitive Receptors

81. Sensitive locations for air quality impacts, surface water impacts and noise impacts in the subproject site were determined in the domestic EIA utilizing remote sensing and ground surveys. **Table 17** shows sensitive areas. The surface water body near the subproject site is: Sandou Canal (**Figure 6** presents sensitive surface water body near the subproject site and presents sensitive areas (air quality and noise).

82. Based on domestic EIA, health protection zone of the subproject is 300 meters. There were no sensitive receptors in the zone.

Table 17: Sensitive areas (air quality, noise and surface water)

Sensitivity	Area	Direction	Distance (m)	Function	Standard
Air quality	Nanfan Village	NW	525	Residential Area	Category II
	Yingju Village	SE	400	Residential Area	Category II
	Songxiaozhai Village	SW	900	Residential Area	Category II
	Qianxiaozhai Village	SW	1,000	Residential Area	Category II
	Shilou Village	NE	480	Residential Area	Category II
Noise	Nanfan Village	NW	525	Residential Area	Category II
	Yingju Village	SE	400	Residential Area	Category II
	Songxiaozhai Village	SW	900	Residential Area	Category II
	Qianxiaozhai Village	SW	1000	Residential Area	Category II
	Shilou Village	NE	480	Residential Area	Category II
Surface water	Sandou Canal	E	15	Agricultural irrigation	Category V

E = east, m = meter, NE = northeast, NW = northwest, SE = southeast, SW = southwest.

Figure 8: Sensitive areas (air quality and noise)

F. Socio-economic and Cultural Resources

83. Xinxiang is a prefecture-level city comprised of four districts, five counties and two county-level cities (**Figure 9**) with a total area of 8,629 km^2. Its population was 6,108,200 at the end of 2016 and the total permanent population (urban and rural) was 5,743,000 (**Table 18**).

Figure 9: Map of Xinxiang City Administrative Divisions

Source: https://en.wikipedia.org/wiki/Xinxiang

Table 18: Data on Xinxiang City Administrative Divisions

Subdivision	Land Area (km^2)	Population (2016)	Population Density (persons/km^2)
Weibin	52	1,824,527	35087
Hongqi	99	206,251	2083
Fengquan	115	95,193	828
Muye	80	237,982	2975
Weihui	882	388,704	441
Huixian	2,007	626,685	312
Xinxiang	365	253,847	695
Huojia	473	317,309	671
Yuanyang	1,339	539,425	403
Yanjin	946	380,771	403
Fengqiu	1,220	587,022	481
Changyuan	1,051	650,484	619

km^2 = square kilometer.
Source: Xinxiang Statistical Bureau, 2016

84. There are 44 ethnicities including Hui, Mongolian, and Manchu. Ethnic minorities accounting for 1.07% and the rest is Han ethnicity.

1. Economy

85. Xinxiang is rich in mineral resources. Coal reserve in Xinxiang is 8.4 billion tons; cement limestone reserve is 10 billion tons; and granite reserve is 2 billion m^3.

86. Xinxiang is one of the important high-quality wheat, grain and cotton production bases in the PRC. It is also one of the livestock production and processing bases in Henan Province. In 2016, the city's GDP was CNY214.073 billion, of which the primary sector accounted for 10.4% or CNY22.26 billion; the secondary sector accounted for 49.1% or CNY105.10 billion; and the tertiary sector accounted for 40.5% or CNY86.70 billion.

2. Transportation

87. The city is a rail junction and industrial center at the head of navigation on the Wei River (Shandong). The river, made navigable for small vessels by river improvements in the 1950s, links the city with Tianjin, the main port for Beijing. Later, due to heavy industrial chemical pollution, the river course had been totally cut off and got filled up. After recent dredges, it is still not navigable. Xinxiang is located at the junction of the Beijing-Guangzhou, Xinxiang-Yueshan and the Xinxiang-Yanzhou Railways.

3. Physical Cultural Resources

88. Xinxiang has a rich history. Xinxiang was site of the Battle of Muye where the Shang Dynasty was overthrown by the Zhou Dynasty. However, the project activities are all on long developed sites within city limits in highly developed and modified industrial and urban environments. There are no known physical cultural resources (PCRs) in the subproject site.[9]

[9] Physical cultural resources (PCR) are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings and may be above or below ground or under water. Their cultural interest may be at the local, provincial, national, or international level. Within the Project area these could include:

- Funeral site: graves, cemeteries, shrines, stupas.
- Religious buildings: Temples or Pagodas, complete or ruins.
- Religious objects: Buddhist images or sculpture.
- Sacred sites: sacred caves, forest, hills or cliffs.
- Historical sites or objects: artifacts, tools, relics, memorials.
- Spirit sites: sites residents believe are occupied by a spirit (house, tree, stone, etc.).

V. ANTICIPATED IMPACTS AND MITIGATION MEASURES

89. Anticipated positive and negative environmental impacts of the proposed subproject were assessed based on the FSR (2014); a technical due diligence review of the FSR undertaken by ADB PPTA specialists; a domestic EIA report prepared by XEPSTDRI; public consultations led by the subborrower and assisted by ADB PPTA consultants; and site visits, surveys and consultations undertaken by ADB PPTA consultants.

90. Environmental impacts during pre-construction, construction, and operation phases were each considered separately. The results of the assessment indicate that during the pre-construction phase environmental issues were very limited, and were mostly associated with ensuring appropriate incorporation of mitigation measures into the project design.

91. Potential negative environmental impacts during construction phase were short-term and localized, and are associated with soil erosion, construction noise, fugitive dust, disruption of traffic and community services, and risks to worker health and safety. Potential negative impacts during operation phase are associated with boiler emissions, odor, waste and wastewater, noise, and health and safety risks to workers.

92. Potential positive impacts during operation phase are significant and long-term, and are associated with emissions and pollution reductions from open burning of straws, chemical fertilizer, and untreated livestock and poultry manure.

A. Pre-Construction Phase Measures to be Implemented During Detailed Design

1. Siting and Land Acquisition

93. Social safeguards due diligence was undertaken for the proposed subproject by PPTA social consultant. The information is summarized below.

94. The land was cultivated land before and belonged to Yingju Village in Yingju County. Land acquisition was conducted by the local government since end of 2013 and complete in 2014, which was not in anticipation of ADB financing. The land was acquired by the local government for the development of Yingju Agriculture Industry Park in batches, according to the local planning and the land acquisition was not for a specific project. The land acquisition started at the end of 2013. Fengqiu Land and Resource Bureau and Fengqiu County Government completed land acquisition, detailed measurement surveys, and project publicity programs at the end of 2013. In January 2014, Yingju Village signed a compensation agreement with Fengqiu Land and Resource Bureau. In February 2014, affected villagers received cash compensations from the Village Committee. The land acquisition and resettlement activities were completed in February 2014.

95. The permanently collective land acquisition area for the subproject is 115.73 mu and all of which was cultivated land. 82 households with 363 villagers in No. 7 Group in Yingju Village were affected by land acquisition and resettlement (LAR). The per capita land area was 2 mu before land acquisition and reduced to 1.7 mu after and the average land loss rate was 15%. No ground attachment and houses were affected by the LAR.

96. According to *the Notice of the Henan Provincial Government on Amending Location-based Land Prices for Land Acquisition (HPG [2013] No.11)* and *the Notice of the Xinjiang City Government on Amending Location-based Land Prices for Land Acquisition (XPG [2011] No.95)*,

the collective land in Yingju Village acquired for the Subproject is Tier-2 land, where the location-based land price is CNY35,000/mu, and the compensation rate for young crops is uniformly at CNY1,000/mu. The households affected by the subproject mainly grow food crops such as wheat and corn. In case of wheat: during 2013 when land was acquired, the average agricultural output was 550 kg/mu and the income was CNY1,232/mu (based on the market price of CNY2.24/kg), and the annual net income was CNY832CNY/mu (excluding fertilizer, irrigation and labor costs, averaging CNY400/mu). The sum of land and young crop compensation is about 43 times of the annual net income of wheat.

97. The total compensation for LAR of this subproject is CNY4.15 million and the average compensation per household is CNY50,729 and the average agriculture income loss was CNY1,172 per household. As a result, the subproject didn't have too much impact on their household income. Some of the AHs have used the land aquisation compensation to carry out individual businesses such as transportation or spend on outside employment which increases their household income. The subborrower has a well-designed system which will provide job opportunities for the local villagers including the AP also.

98. The compensation work for land acquisition of the subproject has been completed and all compensation fees have been paid off. The certificate for the use of state-owned land has been obtained.

99. The land acquisition of the subproject followed relevant PRC laws and regulations, and carried out compensation activities for LAR in accordance with the laws. The land acquisition procedure, compensation standards and resettlement plans were in line with national laws and regulations. No AP's complaint about compensation and payment was received.

100. Overall, the social safeguards due diligence indicates that the project will not result in any involuntary land acquisition, resettlement or physical displacement. There is no loss of personal property, structures, crops, trees or other assets. There are also no potential adverse impacts on disadvantaged or vulnerable groups, including the poor, women and children, and indigenous peoples.

2. Mitigation Measures and Monitoring during Detailed Design

101. Mitigation measures to be adopted during detailed design to minimize the environmental impacts are as follows:

(i) **Detailed Design.** Environmental mitigation measures included in this IEE, EMP, and domestic EIA will be incorporated into the detailed design.

(ii) **Bidding Documents and Contracts.** Environmental mitigation measures included in this IEE, EMP, and domestic EIA will be included in contracts for civil works and equipment installations. All contractors will be required to strictly comply with the EMP.

(iii) **Environmental monitoring.** The environmental monitoring program (EMoP, see Table 3 in Appendix I) will be incorporated into the design to ensure that environmental impacts are closely monitored and activities of the subproject construction and operation are closely supervised against the PRC environmental laws, regulations and standards, ADB SPS, and the subproject EMP and the approved domestic EIA.

3. Grievance Redress Mechanism

102. In accordance with the GRM presented in Chapter VIII of the IEE; (i) a staff member from the subborrower will be assigned overall responsibility for the GRM; (ii) GRM training will be provided to subborrower and GRM access points; and (iii) the GRM access point phone numbers, fax numbers, addresses, and emails will be disclosed to the public.

4. Training and Capacity Building

103. An institutional strengthening and training program will be delivered by the environment consultants and experts (see **Table 4** in **Appendix I**). The training will focus on (i) ADB's and the PRC's environmental, health and safety laws, regulations, and policies; (ii) implementation of the EMoP and GRM; and (iii) international good EHS practices. Training will be provided to the subborrower, relevant staff, and contractors and the construction supervision company personnel.

5. Permitting

104. All necessary construction permits have been obtained from the relevant authorities.

B. Anticipated Impacts and Mitigation Measures during Construction Phase

1. Erosion and Spoil

105. Construction activities such as land leveling, excavation and filling activities may lead to surface erosion. The most vulnerable soil erosion areas in the construction site include excavation sites, leveling sites, spoil sites, temporary construction sites, and other areas where surface soil is disturbed. Soil erosion can also be more serious on slopes or near water bodies. Soil erosion can also occur after the completion of construction if site restoration is inadequate. Finally, construction activities may generate surplus spoil.

106. These impacts can be mitigated through typical good construction practice, erosion controls and site maintenance:

(i) At the construction site, the potential for storm water runoff will be assessed and appropriate storm water drainage systems to minimize soil erosion will be implemented, including perimeter bunds and establishment of temporary detention and settling ponds to control topsoil runoff;
(ii) Land excavation and filling will be balanced to minimize the requirement for fill transportation;
(iii) During earthworks, the area of soil exposed to potential erosion at any one time will be minimized through good project and construction management;
(iv) Spoils will be reused on-site to the maximum extent feasible as fill. Temporary spoil storage sites will be identified, designed, and operated to minimize impacts. Spoil sites will be restored after the completion of storage activities. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site;
(v) Spoils and aggregate piles will be covered with landscape material and/or regularly watered;
(vi) Waste construction material such as residual concrete, bricks, etc. will be used for backfill at the sites or nearby construction sites to the maximum extent feasible;
(vii) Construction and material handling activities will be limited or halted during periods of rains and high winds;

(viii) Any planned paving or vegetating of areas will be done as soon as practical after the materials are removed to protect and stabilize the soil; and
(ix) Once construction is complete, disturbed surfaces will be properly sloped and planted with native trees and grass.

2. Wastewater

107. Inappropriate disposal of domestic wastewater (from construction worker camps and/or workers) or construction wastewater (from drainage of excavation and drilling, washing aggregates, washing construction equipment and vehicles, pouring and curing concrete, and oil-containing wastewater from machinery repairs) may cause soil, surface, and/or groundwater resources contamination.

108. These impacts can be mitigated through typical good wastewater management practices:
(i) Adequate temporary sanitary facilities and ablutions will be provided for construction workers. Toilets will be equipped with septic tanks in accordance with PRC standards. Domestic wastewater will be treated in the septic tanks to meet relevant national standard and discharged based on requirements of relevant national standard;
(ii) Construction wastewater will be directed to temporary detention and settling ponds. Areas where construction equipment is being washed will be equipped with water collection basins and sediment traps. After settling, supernatant will be recycled and sediment will be periodically excavated, and either reused if possible as fill, disposed at official spoil disposal sites, or disposed at official landfills; and
(iii) Maintenance of construction equipment and vehicles will not be allowed on-site to reduce wastewater generation.

3. Air Pollution

109. Anticipated sources of air pollution from construction activities include: (i) dust generated from earth excavation, filling, loading, hauling and unloading; (ii) dust generated from disturbed and uncovered construction areas, especially on windy days; (iii) dust generated from construction material storage areas, especially on windy days; (iv) dust generated by the movement of vehicles and heavy machinery on unpaved access and haul roads; (v) dust generated from aggregate preparation and concrete-mixing; and (vi) emissions from construction vehicles (gaseous CO and NO_2) and heavy diesel machinery and equipment.

110. The domestic EIA indicates that without appropriate mitigations construction phase activities may generate significant localized total suspended particulate (TSP) levels,[10] with worst case conditions occurring in clear weather without watering. Based on previous domestic project experience, assuming a reference point (background data) with TSP level of 0.204 mg/m^3 is located at the subproject boundary site and no mitigation measure are applied:

- the maximum predicted TSP concentration within the construction site is 1.302 mg/m^3, 6.39 times higher than the reference point level; and,
- the predicted TSP concentration 200 m downwind is 0.265 mg/m^3, 1.3 times higher than the reference point level.

111. However, even the application of a simple mitigation measure such as site fencing can have a significant effect. After site fencing:

[10] Airborne particles or aerosols that are less than 100 micrometers are collectively referred to as TSP.

- the maximum predicted TSP concentration is 0.824 mg/m^3, 4.04 times the reference point, and a reduction of 0.478 mg/m^3;
- the predicted TSP concentration 100 m down wind direction is 0.235 mg/m^3, 1.15 times the reference point; and
- the pollution impact range is reduced to a 100 m radius.

112. To reduce air quality impacts during the construction period, the following air quality management measures will be implemented:

(i) Project site under construction will be fully enclosed by fence prior to the commencement of construction;
(ii) Water will be sprayed on active construction sites including where fugitive dust is being generated on a daily basis, and more frequently during windy days;
(iii) All construction piles (spoil, aggregate other construction materials) with the potential to generate dust will be covered and/or regularly watered;
(iv) Construction activities will be halted during high wind events. Once construction is complete disturbed surfaces will be properly sloped and planted with native trees and grass;
(v) Transport vehicles will be limited to low speeds in construction sites;
(vi) Loads will be covered during truck transportation to avoid spillage or fugitive dust generation. Fine materials will be transported in fully contained trucks;
(vii) Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds; and
(viii) Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical.

4. Noise Impacts

113. During the construction phase, noise and vibration will be generated by on site construction activities using heavy equipment such as bulldozers, excavators, and by the transport of construction materials. Construction equipment is considered a point noise source, and the predictive model is as follows:

(a)
$$L_i = L_0 - 20\lg\frac{R_i}{R_0} - \Delta L$$

(b) Where, L_i and L_0 are equipment noise sound levels at R_i and R_0, respectively, ΔL is additional decrement produced by barriers, vegetation and air.

114. For the impact of multiple construction machines on a location, sound level superposition uses the following formula:

$$L = 10\lg\Sigma 10^{0.1\times L_i}$$

115. A significant increase in localized noise is expected during construction. Construction activities will involve excavators, bulldozers, concrete-mixing plants, loaders, graders, rollers, and other heavy machinery, as well as noise from goods and material transportation. Noise during construction will be generated by construction activities.

116. The construction phase can be divided into 4 stages: earthworks, foundation construction,

structure construction, and final finishing:

- The main noise sources during the earthwork stage will be non-directive mobile sources including excavators, bulldozers, loaders and transport vehicles;
- The main noise sources during foundation construction stage will be stationary, including pile machines, land levelers, etc. Although the foundation construction phase period is short, predicted noise levels are high, ranging from 95-105 dB(A);
- The structure construction stage is the longest period in the construction phase. There are a variety of noise sources in this phase including concrete mixers, heavy equipment, cranes, etc;
- The final finishing stage is also lengthy. Main noise sources include electrical saws, drills, cutting machines etc. Noise levels from these noise sources range from 85–95 dB(A) and are short in duration; and
- Materials and equipment transport can occur in all four phases.

117. These noise impacts will occur in mostly inhabited urban areas. Though noise levels may be high, the impacts will be temporary and localized, and can be further mitigated.

118. To ensure construction activities meet the PRC's noise standards and to protect workers and adjacent residents which is about 500 m away from the subproject site, the following mitigation measures will be implemented:

(i) Construction activities, and particularly noisy ones, are to be limited to reasonable hours during the day and early evening. Construction activities will be strictly prohibited during the nighttime (22:00 h to 07:00 h). Exceptions will only be allowed in special cases, and only after getting approval of the surrounding residents, local EPB and other relevant departments;

(ii) When undertaking construction planning, simultaneous high-noise activities will be avoided, and high-noise activities will be scheduled during the day rather than evenings. Similarly, construction sites will be planned to avoid multiple high-noise activities or equipment from operating at the same location;

(iii) Low-noise equipment will be selected as much as possible. Equipment and machinery will be equipped with mufflers and will be properly maintained to minimize noise;

(iv) Noise personnel protective equipment (PPE) will be provided to workers;

(v) Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and rush hours;

(vi) Vehicles transporting construction materials or waste will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools, and hospitals; and

(vii) Based on site visit, the nearest sensitive receptors near the subproject site are presented in **Table 17**. Special attention will be paid to protect sensitive sites near the subproject: high-noise construction activities will be positioned as far away from sensitive sites as possible. Temporary or permanent noise barriers will be installed to protect sensitive sites if necessary.

5. Solid Waste

119. Solid waste generated in the construction phase will include construction and domestic waste. Construction wastes include fill, various building materials such as steel, timbers, rubble, and other types of waste. An estimated of 0.5 kg/day per worker of domestic waste will be generated from construction workers and 2.0 kg/m^2 construction waste will be generated from construction activities. Inappropriate waste storage and disposal could affect soil, groundwater,

and surface water resources, and hence, public health and sanitation.

120. The following solid waste management measure will be implemented:

(i) Wastes will be reused or recycled to the extent possible. Waste construction material such as residual concrete, bricks will be used for backfill at the sites.
(ii) Littering by workers will be prohibited;
(iii) Domestic waste containers will be provided at all work sites. Domestic waste will be collected on a regular basis by the local sanitation departments and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements;
(iv) Construction waste dumpsters will be provided at all work sites. Construction waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements;
(v) Excavated soil will be backfilled on-site to the extent possible. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site;
(vi) There will be no final waste disposal on site. Waste burning at or near the site is strictly prohibited; and
(vii) Contractors will be held responsible for proper removal and disposal of any significant residual materials, wastes, and contaminated soils that remain on the site after construction.

6. Hazardous and Polluting Materials

121. Inappropriate transportation, storage, use and spills of petroleum products and hazardous materials can cause soil, surface and groundwater contamination. To prevent this, the following mitigation measures will be implemented:

(i) A hazardous material handling and disposal protocol that includes spill emergency response will be prepared and implemented by contractors;
(ii) Storage facilities for fuels, oil, chemicals and other hazardous materials will be within secured areas on impermeable surfaces provided with dikes with a storage capacity of at least 110% of the capacity of the hazardous materials stored, and at least 300 m from drainage structures and important water bodies. A standalone site within the storage facility will be designated for hazardous wastes;
(iii) Signs will be placed at chemicals and hazardous materials storage sites to provide information on type and name of chemicals and hazardous materials;
(iv) Suppliers of chemicals and hazardous materials must hold proper licenses and follow all relevant protocols and PRC regulations and requirements; and
(v) A Xinxiang EPB certificated company (the companies can be found in http://fs.xxhb.gov.cn/FSYGL/2014/06/10/1801004261.html) will be hired to collect, transport, and dispose of hazardous materials in accordance with relevant PRC regulations and requirements.

7. Impacts to Flora and Fauna

122. Typical construction impacts on flora and fauna include removal of vegetation and disruption of the ecosystem during construction. If present, rare or endangered flora or fauna may also be impacted. However, the subproject construction site is located in urban environments within the city limits, which have little or no vegetation cover other than recently established grasses and shrubs. Based on site visits, there is no known rare or endangered flora or fauna, parks, nature reserves or areas with special ecological significance which will be impacted by the

subproject. Impacts on flora or fauna are thus expected to be minimal and short-term. Nonetheless, to address potential impacts:

(i) A greening plan will be implemented. Site vegetation plans will be developed at the subproject site using appropriate native species.

Any existing vegetated areas impacted by the subproject will be restored post-construction using appropriate native species.

8. Impacts on Community Disturbance and Safety

123. Project construction activities have the potential to cause community disturbance such as traffic congestion or delays, and public safety risks from heavy vehicles and machinery traffic. Mitigations will be implemented to address traffic and other community disturbance issues.

(i) Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and rush hours;
(ii) Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals; and
(iii) Signs will be placed at construction sites in clear view of the public, warning people of potential dangers such as vehicle moving. All sites will be made secure, discouraging access by members of the public through appropriate fencing whenever appropriate.

9. Worker Occupational Health and Safety

124. Construction may cause physical hazards to workers from noise and vibration, dust, handling heavy materials and equipment, falling objects, work on slippery surfaces, fire hazards, chemical hazards such as toxic fumes and vapors, and others.

125. Contractors will be required to implement adequate precautions to protect the health and safety of their workers:

(i) Each contractor will implement the relevant construction phase EHS plan;
(ii) Identify and minimize the causes of potential hazards to workers. Implement appropriate safety measures;
(iii) Provide training to workers on occupational health and safety, emergency response, especially with respect to using potentially dangerous equipment and storage, handling and disposal of hazardous waste;
(iv) Ensure that all equipment is maintained in a safe operating condition;
(v) Provide appropriate PPE to workers;
(vi) Implement work practices to limit workers' exposure to high-noise or heat working environments in compliance with PRC noise standards for construction sites (GB 12523-2011);
(vii) Ensure regular safety meetings with staff; and
(viii) Ensure that material stockpiles or stacks, such as, pipes are stable and well secured to avoid collapse and possible injury to workers.

10. Physical Culture Resources

126. Based on the domestic EIA and site visits there are no known cultural heritage or archaeological sites at or near the subproject site. However, construction activities have the potential to disturb unknown underground cultural relics. To address this issue, a construction phase chance find procedure will be established and activated if any chance finds of PCRs are

encountered:

(i) construction activities will be immediately suspended if any PCRs are encountered;
(ii) destroying, damaging, defacing, or concealing PCRs will be strictly prohibited in accordance with PRC regulations;
(iii) the local Cultural Heritage Bureau will be promptly informed and consulted; and,
(iv) construction activities will resume only after thorough investigation and with the permission from the local Cultural Heritage Bureau.

C. Anticipated Impacts and Mitigation Measures during Operation Phase

127. The subproject may cause some adverse environmental impacts during operation including air pollution from natural gas combustion, odor gas, noise from subproject operation, use of water, production of wastewater and solid wastes, and fire and safety hazards.

1. Air Pollution

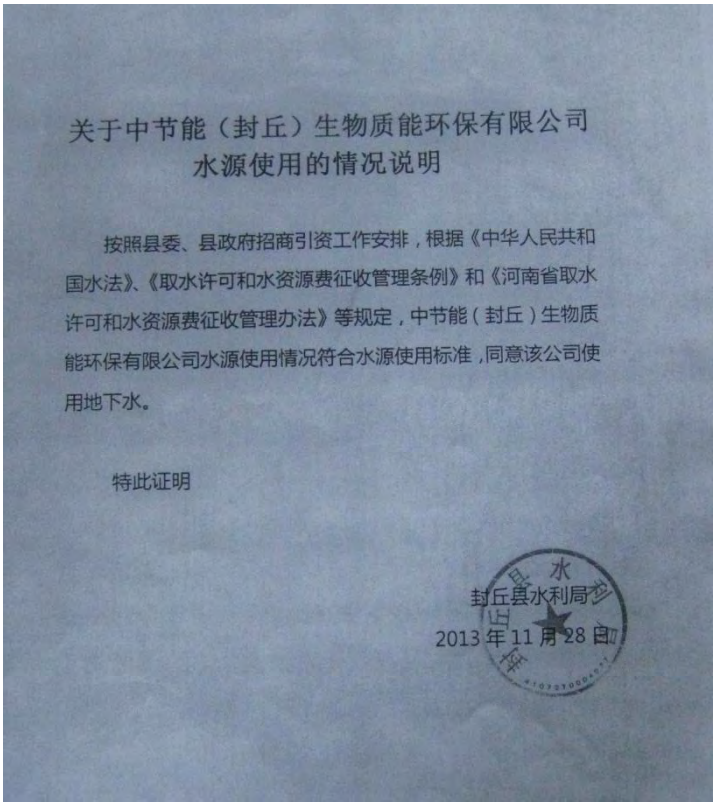
128. The primary emissions to air is odor gas from biogas and organic fertilizer production, exhaust gas from gas-fired boiler and odor gas from manure collection and transportation. To minimize emissions and associated impacts, the subproject will implement the follow measures:

(i) Low NOx natural gas-fired boiler with design emission levels that are in compliance with the most stringent of PRC national standard (see **Table 7)** Natural gas generally produces negligible quantities of particulate matter and sulfur oxides, and levels of nitrogen oxides are about 60% of those from plants using coal (without emission reduction measures). Natural gas-fired plants also release lower quantities CO_2. Exhaust gas of the boiler will be discharged through an 8-meter high chimney;
(ii) Closed fermentation will be used for biogas and organic fertilizer production.
(iii) Layout for biogas and organic fertilizer plants will be reasonable planned. Odor gas sources will be located at main downwind direction;
(iv) Raw material and manure will be sealed or semi-sealed transported and stored.
(v) Odor gas collection equipment will be installed at biogas and organic fertilizer production facilities;
(vi) Collected odor gas will be treated in biological deodorization tower to meet the requirements in emission standards for odor pollutants (GB 14554-93); and
(vii) Greening plan will be implemented at biogas and organic fertilizer production plants to reduce odor gas.

2. Water Consumption

129. The subproject will use groundwater as domestic water and production water. Annual water consumption is 1,065.6 tons which has a low impact to ground water. The ground water intake certification was approved by Fengqiu Water Resources Bureau on 28 November 2013 (**Figure 10**).

Figure 10: Ground water intake certification



关于中节能（封丘）生物质能环保有限公司
水源使用的情况说明

按照县委、县政府招商引资工作安排，根据《中华人民共和国水法》、《取水许可和水资源费征收管理条例》和《河南省取水许可和水资源费征收管理办法》等规定，中节能（封丘）生物质能环保有限公司水源使用情况符合水源使用标准，同意该公司使用地下水。

特此证明

封丘县水利局
2013 年 11 月 28 日

3. Wastewater

130. Wastewater will be produced from canteens and toilet facilities. Production wastewater will include cleaning wastewater, biogas slurry from biogas production, wastewater from biogas dehydration and desulfurization, and wastewater from organic fertilizer production.

131. The following measures will be taken to address production and domestic wastewater:

(i) Wastewater from canteen will be treated by oil-separator, and then used as raw material of biogas production combined with water from toilet facilities;

(ii) Biogas slurry from biogas production, cleaning wastewater, wastewater from biogas dehydration and desulfurization and wastewater from organic fertilizer production will be collected and used for organic manure production; and

(iii) Domestic wastewater and production wastewater will be reused or recycled at the plant and there will be no wastewater discharge from the facility.

4. Solid Waste

132. The subproject will generate domestic waste and production waste. Production waste includes waste from straw chopping, biogas residue from biogas production and residue from organic fertilizer production. If not properly managed this waste can cause visual and environmental impacts. To mitigate this risk, the following measures will be implemented:

(i) Domestic waste bins will be provided and domestic waste will be routinely collected by the local sanitation department for recycling, if possible, or final disposal at an approved waste disposal site;
(ii) No permanent on-site solid waste disposal will be permitted at the subproject site;
(iii) No burning of wastes will be permitted at the subproject site; and
(iv) Waste from straw chopping, biogas residue from biogas production and residue from organic fertilizer production will be sent to organic fertilizer plant and used as raw material for organic fertilizer production.

5. Noise

133. Noise sources during operation will mainly be from noise from pumps, biogas production equipment, and organic fertilier production equipment. To mitigate noise impacts the subproject will implement the following measures:

(i) Low-noise equipment will be used as far as possible, and noise reduction measures such as noise elimination, shock absorption, insulated enclosures and sound dampening materials on exterior walls will be implemented;
(ii) All equipment will be properly maintained to minimize noise;
(iii) Appropriate noise PPE will be provided to the workers who are likely to be exposed to high-noise level environments;
(iv) Layout for biogas and organic fertilizer production workshops will be reasonable planned to reduce noise; and
(v) Greening plan will be implemented at biogas and organic fertilizer production plants to reduce noise.

6. Occupational Health and Safety

134. Plant operation poses risks to workers. Accidental release of chemicals and hazardous materials may present health and safety risks to workers. Biogas and natural gas also presents fire, burn and explosive hazards.

135. To minimize risks associated with leaks of natural gas:

(i) All natural gas works will be in compliance with relevant PRC building code requirements, including the *Code for Design of City Gas Engineering* (GB 50028-2006) and *Regulation on Electric Apparatus Design for Explosion and Fire Risk Environment* (GB50058-92);
(ii) Project site will be equipped with flammable gas detection, alarm and fire suppression systems. Electrical devices within the explosion risk area will be safety equipped;
(iii) Gas pipelines will be grounded and equipped with anti-lightning devices where applicable; and
(iv) All gas related devices will be brightly colored and equipped with warning signs.

136. To mitigate potential health and safety risks to workers, the following measures will be taken:

(i) Operation phase EHS plans including fire prevention and control will be developed and implemented, and workers will be trained regularly on their implementation;
(ii) Biogas and natural gas systems will be designed in strict compliance with relevant PRC fire, health and safety standards. Fire compartments will be established based on the fire risks, and fire-resistant buildings/structures will include fire-proof doors and windows;

(iii) Fire-alarm and suppression systems will be installed and tested regularly to ensure it functions properly;
(iv) PPEs including goggles, gloves, safety shoes, will be provided to workers;
(v) Control measures will be strictly undertaken to ensure the discharge, exhaust and safety relief of flammable fuels in enclosed systems;
(vi) No unauthorized personnel will be allowed into gas-fired facilities; and
(vii) Provide training to workers on occupational health and safety, emergency response.

7. Emergency Response Plan

137. An emergency risk and response plan applicable to all gas related facilities will be established in accordance with the "*National Environmental Emergency Plan*" (24 January 2006) and other relevant PRC laws, regulations and standards and will include measures in the *World Bank EHS Guidelines* with respect to occupational and community health and safety.

D. Anticipated Positive Operation Phase Impacts

138. The project consumes 43,000 tons of corn stock and 30,000 tons of pig manure to produce 4,200,000 m^3 of biological natural gas, 32,400 tons of solid organic fertilizer, and 15,000 tons of liquid organic fertilizer annually. The biological natural gas is compressed and transported to the filling stations. The total output of biological natural gas is 155,862 GJ[11] or 43.3 GWh or 5,318 tons of coal equivalent (tce) and could replace 4.90 million liters of gasoline[12] or 4.25 million liters of diesel[13] based on the heating value calculation. The biological natural gas will improve the availability of local natural gas supply and to encourage more vehicle owners to switch from gasoline or diesel to natural gas. Meanwhile, the project owner will purchase 6,810,000 m^3 liquefied natural gas (LNG) to fully utilize the capacity of the filling station. There are no direct emissions from the project.[14]

139. Gasoline usage for taxi,[15] corn stock open burning and nitrogenous fertilizer utilization[16] are selected to be the reference cases. As the gasoline consumed should meet the standard of GB 17930 Gasoline for motor vehicles, the emissions from gasoline-powered taxi which meet Stage IV emission standard is considered as the baseline for pollutant mitigation calculation. The emissions of reference case are listed in Table 19.

A research conducted by China Automobile Research Center indicated that the compressed natural gas (CNG) emissions will reduce 34% of total hydro carbon (THC), 70% of carbon monoxide (CO), 80% of nitrogen oxide (NO_x), and 83% of particulate matter (PM)[17]

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[11] According to the sample testing report, the heat value of biogas is 37.11MJ/m^3 and H_2S content is 0 mg per cubic meter (limit of detection is 0.03 mg/m^3) which meets the natural gas standard of GB 17820-2012.

[12] The density of gasoline is 1353 liter per ton and heat value 43,070 kJ/kg.

[13] The density of diesel is 1164 liter per ton and heat value 42,652 kJ/kg.

[14] The CO_2 emissions from purifying biogas process come from renewable sources which does not take account.

[15] Due to the drastic cost reduction by switching fuel from oil to natural gas, the CNG vehicles are mainly used for business purposes, like taxi and freight trucks. Currently, most of CNG is used by taxi.

[16] Nitrogenous fertilize is the main chemical fertilizer used in the PRC.

[17] Source: http://news.cnpc.com.cn/system/2016/05/31/001594788.shtml.

compared to Stage IV fuel. The energy savings and emission mitigation from the project implementation is listed in TableA research conducted by China Automobile Research Center indicated that the CNG emissions will reduce 34% of total hydro carbon (THC), 70% of carbon monoxide (CO), 80% of NOx, and 83% of PM[18] compared to Stage IV fuel. The energy savings and emission mitigation from the subproject implementation is listed in **Table 20**. **Emissions from** vehicles contribute in part to the haze of the Beijing–Tianjin–Hebei (BTH) region. Using natural gas as a substitution fuel for gasoline and diesel is one of the options to reduce emissions from automobiles. In 2015, the share of natural gas in primary energy consumption was only 5.9% in the PRC, much less that the world average of 23.7%. More than 30% of the natural gas consumed is imported in the PRC. Increasing availability of domestic natural gas supply could benefit not only pollutant mitigation, but also energy security.

140. This project adopts a proven and best available technology for agricultural waste treatment and produces 4,200,000 m^3 natural gas from agricultural waste. It will save 5,318 tce of energy per annum and reduce CO_2, SO_2, NO_x, PM, CO, and hydrocarbon/VOCs emission at 15,499, 19.3, 192.7, 514.1, 2,393.2, and 453.3 tons respectively.

141. The business model designed for this project can solve the problems faced during the biogas industry development such as low economic performance, unsustainable feedstock supply, and others. It could be replicated to other projects, to form a biogas production industry using agricultural waste. The organic fertilizer produced by this project could improve the soil quality in the long run and improve the air quality as well.

Table 19: Emissions of Reference Cases

	Category	CO	THC	NO_x	PM	SO_2[a]	CO_2[b]
Taxi	Baseline emission factor[c] (g/km)	2.45	0.277	0.135	0.003	50 ppm	--
	Correct factor[d]	1.47	1.43	1.58	1.12	--	
	Emission factor[e] (g/liter)	33.32	3.66	1.98	0.031	0.074	2,361
	Emissions from gasoline[f](ton)	163.2	17.9	9.7	0.15	0.36	11,569
Total reference case emissions		163.2	17.9	9.7	0.15	0.36	11,569

CO = carbon monoxide, CO_2 = carbon dioxide, g/km = grams per kilometer, g/liter = grams per liter, kg/ton = kilograms per ton, NO_x = nitrogen oxide, PM = particulate matter, SO_2 = sulfur dioxide, THC = total hydro carbon.

[a] GB 17930-2016 Gasoline for motor vehicles Stage IV.

[b] China carbon trade network: CO_2 emission factor of gasoline 2.361 kg/liter (www.tanpalfang.com).

[c] Emission under the scenario of speed 30 km/h, temperature 15°C, moisture 50% and 50 ppm sulfur content.

[d] Consider the impacts from temperature, moisture, sulfur content of gasoline, average speed of taxi (assuming 30–40 km/h) and the deterioration of catalytic converter.

[e] Fuel consumption is 10.8 liter/100 km which meets the GB 20997-2007 Limits of fuel consumption for light duty commercial vehicles.

[f] Gasoline consumption of 3,618,807 liters.

Source: Ministry of Environmental Protection: Technical Guidelines of Air Pollutant Inventory for Automobiles.

[18] Source: http://news.cnpc.com.cn/system/2016/05/31/001594788.shtml

142. **Figure 11** illustrates how the emissions reductions are created.

143. Emissions from vehicles contribute in part to the haze of the Beijing–Tianjin–Hebei (BTH) region. Using natural gas as a substitution fuel for gasoline and diesel is one of the options to reduce emissions from automobiles. In 2015, the share of natural gas in primary energy consumption was only 5.9% in the PRC, much less that the world average of 23.7%. More than 30% of the natural gas consumed is imported in the PRC. Increasing availability of domestic natural gas supply could benefit not only pollutant mitigation, but also energy security.

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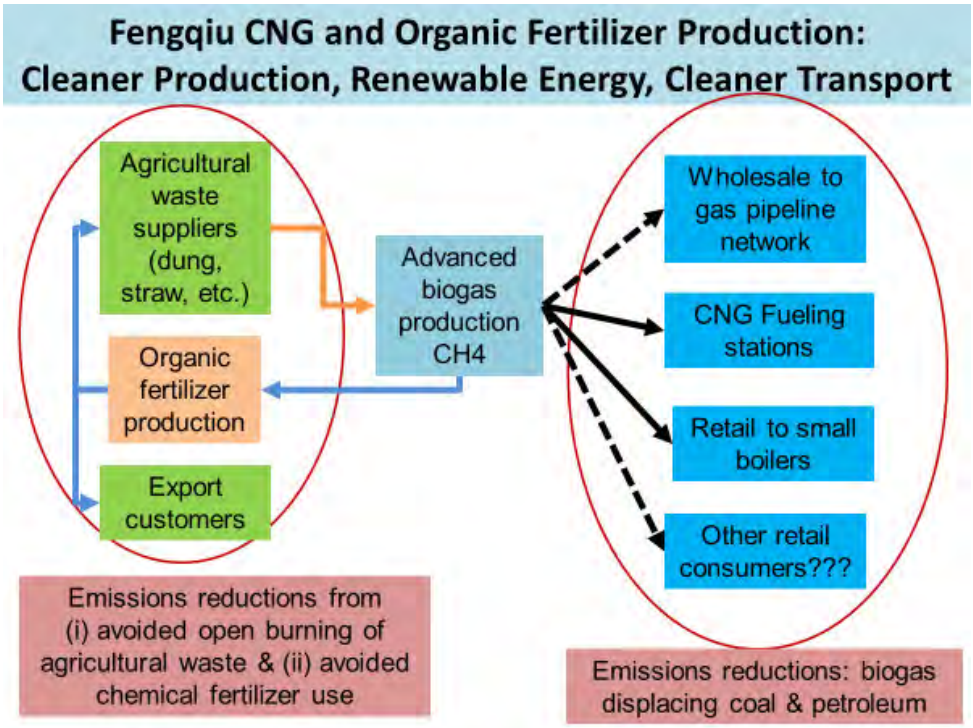
[f] Gasoline consumption of 3,618,807 liters.

Source: Ministry of Environmental Protection: Technical Guidelines of Air Pollutant Inventory for Automobiles.

Figure 11: Subproject Emissions Reductions Pathways



CH_4 = methane, CNG = compressed natural gas.

Table 20: Energy Savings and Pollutant Mitigation

Energy Savings (tce)	5,318[a]					
	CO_2	SO_2	NO_x	PM	CO	THC/VOCs
Total reference case emissions (ton)	11,569	17.9	9.7	0.15	163.2	17.9
Project emissions (ton)	0	0	1.9	0.03	49.0	11.8
Emission reduction(ton)	11,569	17.9	7.8	0.12	114.2	6.1

CO = carbon monoxide, CO_2 = carbon dioxide, NO_x = nitrogen oxide, PM = particulate matter, SO_2 = sulfur dioxide, tce = ton of coal equivalent, THC = total hydrocarbon, VOC = volatile organic compounds.

[a] Excluding energy consumption of the subproject.

VI. ALTERNATIVE ANALYSIS

146. An analysis of subproject alternatives was undertaken during the feasibility stage to determine the most financially and technically feasible way of achieving the project objectives while minimizing environmental and social impacts.

A. No Project Alternative

147. Xinxiang City is one of the important high-quality wheat, grain and cotton production bases in the PRC. It is also one of the livestock production and processing bases in Henan Province. Straw and manure treatment is a problem in rural area of Xinxiang City. In the purpose of saving time and convenient treatment, main straw treatment methods in rural area of Xinxiang City are to throw away or open burning which result in air pollution. The main manure treatment method is directly discharged which also result in water pollution and odor gas. Energy regeneration ratio of biomass in rural area of Xinxiang City is less than 30% which results in a waste of energy and environmental pollution.

148. Besides, a common challenge for many biogas projects in the PRC is how to make effective utilization of generated biogas. The subproject has identified a new way to solve the problem.

149. Implementation of the subproject will: (i) significantly reduce fossil oil consumption; (ii) improve air quality; (iii) reduce GHG emissions; and (iv) effective utilization of generated biogas. For these reasons, the “no project” alternative is considered unacceptable.

B. Biomass treatment method

150. As the world’s second largest energy user, the PRC has experienced serious environmental pollution caused by fossil energy. According to the needs of economic and social development as well as the status of biomass energy application technology in the PRC, focused efforts shall be made in development of biomass power generation, biogas, biomass molded solid fuel and biological liquid fuel. As a renewable energy, biogas is a remarkable substitute for fossil energy whether used for heating and power generation or as fuel.

151. Accelerating the development of biogas and the various types of biogases conforms to the PRC’s national requirements of sustainable development. Focused efforts will be made in developing biomass substitute fuels, leveraging the diversity of biomass energy products and promoting biomass substitute fuel projects and constructing large-scale biomethane projects. It has become a public accepted concept that biomethane produced from such projects is used as fuel gas for motorized vehicles and urban natural gas pipelines and the biogas residue and slurry generated will be returned to the farmland to bring into place a circular economy model allowing for sustainable agricultural ecological cycle and efficient energy utilization.

152. Biomass is the only carbon-containing clean renewable energy that can be transformed into gas, liquid and solid states. Biomass fuel gas, mainly refers to biogas, is not only as a low-carbon clean energy, but also allows effective elimination of environmental pollution during utilization of the various organic waste in the production process. The utilization of biomethane will also reduce the emissions of air pollutants and GHG. The technology of producing biogas or

biomethane using livestock and poultry manure, crop straw among other biomass materials can fundamentally alleviate environmental pollution contributed by agricultural waste. This will achieve repeated transformation and appreciation of manure and crop straw and expand the crop straw industry chain, which representing an important approach to increase farmers' income.

153. Biomethane produced through biogas upgrading can be a partial substitute for fossil natural gas and coal. That is, the upgraded biogas can be used as a direct substitute of coal for combustion and used as fuel for domestic purposes and scaled chemical industry to avoid and reduce environmental pollution and $PM_{2.5}$ caused by coal combustion. Replacing coal with biogas can effectively reduce consumption of fossil fuel and help optimizing energy structure in the PRC.

C. Subproject Siting

154. Yingju Town is rich in biomass. According to technical review of domestic FSR by ADB PPTA consultant, biomass in Yingju Town can meet the raw material requirements of the subproject.

155. Besides, an Exclusivity Agreement (Appendix III) was signed between local government and CECEP Green Carbon Environmental Protection Company to guarantee the raw material supply for biogas production.

D. Overall Alternative Analysis

156. Based on the analysis of alternatives, the subproject has selected the most appropriate siting and design. The subproject also has made an effective way to use biogas generated by the proposed subproject.

VII. INFORMATION DISCLOSURE AND PUBLIC CONSULTATION

A. PRC and ADB Requirements for Disclosure and Public Consultation

1. PRC Requirements

157. Relevant provisions in the PRC *Environmental Impact Assessment Law* (2003) and the *Regulations on the Administration of Construction Project Environmental Protection* (No. 253 Order of the State Council, 1998) require that an EIA study for a construction project shall solicit opinions from affected residents, as well as other organizations and concerned stakeholders. However, the requirements for public consultation are different for various sectors and projects. For an environmental Category A project a full EIA report is required including two rounds of public consultations, while for a Category B project only a simplified tabular EIA is required without the need for public consultation.

158. The "*Provisional Regulations on Public Participation in Environmental Impact Assessment*" (2006) promulgated by State Environment Protection Administration further improved the legislation of public participation in EIA in PRC. It provides detailed requirements for the public participation process, including information disclosure standards, consultation methods, and public enquiry process. It is significant since it was the first document clearly regulating public participation in EIA in the PRC.[19]

159. In 2014, MEP released "*Guiding Ideas on Promoting Public Participation in Environmental Protection*" (2014, No. 48) which defines public participation as 'citizens, legal persons and other organizations' voluntary participation in environmental legislation, enforcement, judicature and law obedience, and the development, utilization, protection and transformation activities related to environment'.

160. The public disclosure and consultation process undertaken during the preparation of the domestic EIA was undertaken in compliance with relevant PRC requirements, including the "*Provisional Regulations on Public Participation in Environmental Impact Assessment*" (2006) and the "*Guiding Ideas on Promoting Public Participation in Environmental Protection*" (2014, No. 48).

2. ADB Requirements

161. ADB's SPS 2009 has specific requirements for information disclosure and public consultation. Information disclosure involves delivering information about a proposed project to the general public and to affected communities and other stakeholders, beginning early in the project cycle and continuing throughout the life of the project. Information disclosure is intended to facilitate constructive engagement with affected communities and stakeholders over the life of the project.

162. The SPS requires that borrowers take a proactive disclosure approach and provide relevant information from environmental assessment documentation directly to AP and stakeholders. In addition, in order to make key documents widely available to the general public, the SPS requires submission to ADB for posting on the ADB website as follows:

19 Wang Ya Nan, 2012. Public Participation in EIA, SEA and Environmental Planning in China. Environmental Impact Assessment Research Centre.

(i) a draft full EIA (including the draft EMP) at least 120 days prior to ADB Board consideration, and/or environmental assessment and review frameworks before project appraisal, where applicable;
(ii) the final EIA/IEE;
(iii) a new or updated EIA/IEE and corrective action plan prepared during project implementation, if any; and
(iv) environmental monitoring reports.

163. The SPS also requires that the borrower carry out consultation with AP and other concerned stakeholders, including civil society, and facilitate their informed participation. Consultations should include presentations on environmental impacts, benefits and mitigation measures, the project GRM, and ADB's Accountability Mechanism. For category A projects, such consultations should include consultations both at an early stage of EIA field work and when the draft EIA report is available.

B. Project Information Disclosure

164. During the domestic EIA preparation, Xinxiang EPB posted the domestic EIA report on its website in March 2014. The disclosed information included:
(i) project name and project information summary;
(ii) name and contact information of the proponent;
(iii) name and contact information of the institute responsible for preparing the EIA;
(iv) potential project environmental impacts and mitigation measures;
(v) key conclusions of the EIA report;
(vi) a link to download an abridged version of the EIA report; and
(vii) contact information and a request for questions, suggestions and feedback from the public.

165. No public feedback was received in response to any of the subproject information notices.

166. Besides, the subborrower disclosed subproject information at the project site during construction phase (**Figure 12**).

Figure 12: Information disclosure at subproject site (2017)

167. The disclosed information includes:

(i) project name and project information summary;
(ii) name and contact information of the proponent;
(iii) summary of potential project environmental impacts and mitigation measures; and
(iv) contact information.

168. As this is a category B project, this IEE will be disclosed on the ADB website (www.adb.org).

C. Public Consultation Meetings

169. During the preparation of domestic EIA, no public consultation meeting was held. In accordance to ADB SPS's requirements, the subborrower held a public consultation meeting on 16 May 2017.

170. During the meeting, information was presented about the project scope, potential environmental impacts, and proposed mitigation measures. Questions and subsequent discussions focused on environmental issues and benefits of the subproject.

171. Meeting participants were also asked to complete a questionnaire (**Table 21**).**Error! R eference source not found.**A total of 15 questionnaires were distributed and 15 completed questionnaires were received. A sample completed questionnaire is presented in Appendix IV, while some photos of the consultation meeting are shown in **Figure 13**.

172. **Table 21** presents summary data on the questionnaire respondents, while **Table 22** presents a summary of the questionnaire results.

173. Most of the respondents work and live within a 3 km radius of the subproject; 66.7% of respondents knew about subproject either from other person, newspapers or information signs, and 73.3% of respondents indicated that they were already familiar with the subproject benefits after the introduction of the subproject. The top three environment issues respondents identified in their neighborhoods are air quality (53.5%), noise (46.7%) and solid waste pollution (33.3%). Surface water quality and noise were identified as the top two issues during both the construction phase and the operation phase. However, most participants also indicated that potential air, waste water, solid waste, and noise impacts can be appropriately mitigated.

174. Overall support for the subproject is very strong; 100% of the respondents indicated that the subproject will improve local economic development; 86.7% indicated that the subproject will improve quality of life; and 100% of respondents indicated that they support the proposed subproject.

Figure 13: Public consultation Meeting in May 2017

(i) Presentation on project by the Project Management Office

(ii) Completing questionnaires

Table 21: Summary data on questionnaire respondents

Parameter	Indicator	No.	%
Sex	Male	11	73.3%
	Female	4	26.7%
Age	Below 30	1	6.7%
	31-40	1	6.7%
	41-50	5	33.3%
	Above 50	8	53.3%
Nationality	Han people	15	100.0%
	Other	0	0
Education Level	Primary School or Below	5	33.3%
	Junior school	8	53.3%
	High school, including technical secondary school	1	6.7%
	Bachelor degree or above, including junior college	1	6.7%
Occupation	Farmer	13	86.7%
	Employee	2	13.3%
	Civil servant	0	0
	Other	0	0

Table 22: Public consultation questionnaire results

Question	Item	No	% (shading denotes highest ranked)
1. What is the main environment pollution near your living areas in your opinion (multiple choice)	Surface water	3	20.0
	Ambient air	8	53.3
	Noise	7	46.7
	Ground water	1	6.7
	Solid waste	5	33.3
	Other	0	0
2. Do you know this project?	Yes	10	66.7
	No	5	33.3

Question	Item	No	% (shading denotes highest ranked)
3. If you know this project, project information is obtained by which way?	Internet	2	13.3
	Newspaper	0	0
	Information signs	7	46.7
	Other person	4	26.7
	Other	2	13.3
4. Distance between your working place and project site	<1 km	9	60
	1-3 km	4	26.7
	3-5 km	1	6.7
	> 5km	1	6.7
5. Distance between your house and project site	<1 km	11	73.3
	1-3 km	2	13.3
	3-5 km	1	6.7
	> 5km	1	6.7
6. Do you understand project information, project component, project benefit etc,?	Yes	10	66.7
	No	2	13.3
	Not clear	3	20.0
7. Do you understand environment impacts of this project?	Yes	9	60.0
	No	2	13.3
	Not clear	4	26.7
8. What are environmental issues of highest concern during construction period?	Surface water	7	46.7
	Ambient air	1	6.7
	Noise	5	33.3
	Dust/PM	1	6.7
	Ground water	1	6.7
	Solid waste	0	0
	Traffic problems	0	0
	Ecological environment	0	0
	Other	0	0
9. What are environmental issues of highest concern during operation period?	Surface water	6	40
	Ambient air	1	6.7
	Noise	4	26.7
	Dust/PM	2	13.3
	Ground water	2	13.3
	Solid waste	0	0
	Ecological environment	0	0
	Other	0	0
10 Based on construction phase mitigation measures proposed in EIA, do you accept the impacts to environment?			
10.1 Ambient air (PM and dust is included)	Accept	14	93.3
	Barely accept	1	6.7
	Do not accept	0	0
	Have no idea	0	0
10.2 Noise	Accept	12	80
	Barely accept	3	20
	Do not accept	0	0
	Have no idea	0	0

Question	Item	No	% (shading denotes highest ranked)
10.3 Surfacewater	Accept	13	86.7
	Barely accept	2	13.3
	Do not accept	0	0
	Have no idea	0	0
10.4 Groundwater	Accept	15	100
	Barely accept	0	0
	Do not accept	0	0
	Have no idea	0	0
10.5 Solid waste	Accept	14	93.3
	Barely accept	1	6.7
	Do not accept	0	0
	Have no idea	0	0
10.6 Ecological environment	Accept	15	100
	Barely accept	0	0
	Do not accept	0	0
	Have no idea	0	0
10.6 Other (traffic problem and inconvenient by project construction)	Accept	15	100
	Barely accept	0	0
	Do not accept	0	0
	Have no idea	0	0
11 Based on operation phase mitigation measures proposed in EIA, do you accept the impacts to environment?			
11.1 Ambient air (PM and dust is included)	Accept	13	86.7
	Barely accept	2	13.3
	Do not accept	0	0
	Have no idea	0	0
11.2 Noise	Accept	14	93.3
	Barely accept	1	6.7
	Do not accept	0	0
	Have no idea	0	0
11.3 Surfacewater	Accept	13	86.7
	Barely accept	2	13.3
	Do not accept	0	0
	Have no idea	0	0
11.4 Groundwater	Accept	14	93.3
	Barely accept	1	6.7
	Do not accept	0	0
	Have no idea	0	0
11.5 Solid waste	Accept	14	93.3
	Barely accept	1	6.7
	Do not accept	0	0
	Have no idea	0	0
11.6 Ecological environment	Accept	15	100
	Barely accept	0	0
	Do not accept	0	0
	Have no idea	0	0
	Yes	15	100
	No	0	0

Question	Item	No	% (shading denotes highest ranked)
12. Do you think whether construction of this project can improve local economic development or not?	Not clear	0	0
13. Do you think whether construction of this project can improve your living quality or not?	Yes	13	86.7
	No	2	13.3
	Not clear	0	0
14. After comprehensive analysis about advantages and disadvantages of this project, do you agree with the construction of this project?	Yes	15	100
	No	0	0
	Not clear	0	0

175. The results in **Table 22** show that there is a very high degree of understanding of, and support for, the subproject from residents and farmers living and working near the subproject site. There are some concerns that the subproject may potentially have negative impacts on the surface water, noise, and air, but there is also a very high confidence in the mitigation measures that are to be adopted by the subproject. Overall, there was very strong (100%) support for the subproject construction.

D. Future Consultation Activities

176. The subborrower will continue to conduct regular community liaison activities during the construction and operations phases, including the implementation of the GRM (see Chapter VIII). Ongoing consultation will ensure that public concerns are understood and dealt with in a timely manner.

VIII. GRIEVANCE REDRESS MECHANISM

A. Introduction

177. A project grievance can be defined as an actual or perceived project related problem that gives ground for complaint by AP. As a general policy, a Project Management Office (PMO) will be established in subborrower and will work proactively toward preventing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. In addition, as the project has strong public support and will not involve any involuntary land or property acquisition or resettlement, significant grievances are unlikely. Nonetheless, during construction and operation it is possible that unanticipated impacts may occur if the mitigation measures are not properly implemented, or unforeseen issues arise. In order to address complaints if or when they arise, a project GRM has been developed in accordance with ADB requirements and Government practices. A GRM is a systematic process for receiving, recording, evaluating and addressing AP's project-related grievances transparently and in a reasonable timeframe.

B. ADB's GRM Requirements

178. ADB's SPS 2009 requires a project to establish a GRM to receive and facilitate resolution of AP's concerns and complaints about the project's environmental performance during construction as well as operation phase of the project. The GRM should be scaled to the risks and adverse impacts of the project; should address AP's concerns and complaints promptly, using an understandable and transparent process; should be readily accessible to all sections of the community at no cost and without retribution; and, should not impede access to the PRC's judicial or administrative remedies.

C. Current GRM Practices in the PRC

179. At the national level a framework to address grievance has been established. State Council Decree No. 431 "*Regulations on Letters and Visits*" (January 2005)" codifies a complaint mechanism at all levels of government, and safeguards the complainants from any retaliation. The MEP's "*Decree No. 34 Environmental Letters and Visits System*" provides specific guidelines to establish a system and address environmental complaints. When APs are negatively affected by project activities, they may complain to the contractors and the project company by themselves or through their community organizations, or complain directly to local EPBs. If the issue is not resolved, they may take legal action, though that is typically considered as a last option.

D. Subproject GRM

180. The objective of the subproject GRM is to prevent and address community concerns, reduce risks, and assist the subproject to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the subproject level GRM has been designed to (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the subproject; (ii) demonstrate concern about community members and their environmental well-being; and (iii) prevent and mitigate any adverse environmental impacts on communities caused by subproject implementation and operations. The GRM will be accessible to all members of the community.

181. The overall approach of the GRM is to deal with grievances at a local level first in an efficient manner, and escalate to higher level of authority if the grievance cannot be resolved. The designated person from the PMO will be responsible for implementation of the GRM. The PMO will be the key contact point for residents, businesses, government departments and other stakeholders who may require information about the subproject or who have an issue they would like to discuss.

182. The GRM will be implemented through five steps, advancing to the next level only if the grievance was unable to be redressed at the previous level.

(i) **Step 1**: If a concern arises, the AP should try to resolve the issue of concern either directly with the contractor or with the contactor via GRM access points (community leaders, neighborhood organizations, local EPB) during the construction phase, and/or the operator during the operation phase. If the concern is resolved successfully no further follow-up action is required. Nonetheless, the contractor (during construction) and/or the operator (during operation) shall record any complaint and actions taken to resolve the issues and report the results to the PMO. If no solution is found within 10 working days or if the complainant is not satisfied with the suggested solution under Step 1, proceed to Step 2. The AP may also skip step 1 and directly file the complaint with the PMO.

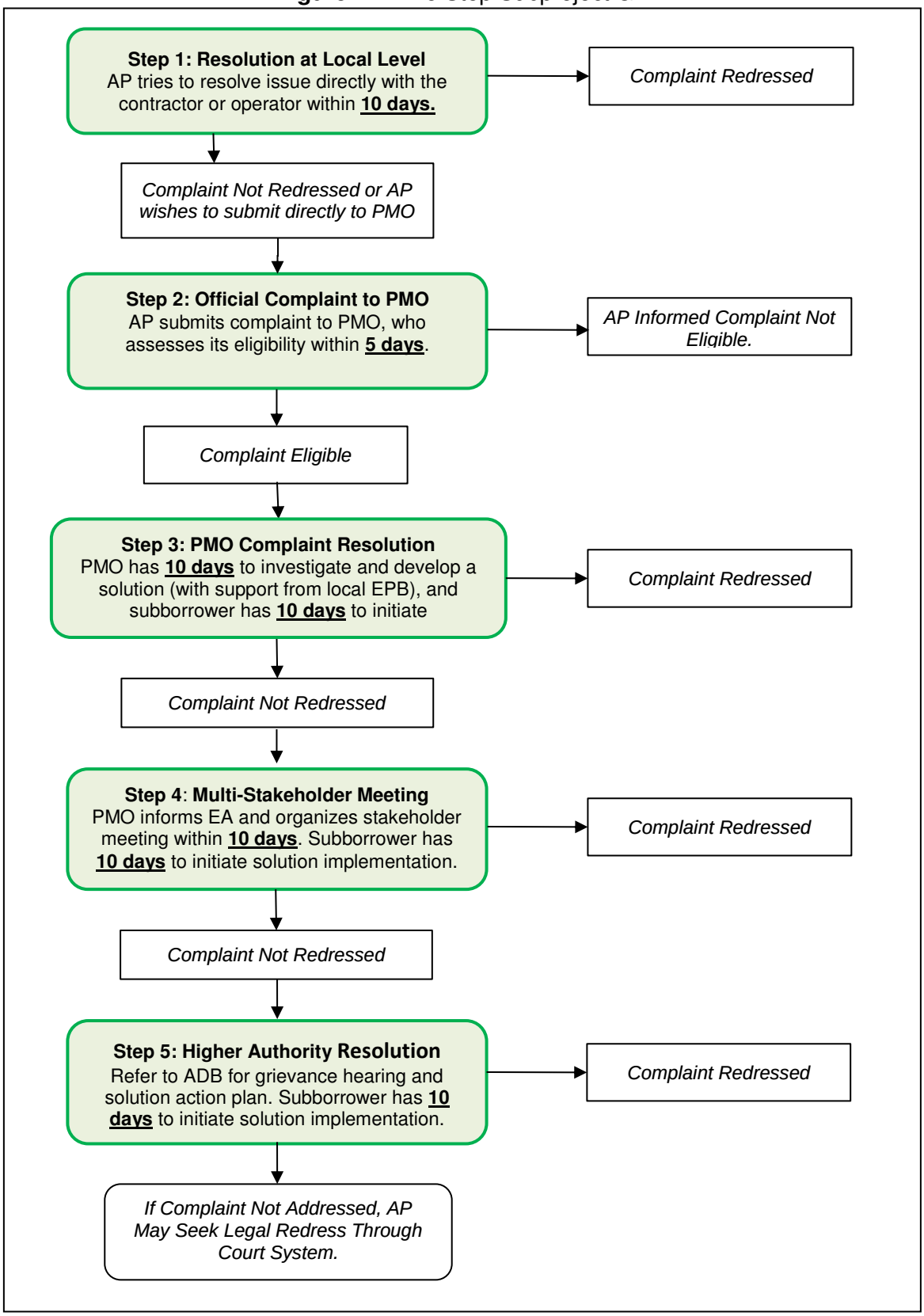
(ii) **Step 2:** The AP will submit the grievance to the PMO, who will record the grievance, assess its eligibility and report back to the AP within 5 working days. If the grievance is eligible, proceed to step 3.

(iii) **Step 3:** The PMO will investigate the complaint, and consult with the subborrower, local EPB, and other stakeholders as appropriate in an attemptto identify a solution. The PMO will give a clear reply to the AP within 10 working days with the suggested solution, and the subborrower will ensure that implementation of the agreed-upon redress solution begins within 10 working days. If no solution is found or if the complainant is not satisfied with the suggested solution under Step 3, proceed to Step 4.

(iv) **Step 4:** The PMO will inform the EA as to the grievance, and will organize a multi-stakeholder meeting within 10 days, where all relevant stakeholders, including the complainant, the EA, subborrower, and local EPB, can discuss the issue. The multi-stakeholder meeting will aim to find a solution acceptable to all, and identify responsibilities and an action plan. The subborrower will ensure that the implementation of agreed-upon redress solution begins within 10 working days of the completion of the multi-stakeholder meeting.

(v) **Step 5:** If the complainant is not satisfied with the suggested solution under Step 4, the grievance will be directed to ADB. ADB will direct the EA to organize a hearing process and shall determine a solution acceptable to all. Based on the hearing results, an action plan shall be developed and the subborrower will ensure that the implementation of the agreed-upon redress solution begins within 10 working days of the completion of the hearing.

Figure 14: Five Step Subproject GRM.



IX. CONCLUSIONS

183. This is the IEE report for Advanced Biogas and Organic Fertilizer subproject of proposed PRC: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility. The subproject will support the strengthening of biomass resources utilization in the Fengqiu County, Xinxiang City.

184. The subproject is expected to have a number of significant positive long-term direct benefits, including replacing of gasoline and diesel by biogas and improving local air quality. The total output of biogas is 155,862 GJ or 43.3 GWh or 5,318 tons of coal equivalent (tce) and could replace 4.90 million liters of gasoline or 4.25 million liters of diesel. The biogas will improve the availability of local natural gas supply and to encourage more vehicle owners to switch from gasoline or diesel to natural gas. The subproject consumes 4.58 GWh of electricity annually for the production process. There are no direct emissions from the subproject.

185. When compared to the equivalent energy consumption through traditional fossil fuel sources, once operational the subproject will: (i) result in annual energy savings equivalent to 4,751 tons of standard coal, thereby providing a global public good by avoiding the annual emission of 15,499 tons of CO_2, a greenhouse gas; and (ii) improve local air quality through the estimated annual reduction of emissions of SO_2 by 19.3 tons, NO_x by 192.7 tons, CO by 2,393.2 tons, PM by 514.1 tons, and VOCs by 453.3 tons.

186. Through the environmental assessment process, it is concluded that the subproject has: (i) selected appropriate technologies to produce biogas and reduce the emission of pollutants; (ii) identified potential negative environment impacts and appropriately established mitigation measures; (iii) received public support from the subproject beneficiaries and AP; (iv) established subproject GRM procedures; and (v) prepared a comprehensive EMP including environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

187. Based on the analysis conducted it is concluded that overall the subproject will result in significant positive socioeconomic and environmental benefits, and will not result in significant adverse environmental impacts that are irreversible, diverse, or unprecedented. Overall, any minimal adverse environmental impacts associated with the subproject can be prevented, reduced, or minimized through the appropriate application of mitigation measures. It is therefore recommended that:

(i) the subproject's categorization as ADB environment category B is confirmed; and
(ii) the subproject will be supported by ADB, subject to the implementation of the commitments contained in the EMP and allocation of appropriate technical, financial and human resources by the subborrower to ensure these commitments are effectively and expediently implemented.

Appendices

Appendix I: Environmental Management Plan

Appendix II: EIA approval

Appendix III: Exclusivity agreement

Appendix IV: Questionnaire sample

APPENDIX I: ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

1. This is the IEE report for the Advanced Biogas and Organic Fertilizer Subproject of proposed PRC: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility. The subproject will support the strengthening of biomass resources utilization in the Fengqiu County, Xinxiang City. The EMP complies with the Asian Development Bank's (ADB) Safeguard Policy Statement (SPS, 2009) and is based on the domestic Environmental Impact Assessment (DEIA) prepared by the Xinxiang Environmental Protection Science and Technology Design and Research Institute (XEPSTDRI).

2. The objectives of the EMP are to ensure (i) implementation of identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of environmental monitoring plan; and (iii) compliance with the PRC's relevant environmental laws, standards and regulations and ADB's SPS 2009. Organizational responsibilities and budgets are clearly identified for execution, monitoring and reporting.

3. The EMP is to be implemented in all phases of the subproject—design, pre-construction, construction, and operation. In the detailed design stage the EMP will be used by the design institution for incorporating mitigation measures into the detailed designs. The EMP will be updated at the end of the detailed design, as needed.

4. The EMP will be included as a separate annex in all bidding and contract documents. The contractors will be informed of their obligations to implement the EMP, and to provide for EMP implementation costs in their bids for project works. The EMP is presented in **Table 1**.

Table 1 Environmental Management Plan

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
Pre-construction						
Transportation and mobilization of construction materials and equipment	Dust generation during vehicle movement	i. Construction material (sand/soil) should be covered while transported. ii. Water to be sprinkled as needed. iii. Emissions from vehicles and equipment should comply with national standards.	Air quality	PRC ambient air quality standards	Subborrower	Subproject design
	Noise generation	i. Movement of vehicles should be restricted during day time. ii. Noise levels from vehicles and equipment to comply with noise standards.	Noise levels	PRC noise standards	Subborrower	Subproject design
Encroachment to environmentally sensitive areas	Loss of precious ecosystems/species	Avoid encroachment by careful site selection.	Floral and faunal habitats loss	PRC regulations	Subborrower	Detail design
Involuntary resettlement or land acquisition	Loss of lands and structures	Compensation paid for temporary/permanent loss of productive land and structures per PRC regulations	Public complaints	PRC regulations	Subborrower	Prior to construction
Construction						
Site Clearance	Loss of flora and fauna	– A greening plan will be implemented. Site vegetation plans will be developed at project site using appropriate native species. – Any existing vegetated areas impacted by the subproject will be restored after construction using appropriate native species.	Subproject construction site	NA	Contractor, subborrower, CECEP	Whole construction stage
Removal of vegetation and subproject construction	Soil erosion and surface runoff	– Land excavation and filling will be balanced to minimize the requirement for fill transportation. – Potential for storm water runoff will be assessed and appropriate storm water drainage systems to minimize soil erosion will be implemented. – During earthworks, the area of soil exposed to potential erosion will be minimized. – Spoils will be reused on-site to the maximum extent feasible as fill. Temporary spoil	Subproject construction site	PRC Control Standards for Soil and Water Loss on Development and Construction Projects (GB50434-2008)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		storage sites will be identified, designed, and operated to minimize impacts. Spoil sites will be restored at the completion of storage activities. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site. – Spoil and aggregate piles will be covered with landscape material and regularly watered. – Waste construction material will be used for backfill at the sites to the maximum extent feasible. – Construction and material handling activities will be limited or halted during periods of rains and high winds. – Any planned paving or vegetating of areas will be done as soon as practical after the materials are removed to protect and stabilize the soil. – Once construction is complete disturbed surfaces will be properly sloped and planted with native trees and grass.				
Subproject Construction	Wastewater generation-Surface and groundwater contamination from construction and domestic wastewater	– Adequate temporary sanitary facilities and ablutions will be provided for construction workers. Toilets will be equipped with septic tanks following PRC standards. Domestic wastewater will be treated in the septic tanks based on requirements of relevant national standards. – Construction wastewater will be directed to temporary detention and settling ponds. Areas where construction equipment is being washed will be equipped with water collection basins and sediment traps. After settling, supernatant will be recycled and sediment will be periodically excavated, and either reused if possible as fill, or disposed at official spoil disposal sites/ landfills. – Maintenance of construction equipment and vehicles will not be allowed on site to reduce wastewater generation.	Subproject construction site	PRC's Ambient Surface Water Quality Standard (GB3838-2002)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
Transportation of construction materials and subproject construction	Increase in air pollution - dust, vehicle emissions	– Construction site will be fully fenced. – Water will be sprayed on active construction sites including where fugitive dust is being generated on a daily basis, and more frequently during windy days. – All construction piles (spoils, aggregate other construction materials) with the potential to generate dust will be covered and/or regularly watered. – Construction activities will be halted during high wind events. Once construction is complete disturbed surfaces will be properly sloped and planted with native trees and grass. – Transport vehicles will be limited to low speeds at construction site. – Loads will be covered during truck transportation to avoid spillage or fugitive dust generation. Fine materials will be transported in fully contained trucks. – Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds. – Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical.	Project construction site	PRC's Air Pollutant Integrated Emission Standard (GB 16297-1996)	Contractor, subborrower, CECEP	Whole construction stage
Mechanized construction and vehicle movement	Increase in noise levels	– Construction activities will be strictly prohibited during the nighttime (22:00 h to 07:00 h). Exceptions will only be allowed in special cases, and only after getting approval of the surrounding residents, local EPB and other relevant departments. – Simultaneous high-noise activities will be avoided, and high-noise activities will be scheduled during the day rather than evening hours. Similarly, construction sites will be planned to avoid multiple high-noise activities or equipment from operating at the same location.	Subproject construction site	PRC's Noise Standards for Construction Site Boundary (GB 12523-2011)	Contractor, subborrower, CEPCE	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		– Low-noise equipment will be selected. Equipment and machinery will be equipped with mufflers and will be properly maintained to minimize noise. – PPE will be provided to workers. – Transportation routes and delivery schedules will be planned to avoid densely populated and sensitive areas and rush hours. – Vehicles transporting construction materials/waste will slow down and not use their horn when passing through or nearby sensitive locations. – Special attention will be paid to sensitive sites near the subproject: high-noise construction activities will be positioned as far away from sensitive sites as possible. Temporary or permanent noise barriers will be installed to protect sensitive sites if necessary.				
Subproject construction	Solid waste generation	– Wastes will be reused/recycled to the extent possible. Construction waste such as residual concrete, bricks will be used for backfill at the sites. – Littering by workers will be prohibited. – Domestic waste containers will be provided at all work sites. Domestic waste will be collected on a regular basis by the local sanitation departments and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements. – Construction waste dumpsters will be provided at all work sites. Construction waste will be collected by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill. – Excavated soil will be backfilled on-site to the extent possible. Excess spoil that cannot be used on-site will be transported to an	Subproject construction site	PRC's Standards for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB 18599-2011)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		approved spoil disposal site. – There should be no final waste disposal on site. Waste incineration at or near the site is strictly prohibited. – Contractors will be held responsible for proper removal and disposal of any significant residual materials, wastes, and contaminated soils that remain on the site after construction.				
Subproject construction	Hazardous and Polluting Materials	– A hazardous material handling and disposal protocol that includes spill emergency response will be prepared and implemented by contractors. – Storage facilities for fuels, oil, chemicals and other hazardous materials will be within secured areas on impermeable surfaces provided with dikes with a storage capacity of at least 110% of the capacity of the hazardous materials stored, and at least 300 m from drainage structures and important water bodies. A standalone site within the storage facility will be designated for hazardous wastes. – Signs will be placed at chemicals and hazardous materials storage sites to provide information on type and name of chemicals and hazardous materials. – Suppliers of chemicals and hazardous materials must hold proper licenses and follow all relevant protocols and PRC regulations and requirements. – A licensed company will be hired to collect, transport, and dispose of hazardous materials.	Subproject construction site	PRC's General Specifications of Engineering and Technology for Hazardous Waste Disposal (HJ 2042 - 2014)	Contractor, subborrower, CECEP	Whole construction stage
Subproject construction	Community Disturbance and Safety	– Transportation routes and delivery schedules will be planned to avoid densely populated and sensitive areas and rush hours. – Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby	Subproject construction site	NA	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		sensitive locations. – Signs will be placed at construction sites in clear view of the public, warning people of potential dangers such as vehicles moving. All sites will be made secure, discouraging access by members of the public through appropriate fencing.				
Subproject construction	Worker Occupational Health and Safety - Risk to workers	– Each contractor will implement the relevant construction phase EHS plan. – Identify and minimize the causes of potential hazards to workers. Implement appropriate safety measures. – Provide training to workers on occupational health and safety, emergency response, especially with respect to using potentially dangerous equipment and storage, handling and disposal of hazardous waste. – Ensure that all equipment is maintained in a safe operating condition. – Provide PPE to workers. – Implement work practices to limit workers' exposure to high-noise or heat working environments in compliance with PRC noise standards for construction sites. – Ensure regular safety meetings with staff. – Ensure that material stockpiles or stacks, such as pipes are stable and well secured to avoid collapse and possible injury to workers.	Subproject construction site	NA	Contractor, subborrower, CECEP	Whole construction stage
Evacuation and earthworks	Damage to PCRs	– Construction activities will be immediately suspended if any PCRs are encountered; – Destroying, damaging, defacing, or concealing PCRs will be strictly prohibited in accordance with PRC regulations; – Local Cultural Heritage Bureau will be promptly informed and consulted; and, – Construction activities will resume only after thorough investigation and permission from local Cultural Heritage Bureau.	Subproject construction site	NA	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
Operation						
Boiler operation, transportation and storage of agricultural wastes and manure	Air pollution and odor	– Low NOx natural gas-fired boiler with design emission levels that are in compliance with the most stringent of PRC national standard. Exhaust gas of the boiler will be discharged through an 8-meters high chimney. – Closed fermentation will be used for biogas and organic manure production. – Layout for biogas and organic manure plants will be reasonable planned. Odor gas sources will be located at main downwind direction. – Raw material and manure will be sealed or semi-sealed transported and stored. – Odor gas collection equipment will be installed at biogas and organic manure production facilities. – Collected odor gas will be treated in biological deodorization tower to meet the national standards. – Greening plan will be implemented at biogas and organic manure production plants to reduce odor gas.	Subproject operation site	PRC's Emission Standards of Air Pollutants from Coal-Burning, Oil-Burning and Gas-Fired Boilers (GB 13271-2014) and Emission standards for Odor Pollutants (GB 14554-93).	Subborrower, CECEP	Whole operation stage
Subproject operation	Discharge of production and domestic wastewater	– Wastewater from canteen will be treated by oil-separator, and then used as raw material of biogas production combined with water from toilet facilities. – Biogas slurry from biogas production, cleaning wastewater, wastewater from biogas dehydration and desulfurization and wastewater from organic manure production will be collected and used for organic manure production. – Domestic wastewater and production wastewater will be reused or recycled at the plant and there will be no wastewater discharge from the facility.	Subproject operation site	PRC's Integrated Sewage Discharge Standard (GB8978-1996)	Subborrower, CECEP	Whole operation stage
Subproject operation	Solid waste	– Domestic waste bins will be provided and domestic waste will be routinely collected by the local sanitation department for recycling	Subproject operation site	PRC's Standards for Pollution	Subborrower, CECEP	Whole operation stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		and final disposal at an approved waste disposal site. – No permanent on-site solid waste disposal will be permitted at project site. – No burning of wastes will be permitted at project site. – Waste from straw chopping, biogas residue from biogas production and residue from organic manure production will be sent to organic manure plant and used as raw material for organic manure production		Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB 18599-2011)		
Equipment operation	Noise impact	– Low-noise equipment will be used as far as possible, and noise reduction measures such as noise elimination, shock absorption, insulated enclosures and sound dampening materials on exterior walls will be implemented. – All equipment will be properly maintained to minimize noise. – Appropriate noise PPE will be provided to the workers who are likely to be exposed to high-noise level environments. – Layout for biogas and organic manure production workshops will be reasonable planned to reduce noise. – Greening plan will be implemented at biogas and organic manure production plants to reduce noise.	Subproject operation site	PRC's Industrial Enterprise Boundary Noise Emission Standard (GB12348-2008)	Subborrower, CECEP	Whole operation stage
Subproject operation	Occupational and community health and safety - risks to Workers and community	– All natural gas works will be in compliance with relevant PRC building code requirements. – Subproject site will be equipped with flammable gas detection, alarm, and fire suppression systems. Electrical devices within the explosion risk area will be safety equipped. – Gas pipelines will be grounded and equipped with anti-lightning devices where applicable. – All gas related devices will be brightly	Subproject operation site	Code for Design of City Gas Engineering (GB 50028-2006) and Regulation on Electric Apparatus Design for Explosion and Fire Risk Environment	Subborrower, CECEP	Whole operation stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		colored and equipped with warning signs – Operation phase EHS plans including fire prevention and control will be developed and implemented, and workers will be trained regularly on their implementation. – Biogas and natural gas systems will be designed in strict compliance with relevant PRC fire, health and safety standards. Fire compartments will be established based on the fire risks, and fire-resistant buildings/structures will include fire-proof doors and windows. – Fire-alarm and suppression systems will be installed and tested regularly to ensure it functions properly. – PPEs including goggles, gloves, safety shoes, will be provided to workers. – Control measures will be strictly undertaken to ensure the discharge, exhaust and safety relief of flammable fuels in enclosed systems. – No unauthorized personnel will be allowed into gas-fired facilities. – Provide training to workers on occupational health and safety, emergency response.		(GB50058-92)		

CECEP = China Energy Conservation and Environmental Protection Group, EHS = environment, health, and safety, NA = not applicable, NOx = nitrogen oxide, PCR = physical cultural resources, PPE = personnel protective equipment, PRC = People's Republic of China.
Source: Domestic EIA Report and ADB PPTA consultants.

B. Implementation Arrangements

5. CECEP will be the executing agency (EA) and the implementing agency (IA). CECEP Huayu Fund Management Co. Ltd. (CECEP Huayu) will manage the Loan. The EA will form a Project Management Office (PMO) at CECEP Huayu including an Environment Officer and a Social Officer.

6. The PMO Environment Officer will be responsible for regular internal inspections of mitigation measures at the construction site, in accordance with the Environmental Monitoring Plan (EMoP). A third party environmental monitoring entity will be engaged by the subborrower and will undertake construction and operation phase ambient environmental monitoring as per the EMoP.

7. The subborrower will be responsible for implementing relevant mitigation measures during construction. Following the award of each construction contract, the contractor will prepare the Construction stage EMP and associated subplans that detail the means by which the Contractor will comply with the EMP. The Contractor will identify a lead focal point for environmental issues (e.g., Chief Site Engineer), will implement the Construction stage EMP, and will take all reasonable measures to minimize the impact of construction activities on the environment. The Contractor will also submit quarterly environmental records to the PMO on EMP implementation, including the EMoP. They are also required to report any spills, accidents, and grievances received, and any actions taken.

8. ADB will conduct due diligence of environment issues during the project review missions. ADB will review the semi-annual and annual environmental monitoring reports submitted by the PMO and will disclose the reports on its website. If the PMO fails to meet safeguards requirements described in the EMP, ADB will seek corrective measures and advise the PMO on items in need of follow-up actions.

9. The subproject implementation organization and the roles and responsibilities of the participating agencies are presented in **Table 2**. The project implementation arrangements are presented in **Figure 1**.

Table 2: Project implementation and management organizations

Organization	Role and Responsibility
CECEP	- Will serve as the EA/IA and project contact point for ADB. - Responsible for coordinating project implementation activities among government agencies such as finance bureau, development and reform commission, environmental protection bureau, water resources bureau, agriculture and forestry bureau, livestock and land resource bureau. - Coordinating the activities of and meeting the requirements of the ADB review missions.

Organization	- Role and Responsibility
CECEP Huayu	On behalf of the executing agency, a PMO will be set-up including a safeguard unit with qualified and experienced full time staff. PMO will be responsible for all subproject organization and implementation activities, including the following: - Formulating subproject management and operating procedures, implementation plans, and budgets. - Ensuring subproject's compliance with loan and project agreements, and with the safeguards requirements as specified in the ESMS. - Managing the activities of the design institutes, procurement agents, and consultants in accordance with government and ADB regulations. - Taking part in capacity development and training. - Overseeing the implementation of different subproject outputs. - Monitoring the subproject's physical and financial progress, and compliance with subproject's reporting requirements, ensuring subproject progress reports are prepared and submitted to ADB on time. - Addressing complaints received from APs. - Organizing project acceptance verification. - Coordinating the activities of and meeting the requirements of ADB review missions. - Supervising the implementation of EMP and EMoP. - Conducting regular site visits and safeguard review missions in accordance with the requirements set forth in the ESMS developed for the FIL. - Preparing and submitting consolidated semi-annual and annual environmental monitoring reports as required by the ESMS to ADB. Requiring subborrowers to prepare corrective action plans in the event of noncompliance with EMP or EMoP.
Subborrower	Main responsibilities include: - Contracting and administering contractors and suppliers. - Supervising construction and monitoring quality control. - Ensuring compliance with EMP, EMoP, engaging external environmental safeguard consultants if needed. - Preparing subproject progress reports for submission to the PMO. - Monitoring subproject's physical and financial progress, and preparing regular progress reports to the PMO. - Testing and commissioning of completed subproject facilities. - Identifying and implementing O&M arrangements. - Coordinating with and assisting the PMO in developing subproject management procedures and detailed implementation plan, and monitoring achievement thereof. - Arranging the commissioning of the constructed facilities. - Preparing progress reports for submission to the executing agency and/or PMO. - Preparing semi-annual and annual environmental monitoring reports and submit to PMO.
Environmental Monitoring Company (EMC)	A qualified independent environmental monitoring company will be recruited to implement the ambient monitoring portion of the EMoP.
ADB	Responsible for the following: - Providing the EA/IA and PMO with guidance to ensure smooth subproject implementation and achieve the desired development impacts and their sustainability. - Conducting regular review missions. - Monitoring the implementation of EMP and EMoP. - Monitoring status of compliance with loan and project covenants, including safeguards. - Reviewing environmental monitoring reports and disclosing them on ADB website. - Regularly updating the subproject performance review reports with the assistance of executing and implementing agencies. and - Regularly updating the subproject information documents for public disclosure at ADB website, including the safeguards documents. - Requiring CECEP Huayu to develop corrective action plan for any non-compliance issues.

ADB = Asian Development Bank, AP = affected person, EA = Executing Agency, EMP = Environmental Management Plan, EMoP = Environmental Monitoring Plan, ESMS = Environmental and Social Management System,FIL = Financial Intermediation Loan, IA = Implementing Agency, O&M = operation and maintenance, PMO = project management office.

C. Potential Impacts and Mitigation Measures

10. The potential impacts of the subproject during pre-construction, construction, and operation have been identified and appropriate mitigation measures developed (see Chapter V of the IEE).

D. Environment Monitoring Plan

11. An EMoP, to monitor the environmental impacts of the subproject and assess the effectiveness of mitigation measures, is presented in **Table 3.** The EMoP includes both compliance inspection undertaken by the PMO Environment Officer, and ambient air, noise, and wastewater monitoring undertaken by the third party environmental monitoring entity. Ambient monitoring will be conducted in compliance with relevant PRC regulations, methods and technical specifications.

12. The data and results of environmental compliance inspection and monitoring activities will be used to assess: (i) the extent and severity of actual environmental impacts against the predicted impacts and baseline data collected before the subproject implementation; (ii) performance or effectiveness of environmental mitigation measures or compliance with pertinent environmental rules and regulations; (iii) trends in impacts; (iv) overall effectiveness of EMP implementation; and (v) the need for additional mitigation measures and corrective actions if non-compliance is observed.

E. Institutional Strengthening and Capacity Building

13. The institutional strengthening and capacity building focuses on the safeguards requirements of relevant PRC laws and regulations and the ADB SPS. The training will focus on the ADB SPS; PRC safeguard requirements; development and implementation of EHS plans during construction and operation; implementation of the EMP, EMoP, and GRM; and worker and community health and safety issues and measures (**Table 4).**

Table 3: Environmental Monitoring Plan (EMoP)

Subject	Parameter	Location	Frequency	Implemented by	Supervised by
A. Construction Phase					
Erosion, Borrow and Spoil	Compliance inspection of implementation of erosion and stormwater control measures	Construction sites, spoil disposal sites	Monthly during construction season; and once after completion of spoil disposal	Contractor and Subborrower	PMO and CECEP
Air Pollution	Ambient dust monitoring (TSP, PM_{10}, $PM_{2.5}$)	Construction site	Quarterly during construction season	third party environmental monitoring entity	PMO and CECEP
	Compliance inspection of implementation of air pollution control measures	Construction site	Monthly during construction season	Contractor and Subborrower	PMO and CECEP
Wastewater	Compliance inspection of implementation of wastewater management measures	Construction site	Monthly during construction season	Subborrower	PMO and CECEP
Noise	Ambient noise monitoring (day and night Leq dB(A))	Construction site	Quarterly during construction season	third party environmental monitoring entity	PMO and CECEP
Solid Waste	Compliance inspection of implementation of solid waste management measures	Waste collection and disposal sites	Monthly during construction season	Contractor and Subborrower	PMO and CECEP
Hazardous and Polluting Materials	Compliance inspections of implementation of hazardous materials management measures	Storage facilities for fuels, oil, chemicals and other hazardous materials. Vehicle and equipment maintenance areas	Monthly during construction season	Contractor and Subborrower	PMO and CECEP
Flora and Fauna	Compliance inspection of land clearing to ensure mitigation	Construction site	Monthly during construction season	Contractor and Subborrower	PMO and CECEP

Subject	Parameter	Location	Frequency	Implemented by	Supervised by
	measures are being implemented				
	Compliance inspection of implementation of traffic control measures	Construction site roads. Transportation routes.	Monthly during construction season	Contractor and Subborrower	PMO and CECEP
Socioeconomic Impacts	Compliance inspection of implementation of Occupational and Community Health and Safety measures and an Emergency Response Plan	Construction site	Monthly during construction season	Contractor and Subborrower	PMO and CECEP
B. Operation Phase					
Air pollutants generated from operation	Odor monitoring and emission monitoring (PM, SO_2, NOx)	Exhaust stacks and site boundaries	Semi-annual	third party environmental monitoring entity	Subborrower, PMO and CECEP
Wastewater	Compliance with operation phase waste water management measures	Project site	Semi-annual	Subborrower	PMO and CECEP
Solid Waste	Compliance with operation phase solid waste management measures	Project site	Semi-annual	Subborrower	PMO and CECEP
Hazardous and Polluting Materials	Compliance with operation phase Hazardous Materials Management Plans (HMMPs)	Project site	Semi-annual	Subborrower	PMO and CECEP
Health and Safety and Emergency Response	Compliance with operation phase occupational and community health and safety management measures and implementation an Emergency Response Plan	Project site	Semi-annual	Subborrower	PMO and CECEP

Table 4: Institutional strengthening and training program

Training Topic	Trainers	Attendees	Contents	Times	Days	# Persons	Budget (USD)
Construction Phase Environment, Health and Safety Training	PMO	Contractors, subborrower	**ADB and PRC laws, regulations and policies** – ADB's safeguard policy statement – Project applicable PRC environmental, health and safety laws, policies, standards and regulations – International environmental, health and safety management practice **GRM** – GRM structure, responsibilities, and timeframe – Types of grievances and eligibility assessment **Implementation of Construction Phase EMP** – Impacts and mitigation measures – Monitoring and reporting requirements – Non-compliance and corrective actions	3 (once prior to start of construction, and then once during years 2 to 3)	2	30	**Training Development** Fixed costs: $2000 per course delivery x 3 = $ 6,000
Operation Phase Environment, Health and Safety Plan Training	PMO	subborrower	**ADB and PRC laws, regulations and policies** – ADB's safeguard policy statement – Project applicable PRC environmental, health and safety laws, policies, standards and regulations – International environmental, health and safety management practice **GRM** – GRM structure, responsibilities, and timeframe – Types of grievances and eligibility assessment	3 (once prior to start of operation, and then once during years 2 and 3)	2	30	**Training Development** Fixed costs: $2000 per course delivery x 3 = $6,000

	Implementation of Operation Phase EMP – Impacts and mitigation measures – Monitoring and reporting requirements – Non-compliance and corrective actions			
	Total	**6**	**60**	**$12,000**

ADB = Asian Development Bank, EMP = environmental management plan, GRM = grievance redress mechanism, PRC = People's Republic of China, PMO = project management office.

F. Reporting Requirements

14. The subborrower will submit semi-annual EMP implementation reports during construction phase and annual reports during operation phase to the PMO on the implementation and compliance with the EMP, including information on all spills, accidents, grievance received, and appropriate actions taken.

15. Based on ambient monitoring results, the subborrower will prepare subproject environmental monitoring reports semi-annually during construction and annually during operation and submit them to the PMO. The PMO will review them and then submit them to the ADB.

16. The environmental reporting requirements are summarized in the **Table 5**.

Table 5: Reporting Requirements

Report	Prepared by	Submitted to	Frequency
A. Construction Phase			
EMP compliance, spills and accidents	Subborrower	PMO	Semi-annually
Environmental monitoring reports	PMO	EA reviews and submits to ADB	Semi-annually
B. Operation Phase			
Environmental monitoring reports	PMO	EA reviews and submits to ADB	Annually

ADB = Asian Development Bank, EA = executing agency, EMP = environmental management plan, PMO = project management office.

G. Performance Indicators

17. Performance indicators (**Table 6**) have been developed to assess the implementation of the EMP. These indicators will be used to evaluate the effectiveness of environmental management.

Table 6: Performance Indicators

No.	Description	Indicators
1	Staffing	(i) PMO established with appropriately qualified staff including Environment Officer (ii) third party environmental monitoring entity engaged
2	Budgeting	(i) Environment mitigation cost during construction and operation is sufficiently and timely allocated (ii) Environment monitoring cost is sufficiently and timely allocated (iii) Budget for capacity building is sufficiently and timely allocated
3	Monitoring	(i) Compliance monitoring is conducted by PMO as per EMP and EMoP

No.	Description	Indicators
		(ii) Construction phase and operation phase ambient and effluent monitoring is conducted by third party environmental monitoring entity
4	Supervision	(i) PMO reviews the implementation of EMP (ii) ADB reviews consolidated environmental monitoring reports
5	Reporting	(i) Semi-annual EMP implementation reports during construction phase and annual reports during operation phase prepared by the subborrower are submitted to PMO
6	Capacity Building	(i) Training on ADB safeguard policy, EMP implementation, and GRM is provided during project implementation
7	Grievance Redress Mechanism	(i) GRM contact persons are designated at all subborrowers and the PMO, and GRM contact information disclosed to the public before construction (ii) All complains are recorded and processed within the time set in the GRM framework of this IEE
8	Compliance with PRC standards	(i) Subproject complies with the PRC's environmental laws and regulations and meets all required standards

ADB = Asian Development Bank, EA = executing agency, EMP = environmental management plan, EMoP = environmental monitoring plan, PMO = project management office.

H. Estimated Budget for EMP Implementation

18. The estimated budget for EMP implementation of the project is presented in **Table 7**. Costs are presented for mitigation implementation, ambient monitoring, capacity building, and GRM implementation. The costs do not include salaries of PMO staff.

I. Mechanisms for Feedback and Adjustment

19. The effectiveness of mitigation measures and monitoring plans will be evaluated through a feedback reporting system. If, during compliance inspections and monitoring, substantial deviation from the EMP is observed, then the PMO will consult with the subborrower and propose appropriate changes to the EMP monitoring and mitigation plan.

20. Any major EMP adjustments will be subject to ADB review and approval and ADB may pursue additional environmental assessment and, if necessary, further public consultation. The revised EMP with ADB confirmation is subject to reposting on the ADB's website as the ADB public communications policy requires. The revised EMP will be passed on to the subborrower for implementation.

Table 7: Estimated Budget for Implementing EMP

Construction Phase							
1. Ambient Monitoring	**Unit**	**Unit Cost**	**# Times**	**Cost USD**	**Cost RMB**	**Source of Funds**
Air - TSP	Quarterly	$ 300	12	$ 3,600	¥24,512	Counterpart Financing
Noise	Quarterly	$ 200	12	$ 2,400	¥16,342	
Subtotal				***$ 6,000***	***¥40,854***	
2. Capacity Building	**Unit**	**Course Cost**	**# Times**	**Cost USD**	**Cost RMB**	
Construction Phase HSE Plan Development and Training	HSE Plan Development	$ 2,000	8	$ 16,000	¥108,944	Counterpart Financing
	HSE Course Development	$ 2,000	1	$ 2,000	¥13,618	
	HSE Course Delivery	$ 4,000	1	$ 4,000	¥27,236	
Subtotal				***$ 22,000***	***¥149,798***	
TOTAL Construction Phase				***Cost USD***	***Cost RMB***	
				$ 28,000	***¥190,652***	
Operation Phase (first 2 years)						
	Unit	**Unit Cost**	**# Times**	**Cost USD**	**Cost RMB**	Counterpart Financing
1. Exhaust Emissions Monitoring	Seasonal Sampling	$ 500.00	4	***$ 2,000***	***¥12,809***	
2. Ambient Monitoring	**Unit**	**Unit Cost**	**# Times**	**Cost USD**	**Cost RMB**	
Noise	Seasonal Sampling	$ 200	4	$ 800	¥5,447	Counterpart Financing
Wastewater	Seasonal Sampling	$ 250	4	$ 1,000	¥6,809	
Subtotal				***$ 1,800***	***¥12,256***	
3. Capacity Building	**Unit**	**Course Cost**	**# Times**	**Cost USD**	**Cost RMB**	
Construction Phase HSE Plan Development and Training	HSE Plan Development	$ 2,000	8	$ 16,000	¥108,944	Counterpart Financing
	HSE Course Development	$ 2,000	1	$ 2,000	¥13,618	
	HSE Course Delivery	$ 4,000	1	$ 4,000	¥27,236	
Subtotal				***$ 22,000***	***¥149,798***	
TOTAL Operation Phase				***Cost USD***	***Cost RMB***	
				$ 25,800	***¥175,672***	
GRAND TOTAL Construction + Operation				***Cost USD***	***Cost RMB***	
				$ 53,800	***¥366,324***	

APPENDIX II: EIA APPROVAL

审批意见： 新环监（2014）160号

新乡市环境保护局

关于《中节能（封丘）生物质能环保有限公司封丘县有机废弃物综合循环利用项目环境影响报告表》的批复

中节能（封丘）生物质能环保有限公司：

你公司上报的由新乡市环境保护科学设计研究院编制的《中节能（封丘）生物质能环保有限公司封丘县有机废弃物综合循环利用项目环境影响报告表》（以下简称《报告表》）及封丘县环保局的审查意见收悉，经研究，批复如下：

一、《报告表》内容符合国家有关法律法规要求和建设项目环境管理规定，评价结论可信。我局批准该《报告表》，原则同意你公司按照《报告表》中所列项目的地点、性质、规模、生产工艺和环境保护对策措施建设。

二、你公司应主动向社会公众公开经批准的《报告表》，并接收相关方的咨询。

三、你公司应全面落实《报告表》提出的各项环保对策措施及环保设施投资概算，确保各项环境保护设施与主体工程同时设计、同时施工、同时投入使用，确保各项污染物达标排放。

（一）依据《报告表》和本批复文件，对项目建设过程中产生的废气、固体废物、噪声等污染，采取相应的防治措施。

（二）项目运行时，外排污染物应满足以下要求：

1. 废气。有组织排放的粉尘应满足《大气污染物综合排放标准》（GB16297-1996）表2二级标准要求；有组织排放的恶臭污染物应满足《恶臭污染物排放标准》（GB14554-93）表2标准要求；无组织排放的恶臭污染物应满足《恶臭污染物排放标准》（GB14554-93）表1二级标准要求；锅炉烟气排放应满足《锅炉大气污染物排放标准》（GB13271-2001）II时段标准要求。

2. 噪声。厂界噪声应满足《工业企业厂界环境噪声排放标准》（GB12348-2008）2类标准要求。

3. 固废。一般固体废物全部妥善处理；一般固废临时贮存按《一般固体废物贮存、处置污染控制标准》（GB18599-2001）进行控制。

（三）全厂主要污染物排放总量控制在下列指标之内：二氧化硫0.2856吨/年，氮氧化物1.3359吨/年。

（四）落实环境风险防范措施，制定环境风险应急预案，严防环境

污染事故发生。

四、项目完工后，须向我局提交试生产申请书，经检查同意后方可进行试生产。试生产期间按规定程序向我局申请竣工环境保护验收。

五、本批复有效期为5年。如该项目逾期方开工建设，其环境影响报告表应报我局重新审核。

公　章

经办人：赵乐亭　　2014年5月9日

APPENDIX III: EXCLUSIVITY AGREEMENT

投 资 协 议 书

甲 方：河南省封丘县人民政府
住所地：河南省封丘县民主路 1 号

乙 方：中节能（北京）实业发展有限公司
住所地：北京市石景山区石景山路 20 号中铁建设大厦 2003

甲、乙双方根据国家、河南省相关法律法规及新乡市，封丘县招商引资优惠政策，本着“诚信、互利、发展、双赢”的原则，就乙方在河南省封丘县投资建设**农业有机废弃物综合利用项目**，经双方共同协商，达成如下协议，供双方遵照执行。

第一条 项目情况

项目名称：**农业有机废弃物综合利用项目**

建设内容：通过建设先进的工业化超大型厌氧发酵工程，对包括秸秆、禽畜粪便、病死禽畜等有机废弃物资源进行综合处理和循环利用，在进行减量化、无害化处理的同时生成天然气和有机肥。

第二条 投资规模

投资规模：预估项目总投资 5.5 亿元，第一期投资约 2 亿元。

建设规模：第一期计划产年处理鲜玉米秸秆 15 万吨，所产沼气可建设 8MW 水平发电机组；第一期达产后将根据原料供应情况继续扩大产能。

项目建设周期：第一期在项目手续完备后 12-18 个月内建设完成。总投资预计在 5 年内完成。

具体项目规模、详细工艺路径、建设周期和经济效益测算将根据封丘县有机废弃物（秸秆与禽畜粪便）资源总量、项目选址周边资源可获取量、天然气及有机肥的当地市场环境等因素深入进行可行性分析，在项目可行性研究报告完成后，可根据需要另行签订补充协议约定。

第三条 项目选址、土地征用

1、项目选址：

乙方项目拟选址在封丘县产业聚集区，项目用地具体位置：北环路北，封黄路西（以土地局测绘图纸为准）；项目占地 100 亩。

2、土地征用：

乙方项目所选地块为工业规划用地，以招拍挂形式取得。

第四条 甲方权利和义务

1、甲方督促乙方按照规划要求和合同约定投资建设。本照节约、集约用地原则，严禁在用地范围内建造与生产无关的基础设施。

2、在河南省发改委及相关部门批复函下达后 3 个月内，乙方完成企业注册；在各项审批手续齐全、具备开工条件后 3 个月内开工建设；在河南省发改委及相关部门批复函下达 1 个月内，乙方向甲方支付保证金 40 万元，在乙方获得项目用地后，此保证金折抵乙方需缴纳的土地出让金；若乙方最终未取得土地，甲方应在乙方提出保证金退还要求后七日内，将保证金无条件一次性退还乙方，如不按时退还，需按照银行同期贷

款利率支付乙方逾期利息。

若乙方取得土地，甲方自乙方交清土地出让金之日起 30 日内负责为乙方办好国有土地使用权证。

3、甲方为乙方提供“五通一平”（道路、供水、排水、电力、通讯和土地平整）。

4、甲方协助乙方办理项目立项、环评和土地、建设、工商等各种相关手续，协助乙方办理并网发电、天然气在封丘县或周边区域的特许经营等相关手续。

5、甲方协助乙方积极争取上级项目扶持资金。甲方根据乙方生产需要，帮助乙方融资扩大生产。

6、在项目开工建设前，甲方须协助乙方办理病死禽畜处理相关手续。

7、甲方承诺在封丘县不再审批农业有机废弃物综合利用及同类型项目，以保证乙方的原料供应和产品销售。

第五条 乙方权利和义务

1、乙方依法享有企业资产所有权和使用权、生产经营自主权、用人用工自主权等各项权利。

2、本协议签订后，乙方及时完成项目公司注册，办理各项审批手续，并严格按照规划、建设的规定进行施工。

3、在甲方的配合下积极办理企业的国有土地使用权证、房产证、卫生证等新企业所需的全套证件。

4、乙方必须严格执行国家有关安全生产、消防、卫生和劳动保障、环境保护等方面的政策和规定，可协助政府无害化处理病死禽畜。

5、乙方项目竣工后，在同等条件下，应优先聘用当地劳动力。

第六条　优惠政策

1、为保证项目可持续发展，在项目建设周期内甲方为乙方保留后期规划建设用地。

2、为支持乙方发展，甲方给乙方提供节能、减排、科技三项费用扶持资金 2 万元／亩，具体扶持资金总额按实际用地计算。扶持资金按项目的进度分三期拨付，项目开工建设拨付支持资金的 30%，项目基础设施建成、设备安装后拨付持资金的 30%，项目建成投产达到设计规模后拨付持资金的剩余部分。

3、甲方对乙方的优惠支持参照《封丘县产业集聚区招商引资优惠办法》，实行“一事一议、特事特办”的办法给予奖励。

4、在项目建设期间，甲方免收乙方项目建设所涉及的有权减免的县级行政收费。

5、乙方除享受《封丘县产业集聚区招商引资优惠办法》外，优先享受上级政府及国家的相关优惠政策及资金支持。

6、乙方企业被认定为高新技术企业后，甲方协助乙方争取国家、省、县及产业集聚区关于高新技术企业的所有优惠政策。

7、该项目在落实国家税收减免政策的同时，为了帮助乙方做大做强，甲方给予乙方 5 年税收优惠政策，即乙方缴纳所得税地方留成部分，自项目投产之日起前三年全部全返，后两年 50%返还。

8、甲方为企业创造最佳的融资环境，通过协调有关商业银行、担保公司等金融机构，在新企业争取流动资金和技改资金等方面提供服务。

对上述优惠政策中的各项条款，若遇与国家法律法规相抵触的，则以国家法律法规为准执行。

第七条　违约责任

1、甲、乙双方应积极遵守本协议书的约定，任何一方违约，应赔偿由此而给对方造成的实际经济损失。

2、因甲方工作及不可抗因素影响乙方开工建设，造成工期延误的，顺延乙方开工、建设和竣工时间。

3、如该项目用地未能获得审批或无法进行征收，则不视为违约，本协议可自行解除，双方均不得以此要求损失。

4、如由于市场环境变化或国家政策调整等甲乙双方可控范围之外因素的影响，需要对原项目建设方案进行适当调整时，双方应本着互谅互让的原则协商解决、共同应对。

第八条　不可抗力

本协议生效后，甲、乙双方因不可抗力原因部分或全部不能履行本协议，遭受不可抗力一方不承担相关责任，但应采取一切合理措施减少因这一事件造成的损失，并自事件发生之日起七个工作日内以书面形式通知对方并提供证明材料。

第九条　争议解决

本协议书履行过程中如发生争议，合作双方应通过友好协商解决。如协商不成，按法律程序诉讼到协议签订地法院解决。

第十条　未尽事宜

未尽事宜，双方可以通过协商签订补充协议。补充协议为本协议书的有效组成部分，与本协议具有同等法律效力。

第十一条　附则

1、本协议经双方法定代表人或授权代表签字并加盖单位公章后生效。

2、本协议一式肆份，甲、乙双方各执贰份，具有同等法律效力，共同遵守执行。

甲 方：河南省封丘县人民政府

法定代表人（或授权代表）：

乙 方：中节能（北京）实业发展有限公司

法定代表人（或授权代表）：

二0一三年8月7日

APPENDIX IV: QUESTIONNARE SAMPLE

河南省封丘县有机废弃物资源综合利用项目

环境影响公众参与调查问卷

姓 名	聂祥连	性 别	女	年 龄	53
民 族	汉	文化程度	初中	职 业	农民
单 位				联系方式	8456543

一、在回答下列问题时，请用 √ 标出您的选择

1. 您认为你生活区域周围最主要的环境污染是（多选）：

A 地表水　B 环境空气 √　C 噪声 √　D 地下水

E 固体废弃物 √　F 其它，请注明

2. 在参加本次活动之前，您是否知道本项目？

A.知道　B.不知道 √

3. 如果您了解本项目，您是通过何种渠道了解本项目的信息？

A. 报纸　B. 网络　C. 标牌宣传　D. √民间渠道　E. 其它

4. 您的工作地点与本项目的距离？

A. 1km 以内　B. √1～3km　C. 3～5km　D. 5km 以外

5. 您的居住点与本项目的距离？

A. 1km 以内　B. √1～3km　C. 3～5km　D. 5km 以外

6. 通过介绍，您是否了解本项目的相关信息，如项目建设内容，环境影响和环保措施等？

A.知道　B.不知道　C. 不太清楚

7. 通过介绍，您是否了解本项目对环境的影响？

A.知道　B.不知道　C. 不太清楚

8. 经介绍后，您认为本项目在建设期间的主要环境影响是

A 地表水　B 地下水　C √噪声　D 环境空气，如扬尘

1

E 固体废弃物 F 交通问题 G 生态环境 H 其它

9. 您认为本项目在运营期间的主要环境影响是

A 地表水 B 地下水 C 噪声 D 环境空气，如粉尘/颗粒物

E 固体废物 F 生态环境 G 其它

10. 在了解项目建设期间要实施的环保措施后，您是否接受本项目建设期对环境的影响

10.1 环境空气（包括扬尘，颗粒物污染）

A. 接受 B. 基本接受 C. 接受 D. 不清楚

10.2 噪声

A. 接受 B. 基本接受 C. 接受 D. 不清楚

10.3 地表水

A. 接受 B. 基本接受 C. 接受 D. 不清楚

10.4 地下水

A. 接受 B. 基本接受 C. 接受 D. 不清楚

10.5 固体废弃物

A. 接受 B. 基本接受 C. 接受 D. 不清楚

10.6 生态环境

A. 接受 B. 基本接受 C. 接受 D. 不清楚

10.7 其它（项目建设带来的交通问题和出行的不便利）

A. 接受 B. 基本接受 C. 接受 D. 不清楚

11. 了解项目运营期间要实施的环保措施后，您是否接受本项目运营期对环境的影响

11.1 环境空气（包括粉尘，颗粒物污染）

A. 接受 B. 基本接受 C. 接受 D. 不清楚

11.2 噪声

A. 接受 B. 基本接受 C. 接受 D. 不清楚

11.3 地表水

A. 接受 B. 基本接受 C. 接受 D. 不清楚

11.4 地下水

A. 接受 B. 基本接受 C. 接受 D. 不清楚

11.5 固体废弃物

A. 接受 B. 基本接受 C. 接受 D. 不清楚

11.6 生态环境

A. 接受 B. 基本接受 C. 接受 D. 不清楚

12. 您认为本项目的建设能否促进当地的经济发展?

A. 会 B.不会 C.说不清

13. 您认为本项目的建设能否改善您的生活质量?

A. 会 B.不会 C.说不清

14. 综合利弊后，您是否赞成本项目的开工建设?

A. 赞成 B.不赞成 C.说不清

二、您对本项目有何要求和建议?

三、您对本项目的环境保护有何要求和建议?

Initial Environmental Examination (Draft)

November 2017

People's Republic of China: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility (Industrial By-product Gas Utilization Subproject)

Prepared by China Energy Conservation and Environmental Protection Group for the Asian Development Bank

CURRENCY EQUIVALENTS

(as of 7 November 2017)

Currency unit	–	yuan (CNY)		
CNY1.00	=	$0.1514	or	€0.1299
$1.00	=	CNY6.6045	or	€0.8578
€1.00	=	CNY7.6995	or	$1.1658

ABBREVIATIONS

ADB	Asian Development Bank
AP	Affected Person
AQI	Air Quality Index
CECEP	China Energy Conservation and Environmental Protection Group
EA	Executing Agency
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EPB	Environmental Protection Bureau
ESMS	Environment and Social Management System
FSR	Feasibility Study Report
GDP	Gross Domestic Product
GHG	Green House Gas
GIP	Good International Practice
GRM	Grievance Redress Mechanism
IA	Implementing Agency
IEE	Initial Environmental Examination
IT	Interim Target
LNG	Liquefied natural gas
MAC	Maximum Acceptable Concentration
MEP	Ministry of Environmental Protection
MSDS	Material Safety Data Sheet
NG	Natural Gas
PCR	Physical Cultural Resources
PPE	Personnel Protective Equipment
PPTA	Project Preparatory Technical Assistance
PRC	People's Republic of China
PSA	Pressure Swing Adsorption equipment
SPS	Safeguard Policy Statement, ADB

TA	Technical Assistance
TSP	Total Suspended Particulates
WB	World Bank
WHO	World Health Organization
WWTP	Waste Water Treatment Plant

WEIGHTS AND MEASURES

BOD_5	Biochemical Oxygen Demand, five days
$CaCO_3$	Calcium Carbonate
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
dB(A)	A-weighted sound pressure level in decibels
DO	Dissolved Oxygen
kg	Kilogram
km	Kilometer
kWh	Kilowatt Hour
Leq	Equivalent Continuous Noise Level
m	Meter
masl	Meters Above Sea Level
m/s	Meters per Second
m^2	Square Meters
m^3	Cubic Meters
mg/l	Milligrams per Liter
mg/m^3	Milligrams per Cubic Meter
$\mu g/m^3$	Micrograms per Cubic Meter
NO_x	Nitrogen Oxides
Nm^3	Normal Cubic Meters
^oC	Degrees Celsius
O_3	Ozone
pH	A measure of the acidity or alkalinity of a solution
PM	Particulate Matter
PM_{10}	Particulate Matter smaller than 10 micrometers
$PM_{2.5}$	Particulate Matter smaller than 2.5 micrometers
SO_2	Sulfur Dioxide
t/h	Tons per Hour
tce	Ton of coal equivalent

NOTES

(i) In this report, "$" refers to US dollars.

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EXECUTIVE SUMMARY

A. Introduction

1. This is the Initial Environmental Examination (IEE) report for the Industrial By-product Gas Utilization Subproject of the proposed People's Republic of China (PRC): Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility.

2. This subproject will use coke oven gas, an industrial by-product, to produce liquefied natural gas (LNG) for use in the transportation sector, as a preferred option in terms of greater market and environmental benefits, to the current practice of using such coke oven gas to generate onsite electricity and steam, or to produce urea or methanol.

B. Policy, Legal and Administrative Framework for Environmental Impact Assessment

3. Environmental impact assessment (EIA) procedures have been established in the PRC for over 20 years. Domestic EIA studies are required to be undertaken by relevant PRC environmental laws and regulations. National and local legal and institutional frameworks for EIA review and approval ensure that proposed projects are environmentally sound, designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environment, health, social, or safety hazards.

4. Following ADB's Safeguard Policy Statement (SPS 2009), an Environmental and Social Management System (ESMS) for the Financial Intermediation Loan (FIL) has been formulated to provide the screening, categorization, and review procedures for subproject selection. In implementing this FIL, subprojects should follow the screening and categorization procedures set out in the ESMS. The subproject has been classified as environment category B following SPS 2009 and the ESMS, and an IEE including an EMP is required.

C. Implementation Arrangements

5. Shanxi Liheng Iron & Steel Co., Ltd. will be the subborrower and responsible for the day-to-day management during the subproject preparation and implementation. China Energy Conservation and Environmental Protection Group (CECEP) will be the executing agency (EA) and implementing agency (IA) and responsible for overall guidance during subproject preparation and implementation.

D. Description of the Environment

1. Location and Topography

6. The subproject will be implemented at Gaoxian Town, Quwo County, Linfen City, Shanxi Province. Linfen has a total area of 20,275 square kilometer (km^2), covers 13% of the province's area. Within its borders Linfen City has a variety of topographical features. It is characterized as having a "U" shape, with mountains covering 29.2% of Linfen City, in all four cardinal directions, a basin, the Linfen Basin covering 19.4%, and intervening hills covering 51.4% in the middle. In the east, from north to south, there are Mountain Huo and the Zhongtiao Mountains. In the west, there are the Lüliang Mountains, with elevations mostly above 1,000 meters (m). The highest point in Linfen CIty is the main peak of Mountain Huo, at 2,347 m, and the lowest is in Xiangning County, at 385 m above sea level. The subproject site is located near the urban core of Gaoxian

Town and the topography in this area is generally flat.

2. Meteorology and Climate

7. Linfen has a continental, monsoon-influenced semi-arid climate (Köppen BSk), with moderately cold, but dry winters, and hot, humid summers. The monthly 24-hour average temperature ranges from −2.7°C in January to 26.1°C in July, and the annual mean temperature is 12.6°C. The annual average precipitation stands at 470 millimeters (mm), with close to 70% of this total rain fall from June to September. The frost-free period lasts on average 190 days per year. Extreme temperatures range from −22.5°C to 40.5°C.

3. Water Resources

8. Annual average water resource in Linfen is 1.52 billion m^3. The per capita water resource is only 350 m^3. The city is located in mountainous plateau hydro-geological unit under semi-humid climate conditions with frequent drought (9 out of 10 years). The territory has undulating terrain and middle low-laying to form Hui River Valley. Main source of groundwater is meteoric water. The chemical composition of groundwater is more bicarbonate water. In the middle of the low-lying areas, it is mostly sulfate water. Groundwater mineralization degree is high, up to 6 grams per liter (g/L). Its depth ranges from 20 to 180 m depending on different hydro-geologic conditions. Water yield of a single well is 5–80 cubic meter per hour (m^3/h).

4. Ecological and Sensitive Resources

9. The subproject site is located in the existing Liheng coking plant which is highly developed and modified industrial environments. Surrounding land use is industrial land with little or no vegetation cover. There are no known rare or endangered flora or fauna, parks, nature reserves or areas with special national, regional or local ecological significance within or adjacent to the subproject site.

5. Socioeconomic Conditions

10. Linfen is known for its rich mineral resources, which include coal, iron ore, copper and lead. The coal reserves in Hedong Coal Field, Huoxi Coal Field and Qinshui Coal Field, amount to 62.9 billion tons. The iron ore reserve in the city exceeds 420 million tons. Coal mining and dressing, coking, metallurgy, non-ferrous metal smelting, and chemicals are the principal industries.

11. Linfen is the fourth largest economy in Shanxi, after the provincial capital city Taiyuan, Changzhi and Yuncheng. In 2016, the city's GDP was CNY120.52 billion, of which the primary sector accounted for 8.0% or CNY9.64 billion; the secondary sector accounted for 46.5% or CNY56. 04 billion; and the tertiary sector accounted for 45.5% or CNY54.84 billion.

6. Physical Cultural Resources

12. Linfen is rich in cultural and historical sites, including Ding Village Ruins, Guangsheng Temple, Hongtong Grand Pagoda Tree, the Ancient City of Jin Kingdom, and the Yao Temple. However, all the subproject activities will be in the existing Shanxi Liheng Iron & Steel Co., Ltd.'s premises. There are no known physical cultural resources (PCRs) in the subproject site.

E. Anticipated Impacts and Mitigation Measures

13. Anticipated positive and negative environmental impacts of the proposed subproject were assessed based on: (i) the Feasibility Study Report (FSR) (2017); (ii) a technical due diligence review of the FSR undertaken by Asian Development Bank (ADB) project preparatory technical assistance (PPTA) consultants; and (iii) site visits, surveys, and consultations undertaken by ADB PPTA consultants.

14. Environmental impacts during pre-construction, construction, and operation phases were considered separately. The results of the assessment indicate that during the pre-construction phase, environmental issues are very limited, and are mostly associated with ensuring appropriate incorporation of mitigation measures into the project design.

15. Potential negative environmental impacts during construction phase are short-term and localized, and are associated with soil erosion, construction noise, fugitive dust, disruption of traffic and community services, and risks to worker and community health and safety. These can be effectively mitigated through good construction and health and safety practices.

16. Potential negative impacts during operation phase are associated with flaring emissions, solid waste, wastewater, noise, and health and safety risks to workers and community. These can be effectively mitigated through good operation and health and safety practices.

17. Potential positive operation phase impacts are significant and long-term, and are associated with providing clean fuel for transportation sector and emissions reductions from gasoline replacement.

F. Analysis of Alternatives

18. Emissions from vehicles contribute in part to the haze in the greater Beijing–Tianjin–Hebei (BTH) region, especially from heavy-duty vehicles. Data from the Ministry of Environmental Protection (MEP) states that the number of heavy-duty vehicles accounts for 4% of total vehicles, but their emissions of nitrogen oxide (NO_x) and particulate matter (PM) make up 78% and 82% of the total vehicle emissions. There are 5.7 million vehicles in total in the Beijing region. Among them, only 0.2 million are diesel-powered heavy-duty vehicles, but they contribute to 90% of PM and 60% of NOx emissions in total vehicle emissions. The use of natural gas as a substitute fuel for diesel is one of the options to reduce emissions from such automobiles. In 2015, the share of natural gas in primary energy consumption was only 5.9%, much less that the world average of 23.7%. More than 30% of the natural gas consumed is imported. Therefore increasing availability of natural gas supply will improve air quality as well as energy security.

19. The market is ready to use natural gas as transport fuels. As of the end of 2015, there were 230,000 LNG vehicles and 2,650 LNG filling stations operating for business. According to the *China National 13th Five Year Plan for Natural Gas Development*, by the year 2020, there will be 400,000 to 500,000 LNG vehicles on the road. The LNG demand will create a LNG-supply based sector other than the traditional natural gas industry. This subproject can be replicable for other projects to meet the market demand.

20. Implementation of the subproject will: (i) significantly reduce fossil oil consumption; (ii) improve air quality; (iii) reduce GHG emissions; and (iv) effective utilization of coke oven gas. For these reasons, the “no project” alternative is considered unacceptable.

G. Information Disclosure and Public Consultations

21. The domestic EIA is being prepared by an environmental firm. ADB PPTA consultant will assist the firm to undertake public consultation based on both ADB and PRC's requirements. According to the environmental firm, two rounds of information disclosure will be conducted.

22. Because the domestic EIA preparation just started, no public consultation meeting has been held. According to the plan, a public consultation meeting will be held after the domestic EIA is finished.

H. Grievance Redress Mechanism

23. A subproject-level grievance redress mechanism (GRM) has been established to receive and facilitate resolution of complaints during the construction and operation phases. The GRM includes procedures for receiving grievances, recording/ documenting key information, and evaluating and responding to the complainants in a reasonable time period. Any concerns raised through the GRM will be addressed quickly and transparently, and without retribution to the affected person.

I. Environmental Management Plan

24. A comprehensive environmental management plan (EMP) has been developed to ensure: (i) implementation of identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of monitoring and reporting against the performance indicators; and (iii) project compliance with the PRC's relevant environmental laws, standards and regulations and the ADB's SPS. The EMP includes an environment monitoring plan (EMoP) to monitor the environmental impacts of the subproject and assess the effectiveness of mitigation measures, and a capacity building and training program focused on health, safety and environment. Organizational responsibilities and budgets are clearly identified for execution, monitoring and reporting. The EMP is presented in Appendix I.

J. Conclusion

25. Through the environmental assessment process, it is concluded that the subproject has: (i) selected appropriate technology to produce LNG and reduce the emission of pollutants; (ii) identified potential negative environment impacts and established mitigation measures; (iii) established subproject-level GRM procedures; and (iv) prepared a comprehensive EMP including environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

26. Overall, any minimal adverse environmental impacts associated with the subproject can be prevented, reduced, or minimized through the appropriate application of mitigation measures. It is therefore recommended that: (i) the subproject is classified as environment category B; (ii) the subproject will undertake public consultation based on requirements from ADB SPS 2009 and PRC policies; and (iii) the subproject will be supported by ADB, subject to the implementation of the commitments contained in the EMP and allocation of appropriate technical, financial and human resources by the subborrower to ensure these commitments are effectively and expediently implemented.

I. INTRODUCTION

A. The Subproject

1. Industrial By-product Gas Utilization Subproject is located in Gaoxian Town, Quwo County, Linfen City, Shanxi Province, PRC. This subproject will use coke oven gas, an industrial by-product, to produce LNG for use in the transportation sector, as a preferred option in terms of greater market and environmental benefits, to the current practice of using such coke oven gas to generate onsite electricity and steam, or to produce urea or methanol. The subproject site is located in the 10-million-ton Steel Recycling Industrial Park in Quwo County, occupying 1,500 acres' land with convenient transport network.

2. Shanxi Liheng Iron & Steel Co., Ltd. (Liheng) is the subborrower which is responsible for daily operation and equipment maintenance of the subproject.

B. Introduction of Subborrower

3. Liheng was established in 2002 with registered capital of CNY400 million and has about 4,000 employees. Liheng has facilities of coke-making, iron-making, steel-making, steel-rolling, combined heat and power (CHP) plants using by-product gas, grinding mill of blast furnace slag, and water treatment and recycling. It is in the 10-million-ton Steel Recycling Industrial Park in Quwo County, Linfen City.

4. Liheng is among the top 100 best private enterprises of Shanxi and top 500 private enterprises of China. It has ISO9001:2000 certification and has been consecutively recognized as "top taxpayer," "model company of energy-saving & emission-reduction," and "enterprise of safety production" in the past years.

5. Liheng has adopted many energy-efficient and environmentally-sound technologies such as coke dry quenching (CDQ) technology, waste heat recovery from sintering mills, exhaust gas recovery from blast furnaces and coke ovens and conversion for power generation. All these efforts enable the company to realize zero discharge of waste water, 100% recycling of the slag, and 100% self-sufficient for power supply to the steel production.

C. Report Purpose

6. ADB's environmental safeguard requirements are specified in ADB Safeguard Policy Statement (SPS) 2009. The subproject has been screened and classified as Environment Category B, requiring an IEE including an EMP.

D. Approach to Report Preparation

7. This report has been prepared based on a domestic feasibility study report (FSR); a technical due diligence review of the FSR undertaken by ADB PPTA consultants; public consultations with key stakeholders and affected persons; and site visits, surveys, and consultations undertaken by ADB PPTA environmental consultants.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

8. This IEE has been prepared in accordance with both the PRC's national and local environmental legal and institutional framework and environmental assessment requirements, and applicable ADB policies, requirements and procedures.

A. PRC Environmental Legal Framework

9. The environmental protection and management system in the PRC consists of a well-defined hierarchy of regulatory, administrative and technical institutions. At the top level the People's Congress of the PRC has the authority to pass and revise national environmental laws; Ministry of Environment Protection (MEP) under the State Council promulgates national environmental regulations; and the MEP either separately or jointly with the Administration of Quality Supervision, Inspection and Quarantine issues national environmental standards. Provincial and local governments can also issue provincial and local environmental regulations and guidelines in accordance with the national ones. In addition, national and local five-year environmental protection plans form an important part of the legal framework.

10. Key applicable PRC environmental laws are listed in **Table 1**. The implementation of environmental laws is supported by a series of associated regulations summarized in **Table 2**.

Table 1: Applicable PRC environmental laws

No.	Title of the Law	Year Issued/Updated
1	Environmental Protection Law	2015
2	Environmental Impact Assessment Law	2016
3	Water Law	2016
4	Water Pollution Prevention and Control Law	2008
5	Air Pollution Prevention and Control Law	2015
6	Noise Pollution Prevention and Control Law	1999
7	Solid Waste Pollution Prevention and Control Law	2005
8	Water and Soil Conservation Law	2011
9	Land Administration Law	2004
10	Flood Control Law	1998
11	Forest Law	1998
12	Grassland Law	2013
13	Prevention and Control of Desertification	2002
14	Wild Fauna Protection Law	2004
15	Wild Flora Protection Law	1996
16	Agricultural Law	2003
17	Urban and Rural Planning Law	2008
18	Energy Conservation Law	2016

Source: ADB PPTA consultants.

11. In addition to environmental laws and regulations, there are occupational health and safety laws and regulations the subproject must comply with, including the *PRC Safety Production Law* (2014), *State Administrative Regulations of Safety Production* (2003), and *PRC Prevention and Control of Occupational Diseases Law* (2011).

Table 2: National Administrative Regulations

No.	Regulation	Year Issued/Updated
1	Environmental Protection Management Regulations on Construction Project	2015
2	The PRC Basic Farmland Protection Ordinance	1998
3	The PRC Air Pollution Prevention and Control Law Implementation Rules	1997
4	The PRC Water Pollution Prevention and Control Law Implementation Rules	2000
5	The PRC Forestry Law Implementation Rules	2000
6	The PRC Water and Soil Conservation Law Implementation Rules	1993
7	The PRC Land Management Regulations Implementation Rules	1999
8	The PRC Wild Plant Protection Ordinance	1997
9	Notification of National Key Function Zoning Issued by the State Council	2010
10	The PRC River Management Ordinance	1988
11	The Decision on Several Environmental Protection Issues	1996
12	The National Ecological and Environmental Protection Platform	2000
13	The State Council Decision on Deepening Reform and Strict Land Management	2004

PRC = People's Republic of China.
Source: ADB PPTA consultants.

B. PRC Environmental Impact Assessment Framework

12. Environmental Impact Assessment (EIA) procedures have been established in the PRC for over 20 years. Article 16 of the PRC *Law on Environmental Impact Assessment* (2003)[1] stipulates that an EIA document is required for any capital construction project producing significant environmental impacts. Projects are classified into three categories for environment impact:

(i) **Category A** projects with significant adverse environmental impacts, for which a full EIA report is required;

(ii) **Category B** projects with adverse environmental impacts which are of a lesser degree and/or significance than those of Category A, for which a simplified tabular EIA report is required; and

(iii) **Category C** projects unlikely to have adverse environmental impacts, for which an EIA registration form is required.

13. A full EIA report for category A project and a simplified tabular EIA report for category B project are similar to ADB's EIA and IEE reports, respectively. The registration form of an EIA is similar to an ADB Category C project.

14. Applicable PRC environmental management and assessment guidelines are summarized in **Table 3**. In 2008, MEP issued "Management Guideline on EIA Categories of Construction Projects" (revised in 2015). MEP guidelines provide detailed EIA requirements for 23 sectors and 199 subsectors based on the project's size, type (e.g., water resources development, agriculture, energy, waste management, etc.), and site environmental sensitivity (e.g., protected nature reserves and cultural heritage sites).

[1] *National Environmental Impact Assessment Law*, published on Oct 28, 2002 and implemented in Sep 1, 2003.

15. MEP's "Guidelines on Jurisdictional Division of Review and Approval of EIAs for Construction Projects" (2009) defines which construction project EIAs require MEP review and approval, and which EIAs are delegated to the provincial environmental protection bureaus (EPB).

Table 3: Applicable PRC environmental management and assessment guidelines

No.	Guideline	Code and/or Year Issued/Updated
1	Guideline for Technical Review of EIA on Construction Projects	HJ 616-2011
2	Management Guideline on EIA Categories of Construction Projects	2008
3	Further Enhance the Management of EIA and Preventing Environmental Risks	2012
4	Guideline on Jurisdictional Division of Review and Approval of EIAs for Construction Projects	2009
5	Guideline on EIA Categories of Construction Projects	2015
6	Interim Guideline on Public Consultation for EIA	2006
7	Technical Guidelines for EIA – General Program	HJ 2.1-2011
8	Technical Guideline for EIA – Atmospheric Environment	HJ 2.2-2008
9	Technical Guideline for EIA – Surface Water	HJ/T 2.3-1993
10	Technical Guideline for EIA – Acoustic Environment	HJ 2.4-2009
11	Technical Guideline for EIA – Groundwater Environment	HJ 610-2016
12	Technical Guideline for EIA – Ecological Impact	HJ 19-2011
13	Technical Guidelines for Environmental Risk Assessment for Construction Projects	HJ/T 169-2004

EIA = environmental impact assessment.
Source: ADB PPTA consultants.

C. Project Domestic EIA Report

16. The subproject was categorized as B under the PRC National EIA Law and Linfen EPB requirements. A tabular EIA report will be prepared by the subborrower and submitted to the Linfen EPB for approval. The domestic EIA will be reviewed by the Linfen EPB. The EIA report will be revised based on the EPB's comments, after which the Linfen EPB will approve the report.

17. As of the writing of this IEE, the domestic FSR was just completed and the domestic EIA is still under preparation by the Shanxi Environmental Protection Science and Technology Design and Research Institute (EIA firm).

D. Relevant International Agreements

18. The PRC has signed a number of international agreements regarding environmental and biological protection. Those which have potential application to the subproject are listed in **Table 4**.

Table 4: Applicable international agreements

No.	Agreement	Year	Purpose
1	Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat	1975	Preventing the progressive encroachment on and loss of wetlands for now and the future
2	Convention Concerning the Protection of the World Cultural and Natural Heritage	1986	Conserving cultural and natural heritage sites.
3	Convention on Biological Diversity	1993	Conservation and sustainable use of

No.	Agreement	Year	Purpose
			biodiversity.
4	UN Framework Convention on Climate Change	1994	Stabilizing GHG concentrations in the atmosphere at a level that will prevent anthropogenic induced climate change.
5	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification	1996	Fighting against desertification and mitigating the effects of drought.
6	Kyoto Protocol	2002	Controlling emissions of anthropogenic GHGs in ways that reflect underlying national differences in GHG emissions, wealth, and capacity to make the reductions.
7	Stockholm Convention on Persistent Organic Pollutants	2004	Safeguarding human health and the environment from POPs, ascertaining sound management of stockpiles and wastes that contain POPs, and taking measures to reduce or eradicate releases from intentional production and use of POPs.
8	Paris climate agreement	2015	Dealing with greenhouse gas emissions mitigation, adaptation and finance starting in the year 2020.

GHG = greenhouse gas, POP = persistent organic pollutants.
Source: ADB PPTA consultants.

E. Applicable PRC Environmental Quality Standards

19. The environmental quality standard system that supports the implementation of the environmental protection laws and regulations in the PRC is classified into two categories by function: ambient environmental standards and pollutant emission/discharge standards. Standards applicable to the subproject are presented in **Table 5**, and key standards are further elaborated below.

1. Ambient Air Quality

20. Ambient air quality limits are intended to indicate safe exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Limits are given for one or more specific averaging periods, typically one-hour average, 24-hour average, and/or annual average. The PRC's recently updated *Ambient Air Quality Standards (*GB3095-2012) has two classes of limit values; Class 1 standards apply to special areas such as natural reserves and environmentally sensitive areas, and Class 2 standards apply to all other areas, including urban and industrial areas. The PRC standards for Class 2 areas are applicable for the subproject.[2]

[2] On 29 February 2012, the China State Council passed the roadmap for ambient air quality standards with the aim of improving the living environment and protecting human health. The Ambient Air Quality Standards (GB 3095-2012) prescribes the first-ever limits for $PM_{2.5}$. It also modified the previous area classifications by combining Class III (special industrial areas) with Class II (residential, mixed use areas).

Table 5: Applicable PRC environmental standards

No.	Standard	Code/Date
1	Ambient Air Quality Standards	GB 3095-2012
2	Groundwater Quality Standard	GB/T 14848-93
3	Surface Water Quality Standards	GB 3838-2002
4	Environmental Quality Standards for Noise	GB 3096-2008
5	Soil Quality Standard	GB15618-1995
6	Noise Standards for Construction Site Boundary	GB 12523-2011
7	Noise Standards for Industrial Enterprises at Site Boundary	GB 12348-2008
8	Standard for Flood Control	GB 50210-94
9	Emission standard of air pollutants for boiler	GB 13271-2014
10	Emission standards for odor pollutants	GB 14554-93

Source: ADB PPTA Consultants.

21. The World Health Organization (WHO) Air Quality Guidelines are recognized as international standards and are adopted by the World Bank Group's Environment, Health and Safety Guidelines (*EHS Guidelines)*. In addition to guideline values, interim targets (IT) are given for each pollutant by the WHO as incremental targets in a progressive reduction of air pollution. WHO guidelines and corresponding PRC standards are presented in **Table 6**.

22. From a review of **Table 6** it can be observed that:

- For total suspended particulates (TSP), there are PRC standards but no corresponding WHO guidelines.
- For particulate matter with diameter less than 10 micrometers (PM_{10}), PRC Class 2 annual average and 24-hour average standards meet WHO IT-1 guidelines (there are no 1-hour average standards or guidelines for either PRC or WHO).
- For particulate matter with diameter less than 2.5 micrometers ($PM_{2.5}$), PRC Class 2 annual and 24-hour standards meet WHO IT-1 guidelines (there are no 1-hour standards or guidelines for either PRC or WHO).

Table 6: PRC ambient Air Quality Standards and WHO ambient air quality guidelines, mg/m^3

Standard	TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	O_3	CO
WHO Ambient Air Quality Guidelines							
Annual mean	--	0.020	0.010	--	0.040	--	--
Annual mean IT-1	--	0.070	0.035	--	--	--	--
24-hr mean	--	0.050	0.025	0.020	--	--	--
24-hr mean IT-1	--	0.150	0.075	0.125	--	--	--
8-hr mean	--	--	--	--		0.100	--
8-hr mean IT-1	--	--	--	--		0.160	--
1-hr mean	--	--	--	--	0.200		0.030
1-hr mean IT-1	--	--	--	--	--		--
PRC Ambient Air Quality Standard (Class 2)							
Annual mean	0.200	0.070	0.035	0.060	0.040	--	--
24-hr mean	0.300	0.150	0.075	0.150	0.100	--	0.004
8-hr mean	--	--	--	--	--	0.160	--
1-hr mean	--	--	--	0.500	0.200	0.200	0.010

CO = carbon monoxide, mg/m^3 = milligram per cubic meter, NO_2 =nitrogen dioxide, O_3= ozone, PM_{10} = particulate matter with diameter less than 10 micrometers, $PM_{2.5}$ = particulate matter with diameter less than 2.5 micrometers, PRC = People's Republic of China, SO_2 = sulfur dioxide, TSP = total suspended particulates, WHO = World Health Organization.
Source: WHO Air Quality Guidelines (2006) in IFC *EHS Guidelines* (2007), and PRC GB 3095-2012.

- For sulfur dioxide (SO_2), WHO only has a 24-hour average guideline (0.125 mg/m^3), which is slightly lower than the PRC standard (0.150 mg/m^3). However, SO_2 levels are low in the subproject area, and the subproject will only contribute extremely low levels of SO_2, so the very minor difference is inconsequential.
- For nitrogen dioxide (NO_2), the PRC standard is equivalent to the WHO annual average guidelines, there is no WHO 24-hour average guideline; and the 1-hour average PRC standard is equivalent to the WHO guideline.

23. Overall, the PRC standards show a high degree of equivalency to the WHO guidelines or IT-1 values, and they are adopted for use in this IEE report.

2. Fugitive Particulate Matter Emission

24. Fugitive emission of particulate matter (PM) such as dust from construction sites is regulated under PRC's *Air Pollutant Integrated Emission Standard* (GB 16297-1996), which sets 120 mg/m^3 as the maximum allowable emission concentration and ≤ 1.0 mg/m^3 as the concentration limit at the boundary of construction sites, with no specification on the particular matter's particle diameter. There is no equivalent standard recommended in the *EHS Guidelines,* and the PRC standard is adopted for use in this IEE report.

3. Surface Water

25. PRC's *Ambient Surface Water Quality Standards* (GB3838-2002) defines five water quality classes for different environmental functions. For example, Class I is the best, such as water at sources of rivers and National Nature Reserves. Class V is the worst quality, suitable only for agricultural and scenic water uses. Based on site visit, the surface water near the subproject area is Fen River which is about 4.5 km away. Class V water quality standard (see **Table 7**) is applicable for Fen River near subproject site. There are no applicable *EHS Guidelines* or target for water quality in this context, and the PRC standard is adopted for use in this IEE report.

Table 7: Applicable surface water standards

No.	Parameter	Class IV Standard (mg/l, pH excluded)
1	pH	6–9
2	Dissolved Oxygen	3
3	COD_{Mn}	10
4	COD_{Cr}	30
5	BOD_5	6
6	NH_3-N	1.5
7	TP	0.3
8	TN	1.5
9	Copper	1.0
10	Zinc	2.0
11	Fluoride	1.5
12	Selenium	0.02
13	Arsenic	0.1
14	Total Mercury	0.001
15	Cadmium	0.005
16	Hexavalent Chromium	0.05
17	Lead	0.05
18	Cyanide	0.2
19	Volatile Phenol	0.01
20	Sulfide	0.5
21	Petroleum	1.0
22	Anionic surfactant	0.3
23	Coliforms	20000

BOD_5 = 5-day biochemical oxygen demand, CODcr = chemical oxygen demand, CODMn = permanganate index, mg/l = milligram per liter, NH_3-N= ammonia nitrogen; pH = potential of hydrogen, TP = total phosphorus; TN = total nitrogen.
Source: GB3838-2002 Surface Water Ambient Quality Standards.

4. Groundwater

26. PRC's *Groundwater Water Ambient Quality Standard* (GB/T14848-93) also defines a number of water quality categories for different environmental functions. Class III standards is applicable for ground water near subproject site (**Table 8**). There is no equivalent standard recommended in the *EHS Guidelines,* and the PRC standard is adopted for use in this IEE report.

Table 8: Applicable groundwater standards

No	Parameter	Unit	Class III Standard
1	pH	-	6.5–8.5
2	COD_{Mn}	mg/l	3.0
3	Sulfate	mg/l	250
4	Chloride	mg/l	250
5	Volatile Phenols	mg/l	0.002
6	Total hardness ($CaCO_3$)	mg/l	450
7	Nitrate NO_{3-}	mg/l	20
8	Nitrite NO_{2-}	mg/l	0.02
9	NH_3-N	mg/l	0.2
10	Molybdenum	mg/l	0.1
11	Cyanide	mg/l	0.05
12	Cadmium	mg/l	0.01
13	Chromium VI	mg/l	0.05
14	Arsenic	mg/l	0.05
15	Zinc	mg/l	1.0

No	Parameter	Unit	Class III Standard
16	Fluoride	mg/l	1.0
17	Lead	mg/l	0.05
18	Iron	mg/l	0.3
19	Manganese	mg/l	0.1
20	Copper	mg/l	1.0
21	Selenium	mg/l	0.01
22	Total coliforms	/L	3.0

COD_{Mn} = permanganate index; mg/l = milligram per liter, NO_3- = nitrate; NO_2- = nitrite; NH_3-N= ammonia nitrogen, pH = potential of hydrogen.
Source: GB/T14848-93 Quality Standard for Ground Water.

5. Wastewater Discharge

27. **Table 9** presents the relevant PRC wastewater discharge standards. The *EHS Guidelines* indicate that wastewater discharged to public or private wastewater treatment systems should: meet the pretreatment and monitoring requirements of the sewerage treatment system into which it discharges; not interfere, directly or indirectly, with the operation and maintenance of the collection and treatment systems, or pose a risk to worker health and safety, or adversely impact characteristics of residuals from wastewater treatment operations; and be discharged into municipal or centralized wastewater treatment systems that have adequate capacity to meet local regulatory requirements for treatment of wastewater generated from the subproject.

28. The subproject will discharge wastewater to existing wastewater treatment plant in the industrial park. The wastewater discharges will be required to meet Class B maximum acceptable concentrations (MACs) in *Wastewater Quality Standards for Discharge to Municipal Sewers* (CJ 343-2010), and the WWTP discharges are required to meet Class 1A of *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plants* (GB 18918-2002).

Table 9: PRC *Wastewater Quality Standards for Discharge to Municipal Sewers*

No	Pollutant	Maximum acceptable concentration (MAC) mg/L (except pH and chromacity)
		Class B
1	pH	6.5–9.5
2	SS	400
3	COD	500
4	Ammonia nitrogen	45
5	TDS	2000
6	Chromacity	70
7	BOD	350
8	Total phosphorus	8

BOD = biochemical oxygen demand, COD = chemical oxygen demand, pH = potential of hydrogen, SS = suspended solid, TDS = total dissolved solid.
Source: PRC Standards CJ-343-2010.

6. Noise

27. **Table 10** presents the relevant PRC *Urban Noise Standards* compared with relevant international guidelines from the WHO (as presented in the *EHS Guidelines*). Category I and II standards are applicable to the subproject area. The classes within the standards are not directly comparable, but the PRC Category I standards are equivalent to WHO Class I standards.

Category II is utilized in this IEE report.

Table 10: PRC *Environmental Quality Standards for Noise* and relevant international guidelines

PRC Standards Leq dB(A)			International Standards One Hour Leq dB(A)		Comparison
Category	**Day** 06-22h	**Night** 22-06h	**Day** 07-22h	**Night** 22-07h	
0: Areas needing extreme quiet, such as special health zones	50	40	WHO Class I: residential, institutional, educational: 55 WHO Class II: industrial, commercial: 70	WHO Class I: Residential, institutional, educational: 45 WHO Class II: Industrial, Commercial: 70	Classes are not directly comparable, but PRC Class II standards are more stringent than WHO Class II standards. PRC standards are utilized in this report.
I: Mainly residential; and cultural and educational institutions	55	45			
II: Mixed residential, commercial and industrial areas	60	50			
III: Industrial areas	65	55			
IV: Area on both sides of urban trunk roads	70	55			

dB(a) = A-weighted decibels, Leq = equivalent continuous noise level, PRC = People's Republic of China, WHO = World Health Organization.
Source: PRC Standards GB3096-2008 and WHO Standards.

28. **Table 11** presents the relevant PRC and international standards (US EPA as there are no WHO or *EHS Guidelines* standards) for on-site construction noise. The PRC standards are more stringent than international guidelines, and are utilized in this IEE report.

Table 11: PRC *Noise Standards for Construction Site Boundary* and relevant international guidelines

Day Leq dB(A)	Night Leq dB(A)	International Standards Leq dB(A)	Comparison
70	55	US EPA: 85 (day, 8-hour exposure)	PRC standards are more stringent than international standards

dB(a) = A-weighted decibels, Leq = equivalent continuous noise level, PRC = People's Republic of China, US EPA = US Environmental Protection Agency.
Source: PRC GB12523-2011 and US EPA Standards.

29. During operation noise at site boundaries should comply with Class II of the PRC *Industrial Enterprise Boundary Noise Emission Standard* (GB12348-2008) (**Table 12**).

Table 12: PRC *Noise Emission Standards for Industrial Enterprise Site Boundary*

Standard Type	Standard Value Leq dB(A)	
	Day	Night
Class 2	60	50

dB(a) = A-weighted decibels, Leq = equivalent continuous noise level, PRC = People's Republic of China.
Source: PRC GB12348-2008.

F. Applicable ADB Policies and Requirements

30. The major applicable ADB policies, requirements and procedures for EIA are the *Safeguard Policy Statement* (SPS, 2009) and the *Environmental Safeguards – A Good Practice Sourcebook* (2012), which jointly provides the basis for this IEE. The SPS promotes good international practice as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*. The policy is underpinned by the ADB Operations Manual for the SPS (OM Section F1, October 2013).

31. The SPS establishes an environmental review process to ensure that projects funded through ADB loans are environmentally sound, are designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environment, health, social, or safety hazards.

32. At an early stage in the project cycle, typically the project identification stage, ADB screens and categorizes proposed projects based on the significance of potential project impacts and risks. A project's environment category is determined by the category of its most environmentally sensitive component, including direct, indirect, induced, and cumulative impacts. Project screening and categorization are undertaken to:

(i) reflect the significance of the project's potential environmental impacts;
(ii) identify the type and level of environmental assessment and institutional resources required for the safeguard measures proportionate to the nature, scale, magnitude and sensitivity of the proposed project's potential impacts; and
(iii) determine consultation and disclosure requirements.

33. ADB assigns a proposed project to one of the following categories:

(i) **Category A.** Proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented; impacts may affect an area larger than the sites or facilities subject to physical works. A full-scale EIA including an EMP is required.
(ii) **Category B**. Proposed project's potential environmental impacts are less adverse and fewer in number than those of category A projects; impacts are site-specific, few if any of them are irreversible, and impacts can be readily addressed through mitigation measures. An IEE, including an EMP, is required.
(iii) **Category C**. Proposed project is likely to have minimal or no adverse environmental impacts. No EIA or IEE is required although environmental implications need to be reviewed.
(iv) **Category FI**. Proposed project involves the investment of ADB funds to, or through, a financial intermediary.

34. SPS 2009 requires a number of additional considerations, including: (i) project risk and respective mitigation measures and project assurances; (ii) project-level grievance redress mechanism; (iii) definition of the project area of influence; (iv) physical cultural resources damage prevention analysis; (v) climate change mitigation and adaptation; (vi) occupational and community health and safety requirements (including emergency preparedness and response); (vii) economic displacement that is not part of land acquisition; (viii) biodiversity conservation and natural resources management requirements; (ix) provision of sufficient justification if local standards are used; (x) assurance of adequate consultation and participation; and (xi) assurance that the EMP includes an implementation schedule and measurable performance indicators. These requirements, which may not be covered in the domestic EIA, have been considered, and

all applicable environmental requirements in SPS 2009 are covered in this IEE.

35. During the design, construction, and operation phases of a project, ADB SPS (2009) also requires the borrower to follow environmental standards consistent with good international practice (GIP), as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*.[3] The *EHS Guideline*s contain discharge effluent, air emissions, and other numerical guidelines and performance indicators as well as prevention and control approaches that are normally acceptable to ADB and are generally considered to be achievable at reasonable costs by existing technologies. When host country regulations differ from these levels and measures, the borrower is to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower is required to provide justification for any proposed alternatives.

[3] *World Bank Group, Environmental, Health, and Safety Guidelines*, April 30, 2007, Washington, USA. http://www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

III. PROJECT DESCRIPTION

A. The Project

36. The subproject will be implemented in the 10-million-ton Steel Recycling Industrial Park of Quwo County, Linfen City, which is located in southern part of Shanxi Province.

37. The proposed subproject uses industrial by-product coke oven gas to produce liquefied natural gas (LNG) for use in the transportation sector. The annual LNG output is 180,000 metric tons. The subproject includes compressor station, gas purification, gas liquefaction, LNG storage tank, and associated facilities such as controlling system and LNG filling station. All these facilities are owned and operated by Liheng.

B. Subproject Rational

38. Coke oven gas, the by-product of coke-making, is produced during the manufacture of metallurgical coke by heating bituminous coal to 900°C to 1,000°C in a chamber from which air is excluded. Coke oven gas can be used as a fuel gas since it has a medium calorific value. Its main compositions are hydrogen (55%–60%), methane (23%–27%), and carbon monoxide (CO) (5%–8%). Other components include nitrogen, CO_2, and hydrocarbons. Raw coke oven gas also contains various contaminants such as hydrogen sulfide, hydrogen cyanide, and benzene. The heating value of coke oven gas ranges from 17 to 19 megajoule (MJ) (4063 to 4541 kilocalories [kcal]) per cubic meter. Currently, most of the coke oven gas is used for electricity and steam generation. Coke oven gas is also used for making hydrogen, ammonia, methanol, and other chemicals. Making natural gas is a more recent technological option for coke oven gas utilization in the PRC.

39. Taking up the highest concentration in coke oven gas, hydrogen is the main component. Since steel companies need a certain amount of hydrogen as the protective gas for steel mills, direct hydrogen production is the first choice of steel companies in the utilization of coke oven gas. Since the 1980s, steel companies such as Bao Steel, An Steel, Wuhan Iron and Steel, Benxi Steel, and Baotou Steel have built several sets of pressure swing adsorption (PSA) equipment on hydrogen-making from coke oven gas that range from 100 cubic meter per hour (m^3/h) to 5,000 m^3/h with a purity rate of 99.999%. Hydrogen-making process from coke oven gas mainly utilizes PSA technology to separate hydrogen from cold coke oven gas, making the hydrogen to purity of 99.99%. A stable demand for hydrogen is the key for PSA to utilize coke oven gas. With the development of fuel cell and hydrogen vehicles, there is broad prospect for hydrogen-making from coke oven gas. Nevertheless, the economic impact at this moment is not high yet due to the limited market for hydrogen.

40. Alternatively, methanol is the fundamental raw material of many chemical products as well as a new alternate energy resource. The production of methyl ether from methanol to replace liquid petroleum gas (LPG) for residents and gasoline and diesel with methanol fuel has become the trend of development. During 2006–2009, a series of policies issued by the PRC Government attracted vast amounts of investment for the manufacturing of methanol production equipment, including methanol-making from coke oven gas, resulting in the excessive production of methanol. In 2010, the methanol production capacity was nearly 38 million tons and the methanol consumption was 20.92 million tons, leading to methanol capacity utilization rate of only 55%. Many of methanol production equipment were commissioned into operation after 2010. The excessive production of methanol will exist for the foreseeable future.

41. Thus, judging from the current market, the use of coke oven gas to produce LNG is the best available choice and enjoys broader development prospects. LNG production with coke oven gas has lower cost and higher energy efficiency comparing to LNG from the gas fields due to the following reasons: (i) the transportation cost of LNG from coke oven gas is lower due to closer distance from coking plants to the market; (ii) the price of coke oven gas is lower than that of natural gas, so LNG from coke oven gas is more competitive in price; (iii) although there is a large amount of hydrogen and nitrogen in the feeding gas, most of the hydrogen is extracted before liquefaction without going through methanol low temperature gas separation, so the LNG production efficiency is relatively low. If mixed refrigerant cycle (MRC) is applied, the efficiency will be further reduced; and (iv) in addition, the hydrogen in this process is recycled and reused, so that the overall LNG production efficiency is reduced. In recent years, the PRC started to strongly promote energy conservation and emission reduction and greatly encourages comprehensive application of coke oven gas. On 30 July 2007, National Development and Reform Commission officially issued Policies on the Utilization of Natural Gas, clearly stating that "it is prohibited to construct LNG project with natural gas produced from large or medium gas field," which restricts the construction of LNG stations and lessens market competitiveness.

C. Key Project Features

42. LNG is natural gas in liquid form that has been pre-processed by the removal of impurities such as heavy hydrocarbon, sulphide, carbon dioxide and water, etc., and converted to liquid at close to atmospheric pressure by cooling it to approximately −162°C. It only takes up to 1/625 of the volume of natural gas in the gaseous form. The liquefaction of natural gas can greatly save storage space and cost, enable more flexible transportation and improve the combustion performance. LNG has higher energy density than compressed natural gas (CNG). For the same volume of cylinder, the storage capacity of LNG is more than 2.8 times higher than that of CNG, making the LNG vehicles travel longer distance. The production of 1 m^3 of natural gas will consume about 2.35 m^3 of coke oven gas; the production of 1 ton of LNG (heating value of 35.16 megajoule per normal cubic meter [MJ/Nm^3]) and by-production of 1,600 m^3 purge gas (heating value of 10.32 MJ/Nm^3) will consume about 3,200 m^3 coke oven gas.

43. There are three processing options for making LNG from coke oven gas:

i) Option 1: only separate methane from coke oven gas. This option is simple with a small amount of investment but low LNG yield;
ii) Option 2: separate methane and hydrogen from coke oven gas. This option has a better economic performance if hydrogen market is good; and
iii) Option 3: add a methanation process to convert CO and CO_2 into methane. This option needs a large amount of capital expenditure but with high LNG yield.

44. Liheng proposes to adopt option 3, the methanation process, to produce more LNG as shown in **Figure 1**, and detailed information is presented in the following paragraphs. Methanation is a mature technology that is a common section of ammonia production process.

Figure 1: LNG Production Flow from Coke Oven Gas

45. **Purification**. The coke oven gas from coking plant contains several kinds of impurities,

among which the contents of benzene and naphthalene are especially higher, about 3,000 mg/Nm^3 and 300 mg/Nm^3, respectively. These two impurities need to be removed from the gas to avoid harm to the separation process in downstream. Adsorption method will be used to remove benzene, naphthalene and tar in the following processes: (i) first, it will use adsorbent to adsorb heavy contents such as benzene, naphthalene, and tar in low pressure and temperature, and (ii) then the adsorbent will be stripped and recycled in high temperature and low pressure. In this way, the adsorbent is recycled and hazardous gas is separated. Therefore, catalyst for later process is protected from contamination, and equipment like pipeline and chiller are protected from being blocked by the crystallization of naphthalene after the pressure rises. Meanwhile, there are various sulphides in coke oven gas that are very toxic to the methanation catalyst. So sulphides will be removed from the coke oven gas before the coke oven gas enters methanation reactor. Generally, wet desulfurization–fine dry desulfurization process will be utilized for gases containing organic sulfur and complex non-organic sulfur. The application of wet desulfurization is mainly to reduce the cost (operation cost and desulfurization cost) of fine dry desulfurization. With proper desulphurization, the total sulfur in coke oven gas after purification can be as low as 0.1 parts per million (ppm) and can meet methanation treatment standards.

46. **Methanation**. The core reaction in the natural gas production from coke oven gas is CO and CO_2 hydrogenated methanation. The CO and CO_2 contents in the purified coke oven gas are normally 7%~11%. By using the methanation reaction, the CO and CO_2 contents can be decreased to an appropriate level. The chemical reactions of methanation are:

$$CO + 3H_2 \rightarrow CH_4 + H_2O$$

$$CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$$

47. **Separation**. The unwanted hydrogen is separated after methanation. Currently, the prevailing hydrogen separation technologies are mainly PSA and membrane separation. The adsorption of hydrogen is far lower than other components, so PSA is widely applied in hydrogen purification and recycling field. PSA has the advantages of low capex, low operation cost, easy operation, high flexibility and free of environmental pollution. The separated hydrogen is partly used for methanation reaction; the rest could be directly used in hydrogen boiler or sold as products.

48. **Cryogenic liquefaction**. The gas converts to liquid below the temperature of -162°C and normal pressure to form LNG.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Location

49. The subproject will be implemented in the 10-million-ton Steel Recycling Industrial Park of Gaoxian Town, Quwo County, located south of Linfen, a prefecture-level city (**Figure 2**). Linfen is located in the southwestern part of Shanxi, on the lower reaches of the Fen River, bounded by Changzhi and Jincheng to the east, the Yellow River to the west (which also forms the border with Shaanxi), Jinzhong and Lüliang to the north, and Yuncheng to the south. The prefecture ranges in latitude from 35°23'N to 36 37'N, spanning 170 kilometers, and in longitude from 110°22'E to 112°34'E, spanning 200 km.

Figure 2: Subproject site location

Source: https://en.wikipedia.org/wiki/China

B. Shanxi Province Overview

50. Shanxi Province is located in north-central PRC, and borders Hebei Province to the east, Henan Province to the south, Shaanxi Province to the west, and Inner Mongolia to the north. The capital of the province is Taiyuan.

51. Shanxi Province has an area of 156,000 km^2, equivalent to 1.6% of the size of the PRC. Most of the province is part of the Loess Plateau, with the higher ground of Taihang Mountains to

the east and the Lvliang Mountains to the west, and a series of broad flatter valleys and basins in the center through which the Fen River runs (**Figure 3**). The highest peak is Mount Wutai (Wutai Shan) in northeastern Shanxi at an altitude of 3,058 masl. The Great Wall of China forms most of the northern border with Inner Mongolia. The Zhongtiao Mountains run along part of the southern border and separates Shanxi from the east-west part of the Yellow River. Mount Hua is to the southwest.

Figure 3: Shanxi Province in China

Source: https://en.wikipedia.org/wiki/Shanxi

52. Shanxi Province is divided into 11 prefecture-level cities (**Figure 4**). The 11 prefecture-level divisions of Shanxi are subdivided into 119 county-level divisions (23 districts, 11 county-level cities, and 85 counties). Those are in turn divided into 1388 township-level divisions (561 towns, 634 townships, and 193 subdistricts).

Figure 4: Map of Shanxi Province administrative divisions

Source: http://d-maps.com

53. The Yellow River forms the western border of Shaanxi Province. The Fen and Qin rivers, tributaries of the Yellow River, run north-to-south through the province, and drain much of its area. The north of the province is drained by tributaries of the Hai River, such as the Sanggan and Hutuo rivers.

54. Shanxi has a temperate continental semi-arid climate (designation Bsk in the Köppen climate classification system). Winters are long, dry and cold, and average January temperatures are below 0°C. Summers are warm and relatively humid, and average July temperatures are between 21°C to 26°C. Spring is extremely dry and prone to dust storms. Shanxi is one of the sunnier parts of the PRC, and early summer heat waves are common. Annual precipitation averages around 350–700 mm, with 60% of it concentrated between June and August.

55. Shanxi is rich in energy and metal resources, particularly coal and aluminum. Proven coal reserves spread over more than 90 counties amount to 300 billion tons, one-third of the proven reserves in the PRC. The industries in the province are predominantly related to the mining of coal and metals, coking and metallurgy, and cause considerable air, water, and soil pollution.

56. Shanxi has a population of 36.8 million (2016) of whom 54% are rural. It is a comparatively underdeveloped province and its nominal GDP in 2016 was CNY1,292.8 billion, ranked 24th in the PRC. Its per-capita GDP was CNY35,130.

C. Site Physical Resources

57. **Linfen City.** Linfen is a prefecture-level city in southwestern Shanxi province, on the lower reaches of the Fen River, bounded by Changzhi and Jincheng to the east, the Yellow River to the west (which also forms the border with Shaanxi), Jinzhong and Lüliang to the north, and Yuncheng to the south. The prefecture ranges in latitude from 35°23' N to 36°37' N, spanning 170 km, and in longitude from 110°22'E to 112°34'E, spanning 200 km.

58. **Geology and Topography.** Linfen County topography is low-lying from east to west. Its east, north and south are surrounded by mountains, including the Buddha Mountain in the east, Ta'er Mountain and Heshangwengdui Mountain in the north, Xiang Mountain, Li Mountain and Wangyue Mountain in the south, and belonging to Zhongtiao mountain range. Its middle and west are flat. Loess hills are widely distributed in the transition zone from mountainous region to rivers. The elevation in most areas is 500–1,500 m above sea level.

59. Linfen has a total area of 20,275 km^2, covers 13% of the province's area. Within its borders Linfen City has a variety of topographical features. It is characterized as having a "U" shape, with its mountains, covering 29.2% of the prefectural area, on all four cardinal directions, a basin, the Linfen Basin, covering 19.4%, in the middle, and intervening hills, covering 51.4%, in between. In the east, from north to south, there are Mount Huo and the Zhongtiao Mountains; in the west there are the Lüliang Mountains, with elevations mostly above 1,000 m. The highest point in the prefecture is the main peak of Mount Huo, at 2,347 m, and the lowest is in Xiangning County, at 385 m. The subproject site is located near the urban core of Gaoxian Town and topography in this area is generally flat (**Figure 5**)

Figure 5: Linfen topography

Source: Google map, 2017

60. **Meteorology and Climate.** Linfen has a continental, monsoon-influenced semi-arid climate (Köppen BSk), with moderately cold, but dry winters, and hot, somewhat humid summers. The monthly 24-hour average temperature ranges from −2.7°C in January to 26.1°C in July, and the annual mean is 12.6°C. The annual precipitation is 470 mm, with almost 70% of this total precipitation occurring from June to September. Extreme temperatures range from −22.5°C to 40.5°C.

Table 13: Average Climatic conditions in Linfen (1971–2000)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C	13.8	21.5	28.8	35	38.4	39.7	40.5	39.2	38.4	32.5	25	15.5	40.5
Average high °C	4	7.8	13.8	21.4	26.9	31.3	32	30.6	25.8	19.7	11.8	5.3	19.2
Daily mean °C	−2.7	1	7	14.3	19.7	24.4	26.1	24.8	19.4	12.8	5	−1.1	12.6
Average low °C	−8.2	−4.5	1.2	7.7	12.7	17.9	21.2	20.2	14.3	7.3	−0.3	−6.1	7
Record low °C	−22.5	−23.1	−10	−5	1.3	8.5	14.7	10.7	2.3	−5	−12.8	−17.6	−23.1
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Average precipitation mm	3.3	5.4	16.8	26.2	37.2	55.2	119.2	91.1	57	36.8	15.6	4.7	468.5
Average precipitation days (≥ 0.1 mm)	2.2	2.8	4.6	5.6	6.4	8.8	12	10	8.6	6.4	3.8	2	73.2

Source: https://en.wikipedia.org/wiki/Linfen

61. **Frost-free Days.** There is an average of 215 frost free days per year. The first frost typically occurs in the first 10 days of November, and the frost typically ends in the first 10 days of March.

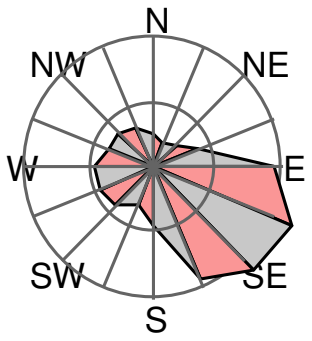
62. **Wind.** The Linfen city has a continental monsoon climate. The dominant wind direction of the area is East-Southeast, accounting for 11.4% of the total windy days per year (based on data from 1994–2013) and the secondary wind direction is east, accounting for 9.3%. Annual average wind speed is 1.6 m/s.

Table 14: Wind data from 1994–2013

Wind direction	N	NNE	NE	ENE	E	ESE	SE	SSE	S
Frequency	2.5	2	2.4	3.7	9.3	11.4	11	9.3	4.5
Wind direction	SSW	SW	WSW	W	WNW	NW	NNW	Calm wind	
Frequency	3.1	4.1	4.4	4.6	3.7	3.8	3.3	16.9	

E = East, N = North, S = South, W = West.
Source: FSR.

Figure 6: Wind rose of Linfen (1994–2013)



Source: FSR

63. **Water Resources.** Annual average water resource in Linfen is 1.52 billion. The per capita water resource is only 350 m^3.

64. **Ground Water Resources.** The city is located in mountainous plateau hydro- geological unit under semi-humid climate conditions, with droughts in 9 out of 10 years. The territory is undulating terrain and middle low-laying to form Hui River Valley. Main source of groundwater is meteoric water. The chemical composition of groundwater is more bicarbonate water. In the middle of the low-lying areas, mostly is sulfate water. Groundwater mineralization degree is high, up to 6 gram per liter (g/L). The depths of groundwater range from 20 m to 180 m depending on different hydrogeologic conditions. Water yield of a single well is 5–80 cubic meter per hour (m^3/h).

D. Environmental Monitoring

65. Because the domestic EIA is still under preparation at the time of this IEE preparation, environmental quality assessment of the subproject site was undertaken by PPTA consultant.

1. Air Quality Monitoring

66. Air quality monitoring data from Linfen EPB air quality monitoring station was collected over a 7 day- period in early April 2017. Monitoring was undertaken for a minimum of 18 hours per day, allowing 24 hour averaging periods for SO_2, NO_2, $PM_{2.5}$, and PM_{10}. The results are presented in **Table 15**. The data show that all parameters except 24-hr mean $PM_{2.5}$ from April 7 to April 8 were in compliance with Class II of *Ambient Air Quality Standards (*GB3095-2012).

Table 15: Air quality monitoring results (ug/m^3)

Date	24-hr mean PM_{10}	24-hr mean $PM_{2.5}$	24-hr mean SO_2	24-hr mean NO_2
April 2, 2017	101	52	45	44
April 3, 2017	109	58	76	41
April 4, 2017	94	62	28	29
April 5, 2017	101	63	72	29
April 6, 2017	127	77	40	30
April 7, 2017	140	86	23	29
April 8, 2017	130	79	20	34
Standard	**150**	**75**	**150**	**80**

NO_2 = nitrogen dioxide, $PM_{2.5}$ = particulate matter with diameter less than 2.5 micrometers, PM_{10} = particulate matter with diameter less than 10 micrometers, SO_2 = sulphur dioxide, ug/m^3 = microgram per cubic meter.
Source: Linfen EPB

2. Surface Water

67. The surface water body near the subproject site is Fen River (**Figure 7**), which is about 4.5 km away from the subproject site.

Figure 7: Surface water near the subproject site

Source: Google map, 2017

68. Based on information from internet,[4] surface water quality of Fen River in Linfen city can meet the Class III of Environmental Quality Standards for Surface Water (GB 3838-2002). Because Class IV water quality standard is applicable for Fen River in Linfen City and Class III is more stringent than Class IV, thus water quality of Fen River in Linfen City is in compliance with the standard.

69. It is noted that surface water quality monitoring of Fen River will be undertaken during the preparation process of domestic EIA.

3. Groundwater

70. Groundwater monitoring data was obtained from Gaoxian Village which is 2 km away from the subproject site (

71. **Figure** 8). Groundwater in Gaoxian Village should meet Class III criteria of GB/T14848-93, and the results indicate that the groundwater quality is not compliance with the standard (**Table**).

Table 16: Groundwater monitoring data

Item	Unit	Limit	July 2014	October 2014	April 2015
pH		6.5–8.5	7.68	7.56	7.66
Total hardness	mg/L	450	820.5	759.63	1861.7
Total dissolved solids	mg/L	1000	2105	1964	4270

[4] http://lf.sxgov.cn/content/2015-11/14/content_6442637.htm

Sulfate	mg/L	250	604.6	593.6	2227
Fluoride	mg/L	1	3	2.96	3.44
Chloride	mg/L	250	138.6	111	412
Ammonia nitrogen	mg/L	0.2	0.04	ND	0.23
Arsenic	µg/L	50	22	0.6	1
Volatile Penol	mg/L	0.002	ND	ND	ND
Nitrate nitrogen	mg/L	20	6.58	4.29	ND
Nitrite nitrogen	mg/L	0.02	0.01	0.01	0.05
Item	**Unit**	**Limit**	**July 2014**	**October 2014**	**April 2015**
Permanganate index	mg/L	3	2.9	2.2	1.5
Total mercury	µg/L	1	ND	0.2	0.1
Lead	µg/L	50	ND	ND	ND
Cadmium	µg/L	10	ND	ND	7
Copper	µg/L	50	ND	ND	ND
Iron	mg/L	0.3	0.031	0.3	0.125
Chromium VI	mg/L	0.05	0.022	0.012	ND
Total coliform	Unit/L	3	1130	1300	230

mg/L = milligram per liter, ND = not determined, pH = potential of hydrogen, µg/L = microgram per liter,
Source: Subborrower
Note: Shading denotes a standard exceedance.

Figure 8: Groundwater monitoring point

Source: PPTA consultant

4. Noise

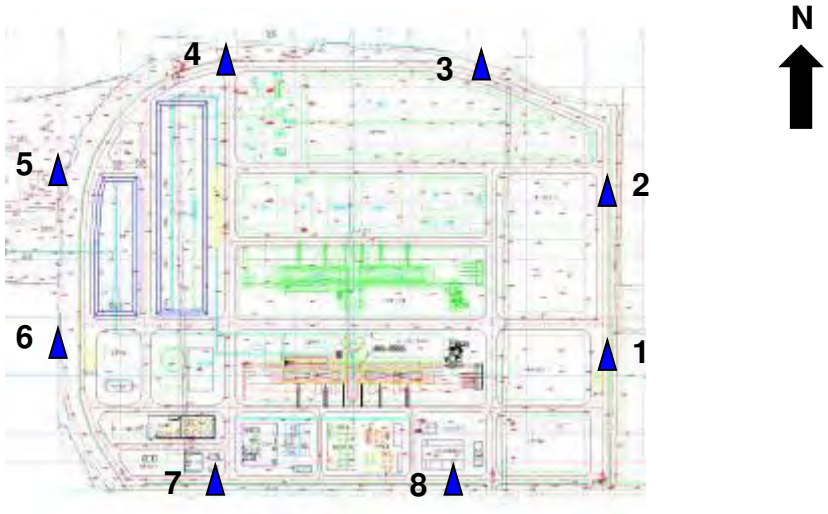
72. Liheng provided noise quality monitoring data (November 16, 2014) at the coking plant site boundaries. Monitoring points are presented in Figure 9. **Table** 17 presents the monitoring data. The data shows that all the monitoring data is compliance with relevant standard: Class II of Emission standard for industrial enterprises noise at boundary (GB 12348-2008).

Table 17: Noise Monitoring Results

No	Daytime dB(A)	Nighttime dB(A)
1	52.2	47.7
2	52.6	47.8
3	49.9	46.1
4	49.8	45.1
5	49.9	46.7
6	51.3	45.4
7	50.7	47.0
8	51.9	47.5
Standard	**60**	**50**

dB(a) = A-weighted decibels.
Source: Subborrower

Figure 9: Noise monitoring points at the coking plant boundaries



Source: Subborrower

73. It is noted that noise monitoring at the site boundaries will be undertaken during the preparation process of domestic EIA.

E. Ecological Resources

74. Based on site survey undertaken during the preparation of the IEE, there are no known

ecological and/or sensitive resources near subproject site.

1. Flora and Fauna

75. The original vegetation of Linfen City is classified as temperate deciduous broad-leaved forest by the Vegetation Regionalization of China (1980). Due to human activities, the original vegetation has been replaced by secondary vegetation. Common shrub species include Vitex negundol and Zizyphus jujube. Cultivated trees along the river banks, roads and villages include Sophora japonica, Anthus altissima, Salix matsudana, Populus tomentosa, Robinia pseudoacacia, Ulmus pumila, and Morus alba. Lands along the river support maize, rape, potato and beans and planted trees. Weeds include Imperata cylindrica var, major, Setaria viridis, Xanthium sibiricum, Artemisia argyi, Tribulus terrestris, Vitex negundo, Humulus scandens, and Plantago asiatica.

2. Flora and Fauna at the Subproject Site

76. The subproject site is located in the existing Liheng coking plant which is highly developed and modified industrial environments. Surrounding land use is industrial land with little or no vegetation cover (**Figure 8**). There are no known rare or endangered flora or fauna, parks, nature reserves or areas with special national, regional or local ecological significance within or adjacent to the Subproject site.

Figure 8: Subproject site conditions

(i) Northern part of subproject site

(ii) Western part of subproject site

(iii) South of subproject site

3. Parks and Protected Areas

77. There are no parks or protected areas in or near subproject site.

4. Sensitive Receptors

78. Sensitive locations for air quality, surface water and noise impacts in the subproject site were determined utilizing remote sensing and ground surveys. **Table 18** and **Figure 9** present sensitive areas (air quality and noise).

Table 18: Sensitive areas (air quality, noise and surface water)

Sensitivity	Area	Direction	Distance (m)	Function	Standard
Air quality	Gaoxian Village	NW	1,400	Residential Area	Category II
	Xishangguan Village	SW	1,500	Residential Area	Category II
Noise	Gaoxian Village	NW	1,400	Residential Area	Category II
	Xishangguan Village	SW	1,500	Residential Area	Category II
Surfacewater	Taizi Lake	SE	1,880	Landscape	Category V

m = meter.

Figure 9: Sensitive areas near the subproject site

F. Socio-economic and Cultural Resources

79. Linfen is a prefecture-level city and is divided in one district, two cities and fourteen counties (**Figure 10**) with a total area of 8,629 km^2. Its population was 4,458,048 at the end of 2016 (**Table**).

Figure 10: Map of Linfen City administrative divisions

1-Yaodu district; 2-Houma City; 3-Huozhuo City; 4-Quwo County; 5-Yicheng County; 6-Xiangfen County; 7-Hongtong County; 8-Gu County; 9-Anze County; 10- Fushan County; 11- Ji County; 12-Xiangning County; 13-Pu County; 14-Daning County; 15-Yonghe County; 16-Xi County; 17-Fenxi County.
Source: https://en.wikipedia.org/wiki/Linfen

Table 19: Data on Linfen City administrative divisions

Subdivision	Land Area (km^2)	Population (2015)	Population Density (persons/km^2)
Yaodu	1,316	971,438	738
Houma	274	246,571	900
Huozhuo	765	290,249	379
Quwo	438	244,106	557
Yicheng	1,163	319,150	274
Xiangfen	1,304	455,935	350
Hongtong	1,563	752,012	481
Gu	1,193	94,660	79
Anze	1,965	84,404	43
Fushan	946	130,246	138
Ji	1,777	109,351	62

Subdivision	Land Area (km^2)	Population (2015)	Population Density (persons/km^2)
Xiangning	2,029	240,057	118
Pu	1,508	110,385	73
Daning	967	66,371	69
Yonghe	1,219	65,356	54
Xi	1,415	106,744	75
Fenxi	880	148,618	169

km^2 = square kilometer.
Source: Linfen Statistical Bureau, 2016

80. There are 28 ethnicities including Hui, Mongolian, and Manchu. Ethnic minorities account for 0.2% and the rest is Han ethnicity. None of the ethnic groups will be affected by the subproject implementation.

1. Economy

81. Linfen is known for its rich mineral resources, which include coal, iron ore, copper, and lead. The coal reserves in Hedong Coal Field, Huoxi Coal Field, and Qinshui Coal Field, amount to 62.9 billion tons. The iron ore reserve in the city is over 420 million tons. Coal mining and dressing, coking, metallurgy, non-ferrous metal smelting, and chemicals are the principal industries.

82. Linfen is the fourth largest economy in Shanxi, after the provincial capital city Taiyuan, Changzhi and Yuncheng. In 2016, the city's GDP was CNY120.52 billion, of which the primary sector accounted for 8.0% or CNY9.64 billion; the secondary sector accounted for 46.5% or CNY56. 04 billion; and the tertiary sector accounted for 45.5% or CNY54.84 billion.

2. Transportation

83. The city has convenient access to railways. The Houma-Xi'an Railway and the Houma-Yueshan Railway, both of which are part of the Europe-Asia Land Bridge, go through the city, linking the city with other major cities along the land bridge. The Datong-Xi'an Railway and Datong-Puzhou Railway, running across Linfen, connect the city with the major cities in Shanxi Province and Xi'an, the capital city of Shaanxi Province.

3. Physical Cultural Resources

84. As one of the originating places of the Chinese nation, Linfen's history can be traced back to over 100,000 years ago, when human settlers began living in this territory. During the Shang Dynasty (1600–1100 BC), Linfen was part of Jizhou. During the Spring-and-Autumn Period, the region was under the control of Jin State. During the Qin Dynasty (221–206 BC), Hedong Shire administrated the territory. During the 15th century, the region developed into an important commercial center.

85. Linfen is rich in cultural and historical sites, such Ding Village Ruins, Guangsheng Temple, Hongtong Grand Pagoda Tree, the Ancient City of Jin Kingdom and the Yao Temple. However, all subproject activities are in the existing Liheng premises. There are no known physical cultural

resources (PCRs) in subproject site.[5]

[5] PCRs are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings and may be above or below ground or under water. Their cultural interest may be at the local, provincial, national, or international level. Within the Project area these could include:

(i) Funeral site: graves, cemeteries, shrines, stupas;
(ii) Religious buildings: Temples or Pagodas, complete or ruins;
(iii) Religious objects: Buddhist images or sculpture;
(iv) Sacred sites: sacred caves, forest, hills or cliffs;
(v) Historical sites or objects: artifacts, tools, relics, memorials; and
(vi) Spirit sites: sites residents believe are occupied by a spirit (house, tree, stone, etc.).

V. ANTICIPATED IMPACTS AND MITIGATION MEASURES

86. Anticipated positive and negative environmental impacts of the proposed subproject were assessed based on the FSR (2017); a technical due diligence review of the FSR undertaken by ADB PPTA specialists; public consultations led by the subborrower and assisted by ADB PPTA consultants; and site visits, surveys and consultations undertaken by ADB PPTA consultants.

87. Environmental impacts during pre-construction, construction and operation phases were each considered separately. The results of the assessment indicate that during the pre-construction phase issues are very limited, and are mostly associated with ensuring appropriate incorporation of mitigation measures into the subproject design.

88. Potential negative environmental impacts during construction phase are short-term and localized, and are associated with soil erosion, construction noise, fugitive dust, disruption of traffic and community services, and risks to worker health and safety. Potential negative impacts during operation phase are associated with boiler emissions, waste and wastewater, noise, and health and safety risks to workers.

89. Potential positive operation phase impacts are significant and long-term, and are associated with providing clean fuel for transportation sector and emissions reductions from gasoline replacement.

A. Pre-Construction Phase Measures to be Implemented During Detailed Design

1. Siting and Land Acquisition

90. Because the subproject is located in existing coking plant, the subproject will not result in any involuntary land acquisition, resettlement or physical displacement, and there will be no loss of personal property, structures, crops, trees or other assets. There are also no potential adverse impacts on disadvantaged or vulnerable groups, including the poor, women and children, and Indigenous Peoples.

2. Mitigation Measures and Monitoring during Detailed Design

91. Mitigation measures to be adopted during detailed design to minimize the environmental impacts are as follows:

(i) **Detailed Design.** Environmental mitigation measures included in this IEE, EMP, and domestic EIA will be incorporated into the detailed design.

(ii) **Bidding Documents and Contracts.** Environmental mitigation measures included in this IEE, EMP, and domestic EIA will be included in contracts for civil works and equipment installations. All contractors will be required to strictly comply with the EMP.

(iii) **Environmental monitoring.** The environmental monitoring program (EMoP, see **Table 3** in **Appendix I**) will be incorporated into the design to ensure that environmental impacts are closely monitored and activities of the project construction and operating are closely supervised against the PRC environmental laws, regulations and standards, ADB SPS, project EMP, and approved domestic EIA.

3. Grievance Redress Mechanism

92. In accordance with the Grievance Redress Mechanism (GRM) presented in Chapter VIII of this IEE, a staff member from the subborrower will be assigned overall responsibility for the GRM; GRM training will be provided to subborrower and GRM access points; and the GRM access point phone numbers, fax numbers, addresses, and emails will be disclosed to the public.

4. Training and Capacity Building

93. An institutional strengthening and training program will be delivered by environmental consultants and experts (see **Table 4** in **Appendix I**). The training will focus on ADB's and the PRC's environmental, health and safety laws, regulations and policies; implementation of the EMoP; the GRM; and international good EHS practices. Training will be provided to the subborrower, relevant staff, contractors, and the construction supervision company personnel.

5. Permits

94. All necessary construction permits will be obtained from the relevant authorities.

B. Anticipated Construction Phase Impacts and Mitigation Measures

1. Erosion and Spoil

95. Construction activities such as land leveling, excavation and filling activities may lead to surface erosion. The most vulnerable soil erosion areas in the construction site include excavation sites, leveling sites, spoil sites, temporary construction sites, and other areas where surface soil is disturbed. Soil erosion can also occur after the completion of construction if site restoration is inadequate. Finally, construction activities may generate surplus spoil.

96. These impacts can be mitigated through typical good construction practice, erosion control, and site maintenance:

(i) At construction site the potential for storm water runoff will be assessed and appropriate storm water drainage systems to minimize soil erosion will be implemented, including perimeter bunds and establishment of temporary detention and settling ponds to control topsoil runoff;
(ii) Land excavation and filling will be balanced so as minimize the requirement for fill transportation;
(iii) During earthworks, the area of soil exposed to potential erosion at any one time will be minimized through good project and construction management;
(iv) Spoils will be reused on-site to the maximum extent feasible as fill. Temporary spoil storage sites will be identified, designed, and operated to minimize impacts. Spoil sites will be restored at the conclusion of storage activities. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site;
(v) Spoils and aggregate piles will be covered with landscape material and/or regularly watered;
(vi) Waste construction material such as residual concrete, bricks, etc., will be used for backfill at the sites to the maximum extent feasible;
(vii) Construction and material handling activities will be limited or halted during periods of rains and high winds;
(viii) Any planned paving or vegetating of areas will be done as soon as practical after the materials are removed to protect and stabilize the soil; and

(ix) Once construction is complete, disturbed surfaces will be properly sloped and planted with native trees and grass.

2. Wastewater

97. Inappropriate disposal of domestic wastewater (from construction workers) or construction wastewater (from drainage of excavation and drilling, washing aggregates, washing construction equipment and vehicles, pouring and curing concrete, and oil-containing wastewater from machinery repairs) may cause soil, surface and/or groundwater resources contamination.

98. These impacts can be mitigated through typical good wastewater management practices:

(i) Existing sanitary facilities and toilets in the coking plant will be provided for construction workers. Domestic wastewater will be treated in existing wastewater treatment plant of the coking plant, then discharged to municipal sewer;

(ii) Construction wastewater will be directed to temporary detention and settling ponds. Areas where construction equipment is being washed will be equipped with water collection basins and sediment traps. After settling, supernatant will be recycled and sediment will be periodically excavated, and either reused if possible as fill, disposed at official spoil disposal sites, or disposed at official or landfills; and

(iii) Maintenance of construction equipment and vehicles will not be allowed on site so as to reduce wastewater generation.

3. Air Pollution

99. Anticipated sources of air pollution from construction activities include: (i) dust generated from earth excavation, filling, loading, hauling and unloading; (ii) dust generated from disturbed and uncovered construction areas, especially on windy days; (iii) dust generated from construction material storage areas, especially on windy days; (iv) dust generated by the movement of vehicles and heavy machinery on unpaved access and haul roads; (v) dust generated from aggregate preparation and concrete-mixing; and (vi) emissions from construction vehicles (gaseous CO and NO_2) and heavy diesel machinery and equipment.

100. To reduce air quality impacts during the construction period, the following air quality management measures will be implemented:

(i) Project site under construction will be fully enclosed by a fence prior to the commencement of construction;

(ii) Water will be sprayed on active construction sites including where fugitive dust is being generated on a daily basis, and more frequently during windy days;

(iii) All construction piles (spoil, aggregate other construction materials) with the potential to generate dust will be covered and/or regularly watered;

(iv) Construction activities will be halted during high wind events. Once construction is completed, disturbed surfaces will be properly sloped and planted with native trees and grass;

(v) Transport vehicles will be limited to low speeds in construction sites;

(vi) Loads will be covered during truck transportation to avoid spillage or fugitive dust generation. Fine materials will be transported in fully contained trucks;

(vii) Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds; and

(viii) Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical.

4. Noise Impacts

101. During the construction phase noise and vibration will be generated by on site construction activities using heavy equipment such as bulldozers, excavators, and by the transport of construction materials. Construction equipment is considered a point noise source, and the predictive model is as follows:

$$L_i = L_0 - 20\lg\frac{R_i}{R_0} - \Delta L$$

(a)

(b) Where, L_i and L_0 are equipment noise sound levels at R_i and R_0, respectively, ΔL is additional decrement produced by barriers, vegetation and air.

102. For the impact of multiple construction machines on a location, sound level superposition uses the following formula:

$$L = 10\lg\Sigma 10^{0.1\times L_i}$$

103. A significant increase in localized noise is expected during construction. Construction activities will involve excavators, bulldozers, concrete-mixing plants, loaders, graders, rollers, and other heavy machinery, as well as noise from goods and material transportation. Noise during construction will be generated from construction activities.

104. The construction phase can be divided into four stages: earthworks, foundation construction, structure construction and final finishing:

- The main noise sources during the earthwork stage will be non-directive mobile sources including excavators, bulldozers, loaders and transport vehicles.
- The main noise sources during foundation construction stage will be stationary, including pile machines, land levelers, etc. Although the foundation construction phase period is short, predicted noise levels are high, ranging from 95-105 dB(A).
- The structure construction stage is the longest period in the construction phase. There are a variety of noise sources in this phase including concrete mixers, heavy equipment, cranes, etc.
- The final finishing stage is also lengthy. Main noise sources include electrical saws, drills, cutting machines etc. Noise levels from these noise sources range from 85–95 dB(A) and are short in duration.
- Materials and equipment transport can occur in all four phases.

105. These noise impacts will occur in mostly inhabited urban areas. Though noise levels may be high, the impacts will be temporary and localized, and can be further mitigated.

106. To ensure construction activities meet PRC noise standards and to protect workers and adjacent residents which is about 500 m away from the subproject site, the following mitigation measures will be implemented:

(i) Construction activities, and particularly noisy ones, are to be limited to reasonable hours during the day and early evening. Construction activities will be strictly prohibited during the nighttime (22:00 h to 07:00 h). Exceptions will only be allowed in special cases, and only after getting approval of the surrounding residents, local EPB, and other relevant departments.

(ii) When undertaking construction planning, simultaneous high-noise activities will be avoided, and high noise activities will be scheduled during the day rather than evening. Similarly, construction sites will be planned to avoid multiple high noise activities or equipment from operating at the same location.
(iii) Low-noise equipment will be selected as much as possible. Equipment and machinery will be equipped with mufflers and will be properly maintained to minimize noise.
(iv) Noise personnel protective equipment (PPE) will be provided to workers.
(v) Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and high traffic times.
(vi) Vehicles transporting construction materials or waste will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools, and hospitals.

5. Solid Waste

107. Solid waste generated in the construction phase include construction and domestic waste. Construction wastes include fill, various building materials such as steel, timbers, rubble, and other types of waste. An estimated of 0.5 kg/day per worker of domestic waste will be generated from construction workers and 2.0 kg/m^2 construction waste will be generated from construction activities. Inappropriate waste storage and disposal could affect soil, groundwater, and surface water resources, and hence, public health and sanitation.

108. The following solid waste management measure will be implemented:
(i) Wastes will be reused or recycled to the extent possible. Waste construction material such as residual concrete, bricks will be used for backfill at the sites;
(ii) Littering by workers will be prohibited;
(iii) Existing domestic waste containers will be used for domestic waste collection. Domestic waste will be collected on a regular basis by the local sanitation departments and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements;
(iv) Construction waste dumpsters will be provided at all work sites. Construction waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements;
(v) Excavated soil will be backfilled onsite to the extent possible. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site;
(vi) There should be no final waste disposal on site. Waste burning or incineration at or near the site is strictly prohibited; and
(vii) Contractors will be held responsible for proper removal and disposal of any significant residual materials, wastes, and contaminated soils that remain on the site after construction.

6. Hazardous and Polluting Materials

109. Inappropriate transportation, storage, use and spills of petroleum products and hazardous materials can cause soil, surface and groundwater contamination. To prevent this, the following mitigation measures will be implemented:
(i) A hazardous material handling and disposal protocol that includes spill emergency response will be prepared and implemented by contractors;

(ii) Existing storage facilities for fuels, oil, chemicals and other hazardous materials in coking plant will be used. All the storage facilities should be within secured areas on impermeable surfaces provided with dikes, and at least 300 m from drainage structures;
(iii) Signs will be placed at chemicals and hazardous materials storage sites to provide information on type and name of chemicals and hazardous materials;
(iv) Suppliers of chemicals and hazardous materials must hold proper licenses and follow all relevant protocols and PRC regulations and requirements; and
(v) A Shanxi EPB certificated company (the company list can be found in http://www.sxhb.gov.cn/cmsContent.action?articleId=51ee433a-60d9-495e-97a5-7302cc34c7c7) will be hired to collect, transport, and dispose of hazardous materials in accordance with relevant PRC regulations and requirements.

7. Impacts to Flora and Fauna

110. Typical construction impacts on flora and fauna include removal of vegetation and disruption of the ecosystem during construction. If present, rare or endangered flora or fauna may also be impacted. However, the subproject construction site is located in existing industrial park, which has little or no vegetation cover other than recently established grasses and shrubs. Based on site visits, there is no known rare or endangered flora or fauna, parks, nature reserves or areas with special ecological significance which will be impacted by the subproject. Impacts on flora or fauna are thus expected to be minimal and short-term. Nonetheless, to address potential impacts:

(i) A greening plan will be implemented. Site vegetation plans will be developed at subproject site using appropriate native species; and
(ii) Any existing vegetated areas impacted by the subproject will be restored post-construction using appropriate native species.

8. Impacts on Community Disturbance and Safety

111. Project construction activities have the potential to cause community disturbance such as traffic congestion or delays, and public safety risks from heavy vehicles and machinery traffic. Mitigations will be implemented to address traffic and other community disturbance issues.

(i) Transportation routes and delivery schedules will be planned during the detailed design to avoid densely populated and sensitive areas and rush hours;
(ii) Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools, and hospitals; and
(iii) Signs will be placed at construction sites in clear view of the public, warning people of potential dangers such as moving vehicles. All sites will be made secure, discouraging access by members of the public through appropriate fencing whenever appropriate.

9. Occupational and Community Health and Safety

112. Construction may cause physical hazards to workers and community from noise and vibration, dust, handling heavy materials and equipment, falling objects, work on slippery surfaces, fire hazards, chemical hazards such as toxic fumes and vapors, and others.

113. Contractors will to be required to implement adequate precautions to protect the health and safety of their workers:

(i) Each contractor will implement the relevant construction phase EHS plan;

(ii) Identify and minimize the causes of potential hazards to workers. Implement appropriate safety measures;
(iii) Provide training to workers on occupational health and safety, emergency response, especially with respect to using potentially dangerous equipment and storage, handling and disposal of hazardous waste;
(iv) Ensure that all equipment is maintained in a safe operating condition;
(v) Provide appropriate PPE to workers;
(vi) Implement work practices to limit workers' exposure to high noise or heat working environments in compliance with PRC noise standards for construction sites (GB 12523-2011);
(vii) Ensure regular safety meetings with staff; and
(viii) Ensure that material stockpiles or stacks, such as, pipes are stable and well secured to avoid collapse and possible injury to workers.

10. Physical Culture Resources

114. Based on site visits, there are no known cultural heritage or archaeological sites at or near the subproject site. However, construction activities have the potential to disturb as yet unknown underground cultural relics. To address this issue, a construction phase chance find procedure will be established and activated if any chance finds of physical culture resources (PCRs) are encountered:

(i) construction activities will be immediately suspended if any PCRs are encountered;
(ii) destroying, damaging, defacing, or concealing PCRs will be strictly prohibited in accordance with PRC regulations;
(iii) the local Cultural Heritage Bureau will be promptly informed and consulted; and,
(iv) construction activities will resume only after thorough investigation and with the permission from the local Cultural Heritage Bureau.

C. Anticipated Operation Phase Impacts and Mitigation Measures

115. The subproject may cause some adverse environmental impacts during operation including air pollution from natural gas combustion, noise from subproject operation, use of water, production of wastewater and solid wastes, and fire and safety hazards.

1. Air Pollution

116. The primary emissions to air are from flaring or venting. Flaring or venting is an important safety measure used at LNG facilities to ensure that gas is safely disposed of in the event of an emergency, power or equipment failure, or other plant upset conditions. Flaring or venting will be used only in emergency or plant upset conditions. Continuous venting or flaring of boil-off gas under normal operations is not considered good industry practice and will be avoided. Guidance for good practice with respect to flaring and venting is provided in the EHS Guidelines for Onshore Oil and Gas Development.

117. To minimize emissions and associated impacts, the subproject will implement the follow measures:

(i) Continuous venting of gas is not considered current good practice and will be avoided;
(ii) Exhaust gas of flaring torch will be in compliance with relevant PRC regulation and requirements;
(iii) Operating flare to control odor and visible smoke emissions;

(iv) Locating flare at a safe distance from local communities and the workforce including workforce accommodation units;
(v) Implementation of burner maintenance and replacement programs to ensure continuous maximum flare efficiency; and
(vi) Metering flare gas.

2. Wastewater

118. The subproject will use municipal water as domestic water and production water. Domestic wastewater will be produced from canteens and toilet facilities. Main production water is circulation water for purification, methanation, separation and cryogenic liquefaction process. Municipal water will be demineralized then can be used as circulation water. Production wastewater will include wastewater from methanation process and separation process and demineralization process. The coking plant already has a waste water treatment plant (WWTP).

119. The following measures will be taken to address production and domestic wastewater:

(i) Wastewater from canteen will be treated by oil-separator, and then sent to existing municipal wastewater treatment plant combined with water from toilet facilities.

(ii) Wastewater from demineralization process will be reused or recycled as much as possible. Remain wastewater will be treated in the existing WWTP of the coking plant.

(iii) Wastewater from circulation system will be treated in the WWTP of the industrial park for recycle.

(iv) Wastewater from methanation process and separation process will be treated in the existing WWTP in coking plant, then reused or recycled.

3. Solid Waste

120. The subproject will generate domestic and production waste. Production waste includes waste catalyst from purification and methanation process and waste adsorption material from separation process. If not properly managed this waste can cause visual and environmental impacts. To mitigate this risk, the following measures will be implemented:

(i) Existing domestic waste bins will be used for domestic waste collection and domestic waste will be routinely collected by the local sanitation department for recycling, if possible, or final disposal at an approved waste disposal site;
(ii) No permanent on-site solid waste disposal will be permitted at subproject site;
(iii) No burning of wastes will be permitted at subproject site; and
(iv) Waste catalyst from purification and methanation process and waste adsorption material from separation process will be sent to Shanxi EPB certificated companies (the company list can be found in http://www.sxhb.gov.cn/cmsContent.action?articleId=51ee433a-60d9-495e-97a5-7302cc34c7c7) for treatment. Transportation and treatment should follow the PRC's regulation and requirements.

4. Noise

121. Noise sources during operation will mainly be from noise from pumps, compressors and LNG production equipment. To mitigate noise impacts the subproject will:

(i) Low-noise equipment will be used as far as possible, and noise reduction measures such as noise elimination, vibration absorption, insulated enclosures and sound dampening materials on exterior walls will be implemented;
(ii) All equipment will be properly maintained in order to minimize noise;
(iii) Appropriate noise PPE will be provided to the workers who are likely to be exposed to high noise level environments;
(iv) Layout for LNG production workshop will be reasonable planned to reduce noise; and
(v) Greening plan will be implemented to reduce noise level.

5. Occupational and Community Health and Safety

122. Plant operation poses risks to workers and community. Accidental release of chemicals and hazardous materials may present health and safety risks to workers. Natural gas also presents fire, burn, and explosive hazards.

123. To minimize risks associated with leaks of LNG:
(i) All gas works will be in compliance with relevant PRC building code requirements, including the *Code for Design of City Gas Engineering* (GB 50028-2006) and *Regulation on Electric Apparatus Design for Explosion and Fire Risk Environment* (GB50058-92);
(ii) Project site will be equipped with flammable gas detection, alarm and fire suppression systems. Electrical devices within the explosion risk area will be safely equipped;
(iii) Gas pipelines will be grounded and equipped with anti-lightning devices where applicable; and
(iv) All gas related devices will be brightly colored and equipped with warning signs.

124. To mitigate potential health and safety risks to workers and community, the following measures will be taken:
(i) Operation phase EHS plans including fire prevention and control will be developed and implemented, and workers will be trained regularly on their implementation;
(ii) Gas systems will be designed in strict compliance with relevant PRC fire, health and safety standards. Fire compartments will be established based on the fire risks, and fire-resistant buildings/structures will include fire-proof doors and windows;
(iii) Fire-alarm and suppression systems will be installed and tested regularly to ensure it functions properly;
(iv) PPEs including goggles, gloves, safety shoes, will be provided to workers;
(v) Control measures will be strictly undertaken to ensure the discharge, exhaust and safety relief of flammable fuels in enclosed systems;
(vi) No unauthorized personnel will be allowed into gas-fired facilities; and
(vii) Provide training to workers on occupational health and safety, and emergency response.

6. Emergency Response Plan

125. An emergency risk and response plan applicable to all gas related facilities will be established in accordance with the “National Environmental Emergency Plan” (24 January 2006) and other relevant PRC laws, regulations and standards and will include measures in the World Bank EHS Guidelines with respect to occupational and community health and safety.

D. Anticipated Positive Operation Phase Impacts

126. The project will use 576 million m^3 coke oven gas to produce 180,000 metric tons of LNG which could replace 239.4 million liters of diesel. Comparing to power generation, this project has a higher energy efficiency. Considering the coke oven gas consumption, power consumption and steam recovery, the energy efficiency of coke oven gas to LNG project is 69%, much higher than the 40% of energy efficiency from coke oven to electricity.[6,7] 1,156 GWh electricity will generated from the coke oven gas if no it's no used for LNG production.

127. The emissions from diesel-powered heavy-duty trucks which meet Stage IV emission standard, and natural gas produced from flare are reference cases for the pollutant mitigation calculation is in Table 3. The diesel consumed should meet the standard of GB 19147-2016 Automobile Diesel Fuels Stage IV as well. The emission data of the reference case is listed in Table 1. A study indicates that, in comparison with Stage IV fuel,[8] LNG emission will reduce 72% of HC, 97% of CO, 20% of CO_2, and 100% of SO_2 and PM. The data of energy savings and emission mitigation from the project implementation is listed in **Table 21. Figure 11** illustrates the emission reductions pathways.

128. This subproject adopts a proven and best available technology for coke oven gas utilization and produces 180,000 tons of LNG every year. It will save 100,224 tce of energy and reduce CO_2, SO_2, NO_x, PM, CO, and hydrocarbon/VOCs emission at 580,964.4 tons, 6,912.0 tons, 1,942.04 tons, 48.6 tons, 29.7 tons, and 15.8 tons per annum respectively.

Table 19: Emissions of Reference Cases

	Category	CO	THC	NO_x	PM	SO_2[a]	CO_2[b]
Truck	**Baseline emission factor[c] (g/km)**	2.2	0.129	5.554	0.153	350ppm	--
	Correction factor[d]	0.867	0.521	0.792	0.570	50ppm	
	Emission factor[e] (g/liter)	4.144	0.237	10.850	0.203	0.0859	2,630
	Diesel emission (ton)	992.1	56.7	2,597.4	48.6	20.6	629,622
Power generation	**Emission factor (kg/m^3)**	--	--	0.000215	0	0.0012	0.79
	Coke oven gas emission (ton)[f]	--	--	123.84	0	691.2	455,040
Total reference case emissions		992.1	56.7	2,721.24	48.6	711.80	1,084,662

CO = carbon monoxide, CO_2 = carbon dioxide, g/km = grams per kilometer, g/liter = grams per liter, kg/m = kilograms per cubic meter, NO_x = nitrogen oxide, PM = particulate matter, ppm = parts per million, SO_2 = sulfur dioxide, THC = total hydro carbon.

[a] GB 17930-2016 Gasoline for motor vehicles Stage IV.

[b] China carbon trade network: CO_2 emission factor of diesel 2.630kg/liter (www.tanpalfang.com).

[c] Emission under the scenario of speed 30 km/h, temperature 15°C, moisture 50%, load 50% and 350 ppm sulfur content.

[d] Consider the impacts from temperature, moisture, sulfur content of diesel, average speed of trucks (assuming 40–80 km/h) and the load factor (100%).

[e] Fuel consumption is 43 liter/100 km which meets the GB 30510-2014 Fuel Consumption Limits for heavy-duty commercial vehicles Stage II.

[f] Annual coke oven gas consumption is 576 million cubic meters.

Source: Ministry of Environmental Protection: Technical Guidelines of Air Pollutant Inventory for Automobiles

[6] Wang Xiulin and etc. Technology and economic analysis for coke oven gas to LNG, China Petroleum and Chemical Industry Standard and Quality, No. 2, Page 37

[7] TAO Peng-wan, Technology and economic analysis for coke oven gas to produce compressed natural gas, Coal chemical industry, 2001, 3, 11-1

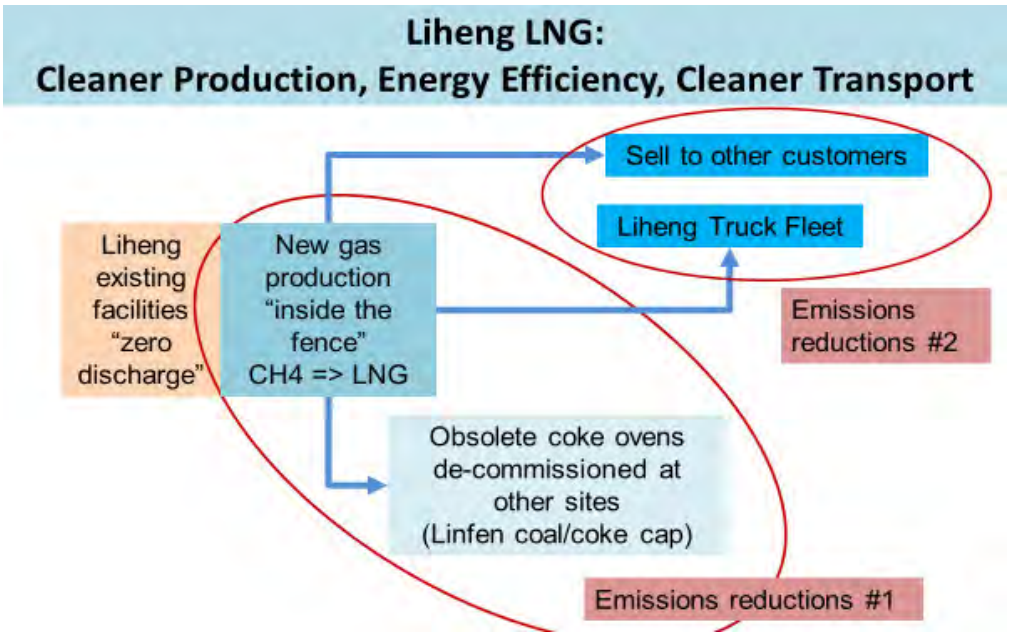
[8] http://www.lngche.com/article-1594-1.html.

Table 20: Energy Savings and Pollutant Mitigation

Energy Savings (tce)	345,600					
	CO_2	SO_2	NO_x	PM	CO	THC
Reference case total emissions (ton)	1,084,662	6,932.6	2,597.4	48.6	992.1	56.7
Project emissions (ton)	503,697.6	20.6	779.2	0	962.4	40.9
Emission reduction(ton)	580,964.4	6,912.0	1,818.2	48.6	29.7	15.8

CO = carbon monoxide, CO_2 = carbon dioxide, SO_2 = sulfur dioxide, NO_x = nitrogen oxide, PM = particulate matter, tce = ton of coal equivalent, THC = total hydrogen carbon.

Figure 11: Liheng Emission Reduction Pathways



CH_4 = methane, LNG = liquefied natural gas.

VI. ANALYSIS OF ALTERNATIVES

129. An analysis of project alternatives was undertaken during the feasibility stage to determine the most financially and technically feasible way of achieving the project objectives while minimizing environmental and social impacts.

A. No Project Alternative

130. Emissions from vehicles contribute in part to the haze in the BTH region, especially from heavy-duty vehicles. Data from the MEP states that the number of heavy-duty vehicles accounts for 4% of total vehicles, but their emissions of NO_x and PM make up 78% and 82% of the total vehicle emissions. There are 5.7 million vehicles in total in the Beijing region. Among them, only 0.2 million are diesel-powered heavy-duty vehicles, but they contribute to 90% of PM and 60% of NOx emissions in total vehicle emissions. The use of natural gas as a substitute fuel for diesel is one of the options to reduce emissions from such automobiles. In 2015, the share of natural gas in primary energy consumption was only 5.9%, much less that the world average of 23.7%. More than 30% of the natural gas consumed is imported, therefore increasing availability of natural gas supply would improve air pollution as well as energy security.

131. The application of LNG in the PRC has not received much attention until recent years. *China National 12th Five-Year Plan for Natural Gas Development* clearly encourages high-efficiency natural gas application projects in LNG vehicles and shipping fuels. The new edition of Policies on the Utilization of Natural Gas issued in December 2012 also lists natural gas vehicles as "preferential development category." LNG's application in transportation sector is becoming the highlight of natural gas sector. As the policy enabling environment was created with the issuance of "The replacement of oil with gas," many companies were pushing the construction of LNG filling stations. The number of LNG filling stations has been rapidly growing from 241 in 2011 to 811 in 2012, and 1,844 in 2013. The equipment manufacturing industry associated with LNG vehicle production has also been developed, including the manufacturing of the LNG vehicle itself and components such as vehicle engines, vehicle-mounted gas cylinder and gas supply system, to LNG filling equipment covering the whole industrial chain. This lays the foundation for the widespread application of LNG and opens the broad market to produce LNG from coke oven gas.

132. The market is ready to use natural gas as transport fuels. By end of 2015, there were 230,000 LNG vehicles and 2,650 LNG filling stations operating for business. According to the *China National 13th Five Year Plan for Natural Gas Development*, by year 2020, there will be 400,000 to 500,000 LNG vehicles on the road. The LNG demand will create a LNG-supply based sector other than the traditional natural gas industry. This subproject can be replicable for other projects to meet the market demand.

133. Implementation of thesubproject will: (i) significantly reduce fossil oil consumption; (ii) improve air quality; (iii) reduce greenhouse gas emissions; and (iv) effective utilization of coke oven gas. For these reasons, the "no project" alternative is considered unacceptable.

B. Coke oven gas treatment method

134. Coke oven gas, the by-product of coke-making, is produced during the manufacture of metallurgical coke by heating bituminous coal to 900°C to 1,000°C in a chamber from which air is excluded. Coke oven gas can be used as a fuel gas since it has a medium calorific value. The heating value of coke oven gas ranges from 17 to 19 MJ (4063 to 4541 kilocalories [kcal]) per

cubic meter. Its main compositions are hydrogen (55%–60%), methane (23%–27%) and carbon monoxide (5%–8%). Other components include nitrogen, CO_2 and hydrocarbons. Raw coke oven gas also contains various contaminants such as hydrogen sulfide, hydrogen cyanide, and benzene. Currently, most of the coke oven gas is used for electricity and steam generation. Coke oven gas is also used for making hydrogen, ammonia, methanol, and other chemicals. Making natural gas is a more recent technological option for coke oven gas utilization in the PRC.

135. Taking up the highest concentration in coke oven gas, hydrogen is the main component among the resources produced. Since steel companies need a certain amount of hydrogen as the protective gas for steel mills, direct hydrogen production is the first choice of steel companies in the utilization of coke oven gas. Since the 1980s, steel companies such as Bao Steel, An Steel, Wuhan Iron and Steel, Benxi Steel, and Baotou Steel have built up several sets of PSA equipment on hydrogen-making from coke oven gas that ranges from 100 m^3/h to 5,000 m^3/h with a purity rate of 99.999%. Hydrogen-making process from coke oven gas mainly utilizes PSA technology to separate hydrogen from cold coke oven gas, making the hydrogen to purity of 99.99%. A stable demand for hydrogen is the key for PSA to utilize coke oven gas. With the development of fuel cell and hydrogen vehicles, there is broad prospect for hydrogen-making from coke oven gas. Nevertheless, the economic impact at this moment is not high yet due to the limited market for hydrogen.

136. Alternatively, methanol is the fundamental raw material of many chemical products as well as a new alternate energy resource. The production of methyl ether from methanol to replace liquid petroleum gas (LPG) for residents and gasoline and diesel with methanol fuel has become the trend of development. During 2006–2009, a series of policies issued by the PRC Government attracted vast amounts of investment for the manufacturing of methanol production equipment, including methanol-making from coke oven gas, resulting in the excessive production of methanol. In 2010, the methanol production capacity was nearly 38 million tons and the methanol consumption capacity was 20.92 million tons, leading to methanol capacity utilization rate of only 46%. Many of methanol production equipment were commissioned into operation after 2010. The excessive production of methanol will exist for the foreseeable future.

137. Thus, judging from the current market, the use of coke oven gas to produce LNG is the best available choice and enjoys broader development prospects. LNG production with coke oven gas has lower cost and higher energy efficiency comparing to LNG from the gas fields due to the following reasons: (i) the transportation cost of LNG from coke oven gas is lower due to closer distance from the coking plant to the market; (ii) the price of coke oven gas is lower than that of natural gas, so LNG is more competitive; (iii) although there is a large amount of hydrogen and nitrogen in the feeding gas, most of the hydrogen is extracted before liquefaction without going through methanol low temperature gas separation, so the energy efficiency is relatively low. If mixed refrigerant cycle (MRC) is applied, the energy efficiency will be further reduced; and (iv) in addition, the hydrogen in this process is recycled and reused, so that the comprehensive LNG production efficiency is reduced. In recent years, the PRC started to strongly promote energy conservation and emission reduction and greatly encourages comprehensive application of coke oven gas. On 30 July 2007, National Development and Reform Commission officially issued Policies on the Utilization of Natural Gas, clearly stating that “it is prohibited to construct LNG project with natural gas produced from large or medium gas field,” which restricts the construction of LNG stations and lessens market competitiveness.

C. Subproject Siting

138. Industrial park has a lot of logistics demand for material and products transfer. Now diesel

truck is the main transportation vehicle. LNG is a better fuel for heavy-duty and long-distance transportation than diesel in terms of cost competitiveness and pollutant emission reduction. The project will improve the availability of LNG supply and encourage more truck drivers to purchase LNG trucks or retrofit their diesel trucks to LNG trucks. Through information technologies, Liheng has built an e-commerce based sales and logistic systems. 140,000 heavy-duty trucks have been registered on its logistic cloud platform. They are the target customers for the LNG produced by the project.

139. Because the best subproject location is close to the existing coking over gas facility and the industrial park has the LNG demand, the subproject location is a best choice.

D. Overall Analysis of Alternatives

140. Based on the analysis of alternatives, the subproject has selected the most appropriate siting and design. The subproject also has made an effective way to produce LNG from coke oven gas.

VII. INFORMATION DISCLOSURE AND PUBLIC CONSULTATION

A. PRC and ADB Requirements for Disclosure and Public Consultation

1. PRC Requirements

141. Relevant provisions in the PRC *Environmental Impact Assessment Law* (2003) and the *Regulations on the Administration of Construction Project Environmental Protection* (No. 253 Order of the State Council, 1998) require that an EIA study for a construction project shall solicit opinions from affected residents, as well as other organizations and concerned stakeholders. However, the requirements for public consultation are different for various sectors and projects. For an environmental Category A project a full EIA report is required including two rounds of public consultations, while for a Category B project only a simplified tabular EIA is required without the need for public consultation.

142. The "Provisional Regulations on Public Participation in Environmental Impact Assessment" (2006) promulgated by State Environmental Protection Administration further improved the legislation of public participation in EIA in China. It provides a detailed requirements for the public participation process, including information disclosure standards, consultation methods, and public enquiry process. It is significant since it was the first document clearly regulating public participation in EIA in the PRC.[9]

143. In 2014, MEP released "Guiding Opinions on Promoting Public Participation in Environmental Protection" (2014, No. 48) which defines public participation as 'citizens, legal persons and other organizations' voluntary participation in environmental legislation, enforcement, judicature and law obedience, and the development, utilization, protection and transformation activities related to environment'.

144. The public disclosure and consultation process undertaken during the preparation of the DEIA will be undertaken in compliance with the relevant PRC requirements, including the "Provisional Regulations on Public Participation in Environmental Impact Assessment" (2006) and the "Guiding Opinions on Promoting Public Participation in Environmental Protection" (2014, No. 48).

2. ADB Requirements

145. ADB's SPS (2009) has specific requirements for information disclosure and public consultation. Information disclosure involves delivering information about a proposed project to the general public and to affected communities and other stakeholders, beginning early in the project cycle and continuing throughout the life of the project. Information disclosure is intended to facilitate constructive engagement with affected communities and stakeholders over the life of the project.

146. The SPS requires that borrowers take a proactive disclosure approach and provide relevant information from environmental assessment documentation directly to affected peoples and stakeholders. In addition, in order to make key documents widely available to the general public, the SPS requires submission to ADB for posting on the ADB website as follows:

[9] Wang Ya Nan, 2012. *Public Participation in EIA, SEA and Environmental Planning in China.* Environmental Impact Assessment Research Centre.

(i) a draft full EIA (including the draft EMP) at least 120 days prior to ADB Board consideration for Category A projects, and/or environmental assessment and review frameworks before project appraisal, where applicable;
(ii) the final EIA/IEE;
(iii) a new or updated EIA/IEE, EMP and corrective action plan prepared during project implementation, if any; and
(iv) environmental monitoring reports.

147. The SPS also requires that the borrower carry out consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Consultations should include presentations on environmental impacts, benefits and mitigation measures, GRM, and ADB's Accountability Mechanism.

B. Project Information Disclosure

148. The domestic EIA is being prepared by a Shangxi EIA firm. ADB PPTA consultant will assist the EIA firm to undertake public consultation based on ADB SPS's requirements and PRC's requirements. Based on information from the EIA firm, two rounds of information disclosure will be held.

149. The first public project information notice will be posted on the Liheng's website, early in the domestic EIA preparation process. The information in the first public notification is listed below:

(i) Project name and summary of the subproject;
(ii) Name and contact information of the subproject proponent;
(iii) Name and contact information of the institute responsible for preparing the domestic EIA;
(iv) EIA procedures and content; and
(v) Request for questions, suggestions and feedback from the public.

150. A second public information notice will be posted on the Liheng's website, prior to the submission of the domestic EIA to the Linfen EPB. The notice included Project name and summary of the project:

(i) Name and contact information of the proponent;
(ii) Name and contact information of the institute responsible for preparing the domestic EIA of the project;
(iii) Potential project environmental impacts and mitigation measures;
(iv) Key conclusions of the domestic EIA; and
(v) Contact information to get abridged versions of the domestic EIA.

151. Besides, during the domestic EIA preparation, Linfen EPB will post the domestic EIA report on its website. The information included:

(i) project name and project information summary;
(ii) name and contact information of the proponent;
(iii) name and contact information of the institute responsible for preparing the EIA;
(iv) potential project environmental impacts and mitigation measures;
(v) key conclusions of the EIA report; and
(vi) contact information and a request for questions, suggestions and feedback from the public.

152. Besides, the subborrower will also post the domestic EIA and this IEE report on its website.

153. This IEE will be disclosed on the ADB website.

C. Public Consultation Meetings

154. Because the domestic EIA preparation just started, no public consultation meeting has been held. Based on information from the Shangxi EIA firm, a public consultation meeting will be held during the domestic EIA preparation process.

155. During the public consultation meeting information will be presented about the subproject status, potential environmental impacts and proposed mitigation measures. Questions and subsequent discussions will focus on environmental issues of the subproject and benefits of the subproject.

156. Participants will be asked to complete a questionnaire (**Table 21**).

Table 21: Project public consultation questionnaire (2017)

Name		**Sex**		**Age**	
Nationality		**Education level**		**Occupation**	
Company		**Title**		**Contact numl**	
1. What is the main environment pollution near your living areas in your opinion (multiple choice)? A. Surface water B. Ambient air C. Noise D. Ground water E. Solid waste F. Others					
2. Do you know this project? A. Yes B. No					
3. If you know this project, project information is obtained by which way? A. Internet B. Newspaper C. Information signs D. Other person E. Other					
4. Distance between your working place and project site A. <1 km B. 1-3 km C. 3-5 km D. > 5km					
5. Distance between your house and project site A. <1 km B. 1-3 km C. 3-5 km D. > 5km					
6. Do you understand this project like project information, project component, project benefit etc,? A. Yes B. No C. Not clear					
7. Do you understand environment impacts of this project? A. Yes B. No C. Not clear					
8. What is environmental issues of highest concern during construction period? A. Surface water B. Ambient air C. Noise D. Dust/PM E. Ground water F. Solid waste G. Traffic problems H. Ecological environment I. Others					
9. What is environmental issues of highest concern during operation period? A. Surface water B. Ambient air C. Noise D. Dust/PM E. Ground water F. Solid waste G. Ecological environment H. Others					
10 Based on construction phase mitigation measures proposed in EIA, do you accept the impacts to environment?					
10.1 Ambient air (PM, dust included) A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.2 Noise A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.3 Surfacewater A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.4 Groundwater A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.5 Solid waste A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.6 Ecological environment A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.7 Other (traffic problem and inconvenient by project construction) A. Accept B. Barely accept C. Do not accept D. Have no idea					
11 Based on operation phase mitigation measures proposed in EIA, do you accept the impacts to environment?					
11.1 Ambient air (PM, dust included) A. Accept B. Barely accept C. Do not accept D. Have no idea					
11.2 Noise A. Accept B. Barely accept C. Do not accept D. Have no idea					
11.3 Surfacewater A. Accept B. Barely accept C. Do not accept D. Have no idea					
11.4 Groundwater A. Accept B. Barely accept C. Do not accept D. Have no idea					
11.5 Solid waste A. Accept B. Barely accept C. Do not accept D. Have no idea					

11.6 Ecological environment A. Accept B. Barely accept C. Do not accept D. Have no idea
12. Do you think construction of this project can improve local economic development or not? A. Yes B. No C. Not clear
13. Do you think whether construction of this project can improve your living quality? A. Yes B. No C. Not clear
14. After comprehensive analysis of project advantages and disadvantages, do you agree with the construction of this project? A. Yes B. No C. Not clear
Suggestions or requirements of the project:
Suggestions or requirements for environment protection of the project:
Project information *(a project summary was provided here), anticipated pollution control measures and environment benefits.*

D. Future Consultation Activities

157. The subborrower will continue to undertake public consultation activities and conduct regular community liaison activities during the construction and operations phases as needed, including the implementation of the GRM (Chapter VIII). Ongoing consultation will ensure that public concerns are understood and dealt with in a timely manner.

VIII. GRIEVANCE REDRESS MECHANISM

A. Introduction

158. A project grievance can be defined as an actual or perceived project related problem that gives ground for complaint by an affected person (AP). As a general policy, a Project Management Office (PMO) will be established by the subborrower, and it will work proactively toward preventing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. In addition, as the project has strong public support and will not involve any involuntary land or property acquisition or resettlement, significant grievances are unlikely to happen. Nonetheless, during construction and operation it is possible that unanticipated impacts may occur if the mitigation measures are not properly implemented, or unforeseen issues arise. In order to address complaints if or when they arise, a subproject-level grievance redress mechanism (GRM) has been developed in accordance with ADB requirements and GRM requirements as specified in the ESMS for CECEP. A GRM is a systematic process for receiving, recording, evaluating, and addressing AP's subproject-related grievances transparently and in a reasonable period of time.

B. ADB's GRM Requirements

159. ADB's SPS 2009 requires a project to establish a GRM to receive and facilitate resolution of AP's concerns and complaints about the project's environmental performance during construction as well as operation phase of the project. The GRM should be (i) scaled to the risks and adverse impacts of the project; (ii) address affected people's concerns and complaints promptly, using an understandable and transparent process; (iii) readily accessible to all sections of the community at no cost and without retribution; and (iv) not impede access to the PRC's judicial or administrative remedies.

C. Current GRM Practices in the PRC

160. At the national level a framework to address grievance has been established. State Council Decree No. 431 "Regulations on Letters and Visits" (January 2005) establishes a complaint mechanism at all levels of government, and safeguards the complainants from any retaliation. MEP "Decree No. 34 "Environmental Letters and Visits System" provides specific guidelines to establish a system and address environmental complaints. When APs are negatively affected by project activities, they may complain to the contractors and the project company by themselves or through their community organizations, or complain directly to local EPBs. If the issue is not resolved they may take legal action, though that is typically considered as a last option.

D. Subproject Level GRM

161. The objective of the project GRM is to prevent and address community concerns, reduce risks, and assist the project to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the subproject level GRM has been designed to (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the project; (ii) demonstrate concern about community members and their environmental well-being; and (iii) prevent and mitigate any adverse environmental impacts on communities caused by project implementation and operations. The GRM will be accessible to all members of the community.

162. The overall approach of the GRM is to deal with grievances at a local level first in an efficient manner, and escalate to higher level of authority if the grievance cannot be resolved. The designated person from the PMO will be responsible for implementation of the GRM. The PMO will be the key contact point for residents, businesses, government departments and other stakeholders who may require information about the project or who have an issue they would like to discuss.

163. The GRM will be implemented through five steps, advancing to the next level only if the grievance was unable to be redressed at the previous level.

(i) **Step 1**: If a concern arises, the AP can try to resolve the issue of concern either directly with the contractor or with the contactor via GRM access points (community leaders, neighborhood organizations, PMO, local EPB) during the construction phase, and/or the operator during the operation phase. If the concern is resolved successfully no further follow-up action is required. Nonetheless, the contractor (during construction) and/or the operator (during operation) shall record any complaint and actions taken to resolve the issues and report the results to the PMO. If no solution is found within 10 working days or if the AP is not satisfied with the suggested solution under Step 1, proceed to Step 2. The AP may also skip step 1 and directly file the complaint with the PMO.

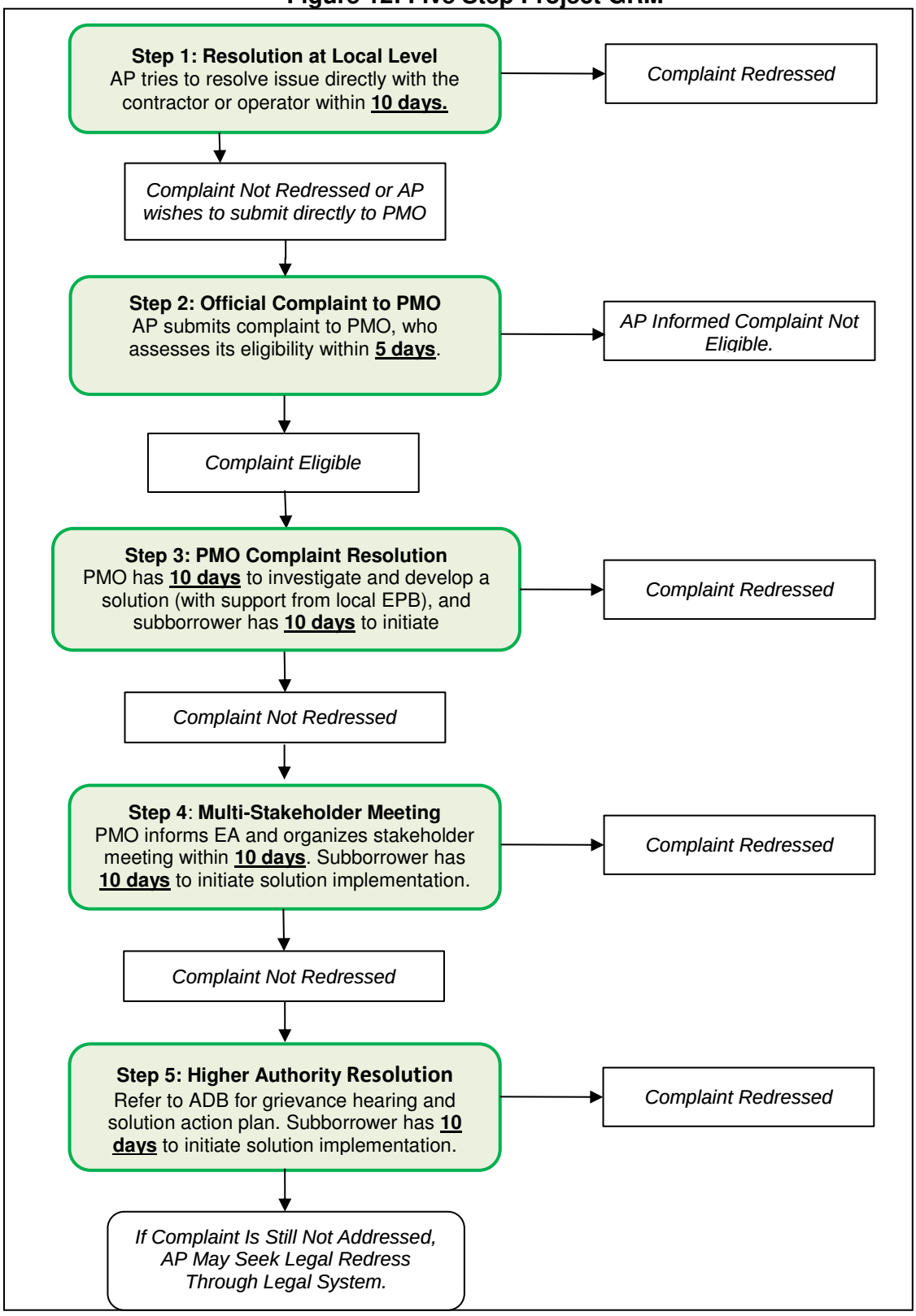
(ii) **Step 2:** The AP will submit the grievance to the PMO, who will record the grievance, assess its eligibility and report back to the AP within 5 working days. If the grievance is eligible, proceed to step 3.

(iii) **Step 3:** The PMO will investigate the complaint, and consult with the subborrower, local EPB, and other stakeholders as appropriate to identify a solution. The PMO will give a clear reply to the AP within 10 working days with the suggested solution, and the subborrower will ensure that implementation of the agreed-upon redress solution begins within 10 working days. If no solution is found or if the complainant is not satisfied with the suggested solution under Step 3, proceed to Step 4.

(iv) **Step 4:** The PMO will inform CECEP of the grievance, and will organize a multi-stakeholder meeting within 10 days, where all relevant stakeholders, including the complainant, CECEP, subborrower, and local EPB, can discuss the issue. The multi-stakeholder meeting will aim to find a solution acceptable to all, and identify responsibilities and an action plan. The subborrower will ensure that the implementation of agreed-upon redress solution begins within 10 working days of the completion of the multi-stakeholder meeting.

(v) **Step 5:** If the complainant is still not satisfied with the suggested solution under Step 4, the grievance will be directed to ADB by CECEP. ADB will direct CECEP to organize a hearing process and shall determine a solution acceptable to all. Based on the hearing results, an action plan shall be developed and the subborrower will ensure that the implementation of the agreed-upon redress solution begins within 10 working days of the completion of the hearing.

Figure 12: Five Step Project GRM



AP = affected person, EPB = environmental protection bureau, PMO = project management office.

IX. CONCLUSIONS

164. This is the IEE report for the Industrial By-product Gas Utilization Subproject of the proposed PRC: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility.

165. This subproject will use coke oven gas, an industrial by-product, to produce LNG for use in the transportation sector, as a preferred option in terms of greater market and environmental benefits, comparing to the current practice of using such coke oven gas to generate onsite electricity and steam, or to produce urea or methanol.

166. The subproject will use coke oven gas to produce 180,000 metric tons of LNG which could replace 239.4 million liters of diesel. Some coke oven gas would otherwise be combusted by flaring. Normally, using 1 Nm^3 coke oven gas could save 0.6 kgce (4,200 kcal or 17.6 MJ) energy, and reduce emission of 0.012 kg SO_2, and 0.79 kg CO_2.

167. Through the environmental assessment process, it is concluded that the subproject has: (i) selected appropriate technologies to produce LNG and reduce the emissions; (ii) identified potential negative environment impacts and appropriately established mitigation measures; (iii) established effective subproject GRM procedures; and (iv) prepared a comprehensive EMP including environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

168. Based on the analysis conducted during the PPTA, it is concluded that overall the subproject will result in significant positive socioeconomic and environmental benefits, and will not result in significant adverse environmental impacts that are irreversible, diverse, or unprecedented. Overall, any minimal adverse environmental impacts associated with the subproject can be prevented, reduced, or minimized through the appropriate application of mitigation measures. It is therefore recommended that:

(i) the subproject is classified as environment category B;
(ii) the subproject will undertake public consultation based on requirements from ADB SPS and the PRC; and
(iii) the subproject will be supported by ADB, subject to the implementation of the commitments contained in the EMP and allocation of appropriate technical, financial and human resources by the subborrower to ensure these commitments are effectively and expediently implemented.

Appendices

Appendix I: Environmental Management Plan

Appendix II: Environmental Audit of Existing Facility

APPENDIX I: ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

1. The EMP is for the Industrial By-product Gas Utilization Subproject of the proposed PRC Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility. This subproject will use coke oven gas, an industrial by-product, to produce liquefied natural gas (LNG) for use in the transportation sector, as a preferred option in terms of greater market and environmental benefits, to the current practice of using such coke oven gas to generate onsite electricity and steam, or to produce urea or methanol.

2. The objectives of the EMP are to ensure (i) implementation of the identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of monitoring and reporting; and (iii) the project compliance with the PRC's relevant environmental laws, standards and regulations and ADB's SPS 2009. Organizational responsibilities and budgets are clearly identified for execution, monitoring and reporting.

3. The EMP is to be implemented in all phases of the subproject cycle including design, pre-construction, construction, and operation. In the detailed design stage the EMP will be used by the design institute for incorporating mitigation measures into the detailed designs. The EMP will be updated at the end of the detailed design, as needed.

4. The EMP will be included as a separate annex in all bidding and contract documents. The contractors will be informed of their obligations to implement the EMP, and to provide for EMP implementation costs in their bids for project works. The EMP is presented in **Table 1**.

Table 1 Environmental Management Plan

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
Pre-construction						
Transportation and mobilization of construction materials and equipment	Dust generation during vehicle movement	i. Construction material (sand/soil) should be covered while transportation. ii. Water to be sprinkled as needed. iii. Emissions from vehicles and equipment should comply with national standards.	Air quality	PRC ambient air quality standards	Subborrower	Subproject design
	Noise generation	i. Movement of vehicles should be restricted during day time. ii. Noise levels from vehicles and equipment to comply with noise standards.	Noise levels	PRC noise standards	Subborrower	Subproject design
Construction phase						
Site Clearance	Loss of flora and fauna	– A greening plan will be implemented. Site vegetation plans will be developed at project site using appropriate native species. – Any existing vegetated areas impacted by the subproject will be restored after construction using appropriate native species.	Subproject construction site	NA	Contractor, subborrower, CECEP	Whole construction stage
Removal of vegetation and evacuation	Soil erosion, surface water runoff	– Potential for storm water runoff will be assessed and appropriate storm water drainage systems to minimize soil erosion will be implemented, including perimeter bunds and establishment of temporary detention and settling ponds to control topsoil runoff. – Land excavation and filling will be balanced so as minimize the requirement for fill transportation. – During earthworks, the area of soil exposed to potential erosion at any one time will be minimized through good project and construction management. – Spoils will be reused on-site to the maximum extent feasible as fill. Temporary spoil storage sites will be identified, designed, and operated to minimize impacts. Spoil sites will be restored after storage activities. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site. – Spoils and aggregate piles will be covered with landscape	Subproject construction site	PRC Control Standards for Soil and Water Loss on Development and Construction Projects (GB50434-2008)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		material and/or regularly watered. – Waste construction material such as residual concrete, bricks, etc., will be used for backfill at the sites to the maximum extent feasible. – Construction and material handling activities will be limited or halted during periods of rains and high winds. – Any planned paving or vegetating of areas will be done as soon as practical after the materials are removed to protect and stabilize the soil. – Once construction is complete, disturbed surfaces will be properly sloped and planted with native trees and grass.				
Subproject construction	Surface and groundwater contamination from construction wastewater and domestic water	– Existing sanitary facilities and toilets in the coking plant will be provided for construction workers. Domestic wastewater will be treated in existing wastewater treatment plant of the coking plant, then discharged to municipal sewer. – Construction wastewater will be directed to temporary detention and settling ponds. Areas where construction equipment is being washed will be equipped with water collection basins and sediment traps. After settling, supernatant will be recycled and sediment will be periodically excavated, and either reused if possible as fill, disposed at official spoil disposal sites, or disposed at official or landfills. – Maintenance of construction equipment and vehicles will not be allowed on site so as to reduce wastewater generation.	Project construction site	PRC's Surface Water Ambient Quality Standard (GB3838-2002)	Contractor, subborrower, CECEP	Whole construction stage
Transportation of construction materials, evacuation and drilling	Increase in dust, equipment and vehicle emissions	– Subproject site under construction will be fully enclosed by fence prior to the commencement of construction. – Water will be sprayed on active construction sites including where fugitive dust is being generated on a daily basis, and more frequently during windy days. – All construction piles (spoils, aggregate other construction materials) with the potential to generate dust will be covered and/or regularly watered. – Construction activities will be halted during high wind events. Once construction is completed, disturbed surfaces will be properly sloped and planted with native trees and grass. – Transport vehicles will be limited to low speeds in	Project construction site	PRC's Air Pollutant Integrated Emission Standard (GB 16297-1996)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		construction sites. – Loads will be covered during truck transportation to avoid spillage or fugitive dust generation. Fine materials will be transported in fully contained trucks. – Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds. – Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical.				
Evacuation, and vehicle movement	Increase in noise levels	– Construction activities, and particularly noisy ones, are to be limited to reasonable hours during the day and early evening. Construction activities will be strictly prohibited during the nighttime (22:00 h to 07:00 h). Exceptions will only be allowed in special cases, and only after getting approval of the surrounding residents, local EPB, and other relevant departments. – Simultaneous high-noise activities will be avoided, and high noise activities will be scheduled during the day rather than evening hours. Construction sites will be planned to avoid multiple high noise activities or equipment from operating at the same location. – Low-noise equipment will be selected as much as possible. Equipment and machinery will be equipped with mufflers and will be properly maintained to minimize noise. – PPE will be provided to workers. – Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and high traffic times. – Vehicles transporting construction materials or waste will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals.	Project construction site	PRC's Noise Standards for Construction Site Boundary (GB 12523-2011)	Contractor, subborrower, CECEP	Whole construction stage
Subproject construction	Solid waste generation	– Wastes will be reused or recycled to the extent possible. Waste construction materials such as residual concrete, bricks will be used for backfill at the sites. – Littering by workers will be prohibited. – Existing domestic waste containers will be used for	Project construction site	PRC's Standards for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		domestic waste collection. Domestic waste will be collected on a regular basis by the local sanitation departments and transported for recycling, reuse, or disposal at a licensed landfill. – Construction waste dumpsters will be provided at all work sites. Construction waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill – Excavated soil will be backfilled on-site to the extent possible. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site. – There will be no final waste disposal on site. Waste burning or incineration at or near the site is strictly prohibited. – Contractors will be held responsible for proper removal and disposal of any significant residual materials, wastes, and contaminated soils that remain on the site after construction.		18599-2011)		
Subproject construction	Hazardous and Polluting Materials	– Hazardous material handling and disposal protocol that includes spill emergency response will be prepared and implemented by contractors. – Existing storage facilities for fuels, oil, chemicals, and other hazardous materials in coking plant will be used. All the storage facilities shoud be within secured areas on impermeable surfaces provided with dikes, and at least 300 m from drainage structures. – Signs will be placed at chemicals and hazardous materials storage sites to provide information on type and name of chemicals and hazardous materials. – Suppliers of chemicals and hazardous materials must hold proper licenses and follow all relevant protocols and PRC regulations and requirements. – A Shanxi EPB certificated company will be hired to collect, transport, and dispose of hazardous materials in accordance with relevant PRC regulations and requirements.	Project construction site	PRC's General Specifications of Engineering and Technology for Hazardous Waste Disposal (HJ 2042 -2014)	Contractor, subborrower, CECEP	Whole construction stage
Site clearance	Removal of vegetation	– A greening plan will be implemented. Site vegetation plans will be developed at subproject site using appropriate native species. – Any existing vegetated areas impacted by the	Project construction site	NA	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		subproject will be restored post-construction using appropriate native species.				
Vehicle movement and other construction activities	Community disturbance and safety	– Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and high traffic times. – Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools, and hospitals. – Signs will be placed at construction sites in clear view of the public, warning people of potential dangers such as moving. All sites will be made secure, discouraging access by members of the public through appropriate fencing whenever appropriate.	Project construction site	NA	Contractor, subborrower, CECEP	Whole construction stage
Subproject construction	Occupational health and Safety	– Each contractor will implement the relevant construction phase EHS plan. – Identify and minimize the causes of potential hazards to workers. Implement appropriate safety measures. – Provide training to workers on occupational health and safety, emergency response, especially with respect to using potentially dangerous equipment and storage, handling and disposal of hazardous waste. – Ensure that all equipments are maintained in a safe operating condition. – Provide appropriate PPE to workers. – Implement work practices to limit workers' exposure to high noise or heat working environments in compliance with PRC noise standards for construction sites (GB 12523-2011). – Ensure regular safety meetings with staff. – Ensure that material stockpiles or stacks, such as, pipes are stable and well secured to avoid collapse and possible injury to workers.	Project construction site	NA	Contractor, subborrower, CECEP	Whole construction stage
Evacuation	Damage to PCRs	– Construction activities will be immediately suspended, if any PCRs are encountered. – Destroying, damaging, defacing, or concealing PCRs will be strictly prohibited in accordance with PRC regulations – Local Cultural Heritage Bureau will be promptly informed and consulted.	Project construction site	NA	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		– Construction activities will resume only after thorough investigation and with the permission from the local Cultural Heritage Bureau.				
Operation phase						
Subproject operation	Combustion emissions and odor	– Continuous venting of gas is not considered current good practice and will be avoided. – Exhaust gas of flaring torch will be in compliance with relevant PRC regulation and requirements. – Operating flare to control odor and visible smoke emissions. – Locating flare at a safe distance from local communities and the workforce including workforce accommodation units. – Implementation of burner maintenance and replacement programs to ensure continuous maximum flare efficiency. – Metering flare gas.	Project operation site	PRC's Emission Standard of Pollutants for Coking Chemical Industry (GB 16171—2012)	Subborrower, CECEP	Whole operation stage
Subproject operation	Discharge of Production and Domestic Wastewater	– Wastewater from canteen will be treated by oil-separator, and then send to existing municipal wastewater treatment plant combined with water from toilet facilities. – Wastewater from demineralization process will be reused or recycled as much as possible. Remain wastewater will be treated in the existing WWTP of the coking plant. – Wastewater from circulation system will be treated in the WWTP of the industrial park for recycle. – Wastewater from methanation process and separation process will be treated in the existing WWTP in coking plant, then reused or recycled.	Project operation site	PRC's Integrated Sewage Discharge Standard (GB8978-1996)	Subborrower, CECEP	Whole operation stage
Subproject operation	Solid Waste generation	– Existing domestic waste bins will be used for domestic waste collection and domestic waste will be routinely collected by the local sanitation department for recycling, if possible, or final disposal at an approved waste disposal site. – No permanent on-site solid waste disposal will be permitted at subproject site. – No burning of wastes will be permitted at subproject site.	Project operation site	PRC's Standards for Pollution Control on the storage and Disposal Site for General Industrial Solid Wastes (GB 18599-2011)	Subborrower, CECEP	Whole operation stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		– Waste catalyst from purification and methanation process and waste adsorption materials from separation process will be sent to Shanxi EPB certificated companies for treatment. Transportation and treatment should follow the PRC's regulation and requirements.				
Equipment operation	Increase in noise level	– Low-noise equipment will be used as far as possible, and noise reduction measures such as noise elimination, vibration absorption, insulated enclosures and sound dampening materials on exterior walls will be implemented. – All equipment will be properly maintained in order to minimize noise. – Appropriate noise PPE will be provided to the workers who are likely to be exposed to high noise level environments. – Layout for LNG production workshop will be reasonable planned to reduce noise. – Greening plan will be implemented to reduce noise level.	Project operation site	PRC's Industrial Enterprise Boundary Noise Emission Standards (GB12348-2008)	Subborrower, CECEP	Whole operation stage
	Occupational and community health and safety	– All gas works will be in compliance with relevant PRC building code requirements. – Subproject site will be equipped with flammable gas detection, alarm and fire suppression systems. Electrical devices within the explosion risk area will be safely equipped. – Gas pipelines will be grounded and equipped with anti-lightning devices where applicable. – All gas related devices will be brightly colored and equipped with warning signs. – Operation phase EHS plans including fire prevention and control will be developed and implemented, and workers will be trained regularly on their implementation. – Gas systems will be designed in strict compliance with relevant PRC fire, health and safety standards. Fire compartments will be established based on the fire risks and fire-resistant buildings/structures will include fire-proof doors and windows. – Fire-alarm and suppression systems will be installed and tested regularly to ensure it functions properly. – PPEs including goggles, gloves, safety shoes, will be	Project operation site	Code for Design of City Gas Engineering (GB 50028-2006) and Regulation on Electric Apparatus Design for Explosion and Fire Risk Environment (GB50058-92)	Subborrower, CECEP	Whole operation stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		provided to workers. – Control measures will be strictly undertaken to ensure the discharge, exhaust, and safety relief of flammable fuels in enclosed systems. – No unauthorized personnel will be allowed into gas-fired facilities. – Provide training to workers on occupational health and safety, and emergency response.				

CECEP = China Energy Conservation and Environmental Protection Group, EHS = environment, health and safety, EPB = environmental protection bureau, LNG = liquefied natural gas, m = meter, NA = not applicable, PCR = physical cultural resource, PPE = personnel protective equipment, PRC = People's Republic of China, WWTP = wastewater treatment plan.

B. Implementation Arrangements

5. CECEP will be the executing agency (EA) and the implementing agency (IA). CECEP Huayu Fund Management Co. Ltd. (CECEP Huayu) will manage the Loan. The EA will establish a Project Management Office (PMO) at CECEP Huayu including hiring an Environment Officer and a Social Officer.

6. The EA will retain an environment expert if needed to provide support to the PMO in mitigation implementation, environmental monitoring, reporting, and addressing any environment related issues that arise including grievances. The environmental expert will also support contractors in developing Contractor Environmental Management Plans (CEMPs) and associated subplans prior to construction and operation.

7. The PMO Environment Officer will be responsible for regular internal inspections of mitigation measures at the construction site, in accordance with the Environmental Monitoring Plan (EMoP). A third party environmental monitoring entity will be engaged by the subborrower and will undertake construction and operation phase ambient environmental monitoring as per the EMoP.

8. The contractor will be responsible for implementing relevant mitigation measures during construction. Following the award of each construction contract, the contractor will prepare the CEMP and associated subplans which detail the means by which the Contractor will comply with the EMP. The Contractor will identify a lead focal point for environmental issues (e.g., Chief Site Engineer), will implement the CEMP, and will take all reasonable measures to minimize the impact of construction activities on the environment. The Contractor will also submit quarterly environmental records to the PMO on EMP implementation, including the EMoP. They are also required to report any spills, accidents, and grievances received, and any actions taken.

9. CECEP will visit the subproject site regularly to ensure the EMP and EMoP are implemented properly. CECEP will review the semi-annual and annual environmental monitoring reports submitted the subborrower and consolidate them with the reports from other subborrowers. CECEP will submit the consolidated semi-annual and annual environmental monitoring reports to ADB as specified in the ESMS.

10. ADB will conduct due diligence of environment issues during the subproject review missions. ADB will review the semi-annual and annual environmental monitoring reports submitted by EA and will disclose them on its website. If the PMO fails to meet safeguards requirements described in the EMP, EA/ADB will seek corrective measures and advise the PMO on items in need of follow-up actions.

11. The subproject implementation organization and the roles and responsibilities of the participating agencies are presented in **Table 2**.

Table 2: Project implementation and management organizations

Organization	Role and Responsibility
CECEP	- Serving as the EA/IA and project contact point for ADB. - Ensuring the subproject is in full compliance with ADB's SPS 2009, applicable national laws and regulations, loan covenants, ESMS, and the EMP. - Conducting regular review missions. - Submitting consolidated environmental monitoring reports to ADB as required in the ESMS. - Coordinating the activities of and meeting the requirements of ADB review missions.
CECEP Huayu	On behalf of the executing agency, a Project Management Office Huayu will be set up (PMO) including a safeguard unit with suitably qualified and experienced full time staff. PMO will be responsible for all project organization and implementation activities, including the following: - Formulating the subproject management and operating procedures, implementation plans, and budgets. - Ensuring subproject's compliance with loan and project agreements and with the safeguards requirements as specified in the ESMS. - - Communicating and coordinating with concerned offices and with external contacts. - Taking part in capacity development and training. - Overseeing implementation of different subproject outputs. - Monitoring the subproject's physical and financial progress and compliance with subproject's reporting requirements, ensuring project progress reports are prepared and submitted to ADB on time. - Addressing complaints received from APs. - Organizing subproject acceptance verification. - Coordinating the activities of and meeting the requirements of ADB review missions. - Supervising the implementation of EMP and EMoP. - Conducting regular site visits and safeguard review missions in accordance with the requirements set forth in the ESMS. - Preparing and submitting consolidated semi-annual/annual environmental monitoring reports as required by the ESMS to ADB. - Requiring subborrowers to prepare corrective action plans in the event of noncompliance with EMP or EMoP.
Subborrower	Main responsibilities include: - Contracting and administering contractors and suppliers. - Supervising construction and monitoring quality control. - Ensuring compliance with EMP, EMoP, engaging external environmental safeguard consultant if needed. - Preparing subproject progress reports for submission to the PMO. - Monitoring project's physical and financial progress and preparing regular progress reports to the PMO. - Testing and commissioning of completed project facilities. - Identifying and implementing O&M arrangements. - Coordinating with and assisting the PMO in developing subproject management procedures and detailed implementation plan, and monitoring achievement thereof. - Preparing progress reports for submission to the executing agency and/or PMO. - Preparing semi-annual/annual environmental monitoring reports and submitting to PMO.
Environmental Monitoring Company	A qualified independent environmental monitoring company will be recruited to implement the ambient monitoring portion of the EMoP.
ADB	Responsible for the following: - Providing the EA/IA and PMO with guidance to ensure smooth project implementation and achieve the desired development impacts and their sustainability. - Conducting regular review missions. - Monitoring the implementation of EMP and EMoP. - Monitoring status of compliance with loan and project covenants, including safeguards. - Reviewing environmental monitoring reports and disclosing them on ADB website. - Regularly updating the subproject information documents for public disclosure at ADB web site, including the safeguards documents. - Requiring CECEP Huayu to develop corrective action plan for any non-compliance issues.

ADB = Asian Development Bank, AP = affected person, CECEP = China Energy Conservation and Environmental Protection Group, CECEP Huayu = CECEP Huayu Fund Management Co. Ltd., EA = executing agency, EMP = environmental management plan, EMoP = environmental monitoring plan, ESMS = environmental and social management system, IA = implementing agency, O&M = operation and maintenance, PMO = project management office.

C. Potential Impacts and Mitigation Measures

12. The potential impacts of the subproject during pre-construction, construction and operation have been identified and appropriate mitigation measures developed (Chapter V of the IEE and **Table 1** of Appendix).

D. Environment Monitoring Plan

13. An EMoP to monitor the environmental impacts of the subproject and assess the effectiveness of mitigation measures is presented in **Table 3.** The EMoP includes compliance inspection undertaken by the PMO Environment Officer supported by an environment expert if needed, and ambient air, noise, and wastewater monitoring undertaken by the a third party environmental monitoring entity. Ambient monitoring will be conducted in compliance with relevant PRC regulations, methods, and technical specifications.

14. The data and results of environmental compliance inspection and monitoring activities will be used to assess: (i) the extent and severity of actual environmental impacts against the predicted impacts and baseline data collected before subproject implementation; (ii) performance or effectiveness of environmental mitigation measures or compliance with pertinent environmental rules and regulations; (iii) trends in impacts; (iv) overall effectiveness of EMP implementation; and (v) the need for additional mitigation measures and corrective actions if non-compliance is observed.

E. Institutional Strengthening and Capacity Building

15. The institutional strengthening and capacity building focuses on the safeguards requirements of relevant PRC laws and regulations and ADB SPS 2009. The training will focus on ADB SPS 2009; PRC safeguard requirements; development and implementation of EHS plans during construction and operation; implementation of the EMP, EMoP, GRM, and worker and community health and safety issues and measures (**Table 4).**

Table 3: Environmental Monitoring Plan (EMoP)

Subject	Parameter	Location	Frequency	Implemented by	Supervised by
A. Construction Phase					
Erosion, Borrow and Spoil	Compliance inspection of implementation of erosion and stormwater control measures	Construction sites, spoil disposal sites	Monthly during construction stage; and once after completion of spoil disposal	Subborrower	PMO and EA
Air Pollution	Ambient dust monitoring (TSP, PM_{10}, $PM_{2.5}$)	Construction site	Quarterly during construction stage	Third party environmental monitoring entity	PMO and EA
	Compliance inspection of implementation of air pollution control measures	Construction site	Monthly during construction stage	Subborrower	PMO and EA
Wastewater	Compliance inspection of implementation of wastewater management measures	Construction site	Monthly during construction stage	Subborrower	PMO and EA
Noise	Ambient noise monitoring (day and night Leq dB(A))	Construction site	Quarterly during construction stage	Third party environmental monitoring entity	PMO and EA
Solid Waste	Compliance inspection of implementation of solid waste management measures	Waste collection and disposal sites	Monthly during construction stage	Subborrower	PMO and EA
Hazardous and Polluting Materials	Compliance inspections of implementation of hazardous materials management measures	Storage facilities for fuels, oil, chemicals and other hazardous materials. Vehicle and equipment maintenance areas.	Monthly during construction stage	Subborrower	PMO and EA
Flora and Fauna	Compliance inspection of land clearing to ensure mitigation measures are being implemented	Construction site	Monthly during construction stage	Subborrower	PMO and EA

Subject	Parameter	Location	Frequency	Implemented by	Supervised by
Socioeconomic Impacts	Compliance inspection of implementation of traffic control measures	Construction site roads. Transportation routes.	Monthly during construction stage	Subborrower	PMO and EA
	Compliance inspection of implementation of Occupational and Community Health and Safety measures and an Emergency Response Plan	Construction site	Monthly during construction stage	Subborrower	PMO and EA
B. Operation Phase					
Air pollutants generated from operation	Flaring torch monitoring and emission monitoring (PM, SO_2, NOx)	Exhaust stacks and site boundaries	Semi-annual	Third party environmental monitoring entity	PMO and EA
Wastewater	Compliance inspection during operation phase of waste water management measures implementation	Subproject site	Semi-annual	Subborrower	PMO and EA
Solid Waste	Compliance inspection during operation phase of solid waste management measures implementation	Subproject site	Semi-annual	Subborrower	PMO and EA
Hazardous and Polluting Materials	Compliance inspection during operation phase of Hazardous Materials Management Plans implementation	Subproject site	Semi-annual	Subborrower	PMO and EA

Subject	Parameter	Location	Frequency	Implemented by	Supervised by
Health and Safety and Emergency Response	Compliance inspection during operation phase of occupational and community health and safety management measures and an Emergency Response Plan implementation	Subproject site	Semi-annual	Subborrower	PMO and EA

Table 4: Institutional strengthening and training program

Training Topic	Trainers	Attendees	Contents	Times	Days	# Persons	Budget (USD)
Construction Phase Environment, Health and Safety Training	Qualified environment expert	Contractors, PMO, subborrower	**ADB and PRC laws, regulations and policies** – ADB's safeguard policy statement – Project applicable PRC environmental, health and safety laws, policies, standards and regulations – International environmental, health and safety management practice in civil irrigation and drainage construction **GRM** – GRM structure, responsibilities, and timeframe – Types of grievances and eligibility assessment **Implementation of Construction Phase EMP** – Impacts and mitigation measures – Monitoring and reporting requirements – Non-compliance and corrective actions	3 (once prior to start of construction, and then once during years 2 to 3)	2	30	**Training Development** Fixed costs: $2,000 per course delivery x 3 = $ 6,000
Operation Phase Environment, Health and Safety Plan Training	Environment Expert	PMO, subborrower	**ADB and PRC laws, regulations and policies** – ADB's safeguard policy statement – Project applicable PRC environmental, health and safety laws, policies, standards and regulations – International environmental, health and safety management practice in civil irrigation and drainage operation **GRM** – GRM structure, responsibilities, and timeframe – Types of grievances and eligibility assessment **Implementation of Operation Phase EMP** – Impacts and mitigation measures – Monitoring and reporting requirements – Non-compliance and corrective actions	3 (once prior to start of operation, and then once during years 2 and 3)	2	30	**Training Development** Fixed costs: $2,000 per course delivery x 3 = $6,000
			Total	**6**		**60**	**$12,000**

F. Reporting Requirements

16. The subborrower will submit semi-annual environmental monitoring reports during construction phase and annual reports during operation phase to the PMO on the implementation and compliance with the EMP, including information on all spills, accidents, grievance received, and appropriate actions taken.

17. CECEP will review these reports and consolidate them with the environmental monitoring reports from other subborrowers and submit to ADB.

18. The environmental reporting requirements are summarized in the **Table 5**.

Table 5: Reporting Requirements

Report	Prepared by	Submitted to	Frequency
A. Construction Phase			
Environmental monitoring reports	PMO	EA reviews and submits to ADB	Semi-annually
B. Operation Phase			
Environmental monitoring report	PMO	EA reviews and submits to ADB	Annually

ADB = Asian Development Bank, CECEP = China Energy Conservation and Environmental Protection Group, EA = executing agency.

G. Performance Indicators

19. Performance indicators (**Table 6**) have been developed to assess the implementation of the EMP. These indicators will be used to evaluate the effectiveness of environmental management.

Table 6: Performance Indicators

No.	Description	Indicators
1	Staffing	(i) PMO established with appropriately qualified staff including Environmental Officer. (ii) Appropriately qualified environmental expert recruited if needed. (iii) Third party environmental monitoring entity engaged.
2	Budgeting	(i) Environment mitigation cost during construction and operation is sufficiently and timely allocated. (ii) Environment monitoring cost is sufficiently and timely allocated. (iii) Budget for capacity building is sufficiently and timely allocated.
3	Monitoring	(i) Compliance monitoring is conducted by subborrower per EMP and EMoP. (ii) Construction and operation phase ambient air quality and effluent monitoring is conducted by a third party environmental monitoring entity.
4	Supervision	(i) EA reviews the implementation of EMP; (ii) ADB reviews consolidated environmental monitoring reports.

No.	Description	Indicators
5	Reporting	(i) Semi-annual environmental monitoring reports during construction phase and annual reports during operation phase prepared by the subborrower are submitted to EA.
6	Capacity Building	(i) Training on ADB safeguard policy, EMP implementation, and GRM is provided during subproject implementation.
7	Grievance Redress Mechanism	(i) GRM contact persons are designated at all subborrowers and the PMO, and GRM contact information disclosed to the public before construction. (ii) All complains are recorded and processed within the set time framework in the GRM of this IEE.
8	Compliance with PRC standards	(i) Subproject complies with the PRC's environmental laws and regulations and meets all required standards.

ADB = Asian Development Bank, CECEP = China Energy Conservation and Environmental Protection Group, EMP = environmental management plan, EMoP = environmental monitoring plan, IEE = initial environmental examination, PMO = project management office.

H. Estimated Budget for EMP Implementation

20. The estimated budget for EMP implementation of the subproject is presented in **Table 6**. Costs are presented for mitigation implementation, ambient monitoring, capacity building, and GRM implementation. The costs do not include salaries of PMO staff.

I. Mechanisms for Feedback and Adjustment

21. The effectiveness of mitigation measures and monitoring plans will be evaluated through a feedback reporting system. If, during compliance inspections and monitoring, substantial deviation from the EMP is observed, PMO will consult with CECEP and propose appropriate corrective action plan.

22. Any major EMP adjustments will be subject to ADB review and approval and ADB may pursue additional environmental assessment and, if necessary, further public consultation. The revised EMP with ADB confirmation is subject to reposting on the ADB's website as the ADB public communications policy requires. The revised EMP will be passed on to the subborrower for implementation.

Table 7: Estimated Budget for Implementing EMP

Construction Phase							
1. Ambient Monitoring	**Unit**	**Unit Cost**	**# Times**		**$**	**CNY**	**Source of Funds**
Air - TSP	Quarterly	$ 300	12	$	3,600	¥24,512	Counterpart Financing
Noise	Quarterly	$ 200	12	$	2,400	¥16,342	
Subtotal				***$***	***6,000***	***¥40,854***	
2. Capacity Building	**Unit**	**Course Cost**	**# Times**		**$**	**CNY**	
Construction Phase HSE Plan Development and Training	HSE Plan Development	$ 2,000	8	$	16,000	¥108,944	Counterpart Financing
	HSE Course Development	$ 2,000	1	$	2,000	¥13,618	
	HSE Course Delivery	$ 4,000	1	$	4,000	¥27,236	
Subtotal				***$***	***22,000***	***¥149,798***	
TOTAL Construction Phase					**$**	**CNY**	
				$	***28,000***	***¥190,652***	
Operation Phase (first 2 years)							
	Unit	**Unit Cost**	**# Times**		**$**	**CNY**	Counterpart Financing
1. Exhaust Emissions Monitoring	Seasonal Sampling	$ 500.00	8	***$***	***4,000***	***¥24,809***	
2. Ambient Monitoring	**Unit**	**Unit Cost**	**# Times**		**$**	**CNY**	
Noise	Seasonal Sampling	$ 200	12	$	2,400	¥16,342	Counterpart Financing
Wastewater	Seasonal Sampling	$ 250	12	$	3,000	¥20,427	
Subtotal				***$***	***5,400***	***¥36,769***	
3. Capacity Building	**Unit**	**Course Cost**	**# Times**		**$**	**CNY**	
Construction Phase HSE Plan Development and Training	HSE Plan Development	$ 2,000	8	$	16,000	¥108,944	Counterpart Financing
	HSE Course Development	$ 2,000	1	$	2,000	¥13,618	
	HSE Course Delivery	$ 4,000	1	$	4,000	¥27,236	
Subtotal				***$***	***22,000***	***¥149,798***	
TOTAL Operation Phase					**$**	**CNY**	
				$	***31,400***	***¥213,803***	
GRAND TOTAL Construction + Operation					**$**	**CNY**	
				$	***59,400***	***¥404,455***	

APPENDIX II: ENVIRONMENTAL AUDIT OF EXISSTING FACILITY– LIHENG COKING PLANT

A. Introduction

1. This is an environmental audit of the Liheng Coking Plant, conducted as part of the preparatory assistance for the development of the proposed coking oven gas utilization subproject.

2. The subproject will be located within the existing premises of the Liheng Coking Plant. The Liheng Coking Plant is an existing facility, and per ADB SPS 2009, an environmental audit of the existing facility is required.

B. Environmental Audit Approach

3. This report is based on a site visit, consultations with Liheng Coking Plant managers and technical staff, and a review of plant environmental and technical documents. The site visit was undertaken on 14 March 2017.

4. Documentation reviewed during and after the facility visit included:
   (i) PRC Project Environmental Impact Assessment (EIA) reports;
   (ii) EIA approval by Linfen EPB;
   (iii) Project environmental monitoring reports (Linfen EPB);
   (iv) Continuous emissions monitoring system (CEMS) data;
   (v) third party ISO Certifications;
   (vi) Health and Safety regulations; and,
   (vii) Environment and Safety and Management System Manual.

C. Project Description

1. Type

5. The Liheng Coking Plant is an existing coal-fired coking plant used for coke production in Gaoxian Town, Quwo County, Linfen City, Shanxi Province, PRC. The facility is owned and operated by the Shanxi Liheng Iron & Steel Co., Ltd.

2. Location

6. The Liheng Coking Plant is located on a 30 hectare site at West Ligang Road, 10-million-ton Steel Recycling Industrial Park (**Error! Reference source not found.**). The general area is predominantly industrial zone. The north of the Liheng Coking Plant is Datong-Puzhou Railway; south of the plant is We Ligang Road and Zhongyu Steel Company; west of the plant is Shanxi Liheng Iron & Steel Co. Ltd (Liheng) and east of the plant is Sinopec Quwo subcompany.

Figure 1: Liheng Coking Plant location

Source: Google Maps, 2017.

Figure 2: Liheng Coking Plant and Surrounding Area

Source: Google Maps, 2017

7. **Figure** 3 shows an aerial view of the Liheng Coking Plant including the subproject site, coal storage room, different workshops and stacks.

Figure 3: Liheng Coking Plant layout showing subproject 4 location

Source: Google Maps 2017

Figure 4: Subproject site at Liheng Coking Plant

Source: TA Consultants.

3. Purpose and Capacity

8. The Liheng Coking Plant was constructed in 2011 and finished in 2015. Annual production capacities of various products of the Plant are presented **Table 1**1. Annual coal consumption is 2,110,350 tons.

Table 1: Capacity of Liheng coking plant

NO	Production	Capacity
1	Coke	1.45 million
2	Coke oven gas	646.37 million m^3
3	Tar	77600 tons
4	sulphur	2798 tons
5	Ammonium Sulphate	19185 tons
6	crude benzene	18180 tons
7	ammonium thiocyanate	1386 tons
8	ammonium sulfate	1500 tons
7	Power generation	763 million kWh

kWh = kilowatt-hour, m^3 = cubic meter.

4. Emission Controls and Stacks

9. The Liheng Coking Plant currently is equipped with 4 x 15 megawatt (MW) turbines for power generation, 4 x 19 ton per hour (t/h) waste heat recovery boilers and one extraction condensing turbine to make full use of extra coke oven gas. The turbines are equipped with low NOx burners for NOx control.

10. Coke oven is equipped with wet magnesium oxide (MgO) flue gas desulfurization (FGD) scrubbers for SO_2 removal in the exhaust gas and selective catalytic reduction (SCR) denitrification for NOx removal.

11. There are two stacks in the facility. One 145 m stack is used to exhaust flue gases from the 4 x 15 MW turbines and coke oven. Another 35.5 m stack is used to exhaust gas from desulfurization tower.

Figure 5: Two stacks of Liheng Coking Plant

Source: Consultant.

5. Fuel

12. Coal is primarily sourced from Shanxi province and transported to coking plant for production by vehicles. Coal characteristics are presented in Table 2. Coal is stored onsite in a storage room.

Table 2: Coal Characteristics

Indicator	1 x 130 t/h PC Steam Boilers
Heat Value (Kcal/kg)	5,300–6,000
Moisture (%)	≤10
Sulphur content (%)	≤0.8
Vdaf (%)	18–23
Ash Fusion Temperature (°C)	＞1300
Grindability Index	＞1.5

Kcal/kg = kilocalorie per kilogram, t/h = ton per hour, Vdaf = volatile matter contents on dry ash basis.
Source: Liheng

Figure 6: Liheng coal storage room

Source: Consultant.

6. Water Supply and Wastewater

13. The Liheng Coking Plant uses water from the municipal water for its production and domestic water. Production water is treated by ion exchange system. The total annual water consumption at the plant is 1.7 million m^3.

14. Domestic wastewater is discharged to the municipal sewer and treated at the adjacent wastewater treatment plant (WWTP). All of the production wastewater is treated at onsite WWTP, and then recycled.

7. Solid Wastes

15. Domestic waste is collected by local sanitation department and sent to Quwo Landfill for treatment.

16. Hazardous wastes, such as waste catalyst is sent to a Shanxi Environmental Protection Bureau (EPB) certified hazardous waste treatment facility for treatment. Other production wastes are collected and combined with coal, then used for coke production.

D. Environmental Management

1. Environmental Impact Assessment

17. The Liheng Coking Plant is in compliance with all relevant PRC EIA requirements. The environmental assessment process has been an ongoing one as the plant has been expanded and upgraded. The EIA approval and environmental monitoring reports were provided to the audit team (see **Annexes 1** to **4**).

2. Relevant Environmental Standards

18. **Table 3** presents a summary of relevant emission standards applicable to the Liheng Coking Plant.

Table 3: Summary of Environmental Pollution Standards Applicable to the Liheng Coking Plant

Pollutant	Limit	Standard
Stack Emissions	At stack outlet	Table 5 of *Emission standards of pollutants for coking chemical industry* (GB 16171—2012).
Fugitive PM	1.0 mg/m^3 at site boundary	Table 2 of Integrated Emission Standard of Air Pollutants (GB 16297-1996)
Noise		
Daytime Noise (06:00–22:00 h)	60 dB(A) at site boundary	Class II Emission Standard for Industrial Enterprises at Site Boundary (GB 12348-2008)
Nighttime noise (22:00–06:00 h)	50 dB(A) (at site boundary)	
Wastewater	At discharge point to municipal waste water system	Table 2 of *Emission standard of pollutants for coking chemical industry* (GB 16171—2012).

dB (A) = A-weighted sound pressure level in decibels, mg/m^3 = milligram per cubic meter, PM = particulate matter.
Source: PPTA consultant

19. **Table** 4 presents the relevant ambient air quality standards: *Class II*, *Ambient Air Quality Standards* (GB 3095—2012) for the Liheng Coking Plant surrounding urban area, while Table 5 presents ambient noise standard: *Class II, Environmental Quality Standards for Noise* (GB3096-2008). There is no applicable surface water quality standard as all domestic wastewater from the plant is discharged to the municipal sewer.

Table 4: Applicable ambient air quality standards

Pollutants	Annual mean (class 2) mg/m^3	24-hr mean (class 2) mg/m^3	1-hr mean (class 2) mg/m^3
TSP	0.200	0.300	--
PM_{10}	0.070	0.150	--
$PM_{2.5}$	0.035	0.075	--
SO_2	0.060	0.150	0.500
NO_2	0.040	0.080	0.200

NO_2 = nitrogen dioxide, mg/m^3 = $PM_{2.5}$ = particulate matter with diameter less than 2.5 micrometers, PM_{10} = particulate matter with diameter less than 10 micrometers, SO_2 = sulphur dioxide, TSP = total suspended particle.
Source: PPTA consultant

Table 5: Applicable ambient environment noise standards

Item	Class II
Daytime Noise (06:00-22:00 h)	60 dB(A)
Nighttime noise (22:00-06:00 h)	50 dB(A)

dB (A) = A-weighted sound pressure level in decibels.
Source: PPTA consultant

3. Environmental Monitoring

20. The Liheng Coking Plant is equipped with a continuous emissions monitoring systems (CEMS) that monitors in real time SO_2, NOx, PM, and air flow. Data is sent electronically to the Linfen EPB Data Center. The Linfen EPB monitors daily average concentrations, and staff indicates that the EPB can be on site within as little as 1 hour if the CEMS indicates serious noncompliance.

4. Compliance

21. According to the interview with Liheng Coking Plant staff, the plant has been operating in compliance with relevant emission standards.

22. Third party wastewater and exhaust gas of coking oven monitoring reports given to the auditing team indicate that the coking plant was in compliance with relevant standards.

23. Noise monitoring is undertaken on a quarterly basis. The plant staff reported that the plant is in compliance with the relevant noise standards (*Emission Standard for Industrial Enterprises at Site Boundary* (GB 12348-2008) Class 2: 60 dB(A) from 06-22 h, and 50 dB(A) from 22-06 h), and that no noise complaints have been received.

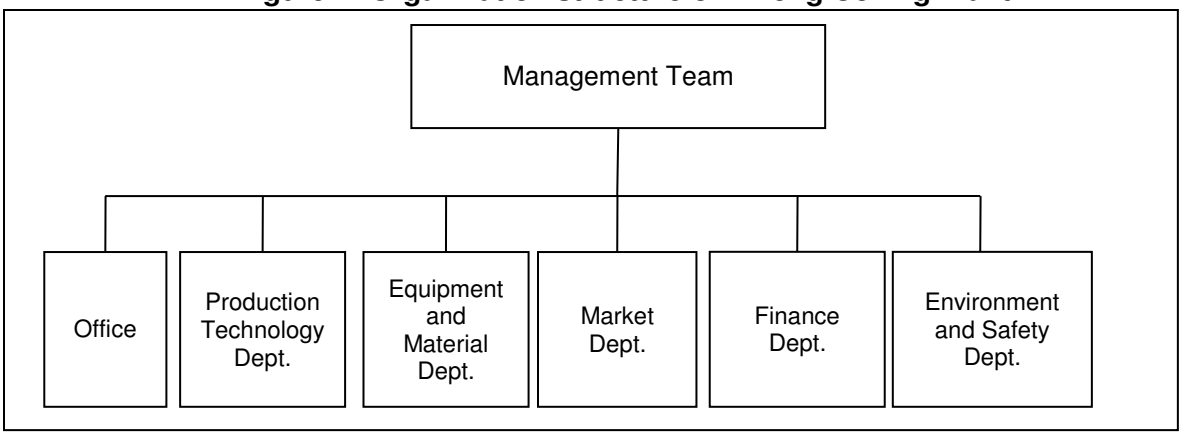
24. Wastewater is monitored on a quarterly basis. Discharged wastewater must comply with *Emission standard of pollutants for coking chemical industry* (GB 16171—2012).

5. ISO Certification, Staffing and Environmental Management

25. The Liheng Coking Plant's parent company, Liheng, has been certified for ISO 9001 (Quality Management Systems), ISO 14001 (Environmental Management Systems) and OHSAS 18001 (Occupational Health and Safety).

26. The facility has a total of 600 staff. Environmental, health and safety (EHS) responsibilities are assigned to the Environment and Safety Department, which has a staff of 4 and includes an environment engineer and a safety engineer (**Figure**).

Figure 7: Organization structure of Liheng Coking Plant



27. The Liheng Coking Plant has an Environment and Safety Management System. A copy of the latest management system manual (2016) was shown to the audit team. The manual refers to a series of procedural control documents for environmental, safety and occupational health management that the coking plant must comply with, including:

- Identification and assessment of environmental factors;
- Obtaining the update of laws, regulations and other requirements;
- Environment policies, targets, indicators and environment management programs;
- Wastewater management;
- Energy and resources;
- Environmental monitoring and monitoring equipment;
- Compliance assessment;
- Emergency preparation and response;
- Occupational health and safety;
- Safety management system;
- Safety and fire protection responsibility;
- Safety management content;
- Check and rectification of potential dangers;
- Safety education for staff;
- Special operation training management;
- Report and treatment procedures for accidents;
- Personal protection equipment management;
- Safety production expenses management.
- Prevention and corrective measures.
- Management of occupational hazardous factors;
- Operation and management of occupational hazard factors protection facilities;
- Personal protection equipment management;
- Occupational hazardous factors monitoring;
- Management of occupational hazardous factors monitoring points;
- Environment assessment of work place;
- Notice of occupational hazardous factors;
- Occupational hazardous factors control and prevention;

- Emergency plan for occupational hazard accident;
- Publicity and education;
- Noise standard and noise control;
- High-temperature control.

28. The manual is annually reviewed and updated as required.

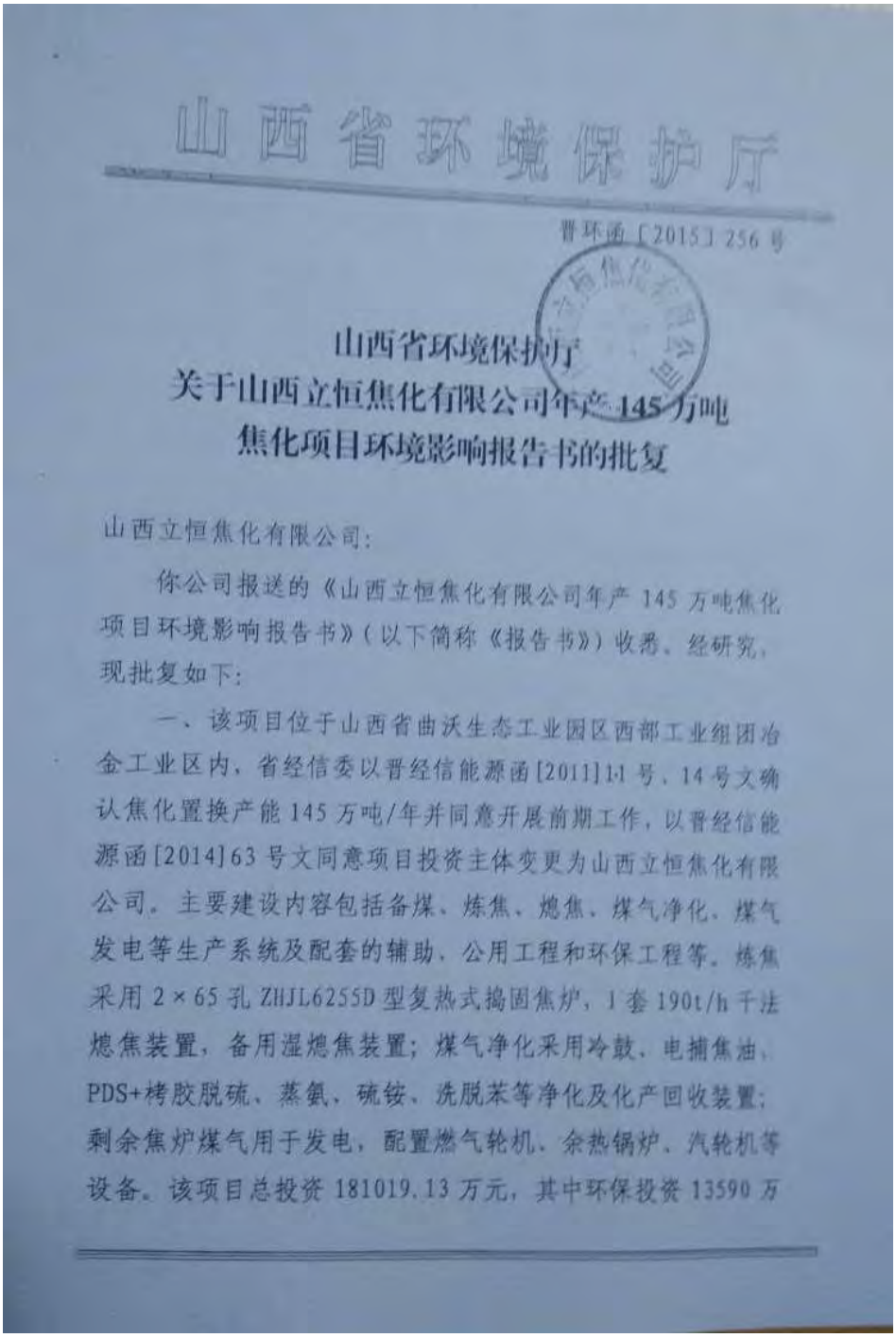
E. Conclusion

29. The Liheng Coking Plant has undergone an appropriate environmental impact assessment process and has received the necessary Environmental Acceptance by the Linfen EPB. The facility is ISO 9001, 14001 and 18001 certified, and there are environmental, health, and safety polices and systems in place.

30. Combustion exhaust gas is treated to meet relevant standards, and wastewater is either recycled or treated at the local and onsite municipal WWTP. Hazardous waste is treated at a certified facility.

31. According to the interview with Liheng Coking Plant staff, the plant has been operating in compliance with relevant standards ever since it became operational.

ANNEX I EIA APPROVAL



山西省环境保护厅

晋环函〔2015〕256号

山西省环境保护厅
关于山西立恒焦化有限公司年产145万吨
焦化项目环境影响报告书的批复

山西立恒焦化有限公司：

你公司报送的《山西立恒焦化有限公司年产145万吨焦化项目环境影响报告书》（以下简称《报告书》）收悉。经研究，现批复如下：

一、该项目位于山西省曲沃生态工业园区西部工业组团冶金工业区内，省经信委以晋经信能源函[2011]1-1号、14号文确认焦化置换产能145万吨/年并同意开展前期工作，以晋经信能源函[2014]63号文同意项目投资主体变更为山西立恒焦化有限公司。主要建设内容包括备煤、炼焦、熄焦、煤气净化、煤气发电等生产系统及配套的辅助、公用工程和环保工程等。炼焦采用2×65孔ZHJL6255D型复热式捣固焦炉，1套190t/h干法熄焦装置，备用湿熄焦装置；煤气净化采用冷鼓、电捕焦油、PDS+栲胶脱硫、蒸氨、硫铵、洗脱苯等净化及化产回收装置；剩余焦炉煤气用于发电，配置燃气轮机、余热锅炉、汽轮机等设备。该项目总投资181019.13万元，其中环保投资13590万

元。根据山西省环境保护技术评估中心对《报告书》的评估报告、临汾市环境保护局对《报告书》的初审意见，在严格落实《报告书》提出的各项环境保护对策措施的情况下，可做到污染物达标排放并满足总量控制指标要求，同意《报告书》和评估报告对该项目建设环境保护可行的结论。

二、在项目建设和运行管理中，应重点做好以下工作：

（一）强化大气污染防治措施。精煤堆场全封闭，精煤破碎、转运均采用封闭式设计；装煤、推焦烟气送“二合一”地面站采用脉冲布袋除尘器处理，采用弹性刀边炉门、水封式上升管等措施控制无组织逸散，干熄焦废气送除尘地面站采用脉冲布袋除尘器处理，焦炉燃用净化后的煤气，烟气采用 SCR 工艺尾部脱硝，通过 145 米高烟囱排放，炼焦工段其余各产尘点均采用脉冲布袋除尘器处理；煤气净化工段脱硫再生尾气送洗涤塔用蒸氨废水洗涤，硫铵干燥尾气经旋风除尘+湿式洗涤净化处理，粗苯管式炉燃用净化后的煤气，焦油贮槽、循环氨水中间槽、苯贮槽放散气送排气洗净塔用蒸氨废水洗涤，外排废气执行《炼焦工业污染物排放标准》（GB16171-2011）表 5 规定的限值，焦炉炉顶及厂界执行表 7 规定的限值。剩余焦炉煤气经精脱硫装置使 $H_2S \leqslant 20mg/m^3$ 后用于发电，采用低氮燃烧技术，外排废气执行《火电厂大气污染物排放标准》（GB13223-2011）表 1 中以气体为燃料的燃气轮机组规定的限值。

（二）严格落实水污染防治措施，做到清污分流、雨污分流，实现废水分类收集、分质处理。冷鼓剩余废水、粗苯分离

水、煤气终冷水、物料贮槽分离水送蒸氨工段处理；炼焦水封水、蒸氨废水、生活化验污水送生化站采用 A^2/O 工艺处理，处理后的废水作为立恒钢铁公司高炉冲渣用水和湿法熄焦运行时的熄焦补充水；循环系统排污水和锅炉排污水、脱盐水站排水送园区内的山西福瑞鑫污水处理有限公司处理，处理后的废水回供园区冶金企业做循环系统补充水，浓相水供冶金企业高炉冲渣、转炉闷渣、原料场喷洒用水，不外排。

（三）合理处置各类固体废弃物，严防造成二次污染。焦油渣、酸焦油渣、沥青渣、脱苯再生残渣、废油渣、生化污泥、除尘灰掺煤炼焦，废脱硫吸附剂由供应企业回收处理，要按照《危险废物贮存污染控制标准》（GB18597-2001）的要求在厂内设暂存设施，废焦炭、焦粉送立恒钢铁公司烧结高炉综合利用。

（四）本项目主要噪声源主要为振动筛、空压机、汽轮机及各种风机、泵类等。应选用低噪声设备，并采取消声、隔声、基础减振等防噪措施。厂界噪声执行《工业企业厂界环境噪声排放标准》（GB12348-2008）中 2 类规定的限值。

（五）你公司要建立有效的环境风险防范与应急管理体系并不断完善，最大限度地减少因生产安全事故引发突发环境事件造成的危害，按照国家和省有关突发环境事件应急预案管理的规定，编制突发环境事件应急预案，并在试生产前完成在环保部门的备案。

（六）认真履行《报告书》制定的环境管理和监测计划。配备必要的监测仪器设备，规范排污口的建设，在焦炉烟囱、

地面站排气筒、废水生化处理站出口安装在线监测装置，及时掌握污染物排放情况，并采取相应的环保措施，确保污染物长期稳定达标排放。

（七）该项目主要污染物排放总量控制指标为：二氧化硫339.58吨/年、氮氧化物1121.7吨/年、烟尘267.3吨/年、粉尘50.6吨/年。

（八）积极配合当地政府部门，加快落实不满足本项目防护距离要求的段家村、常家村共54户居民的搬迁安置，在搬迁工作完成后方可投入试生产。

三、项目建设必须严格执行配套建设的环境保护设施与主体工程同时设计、同时施工、同时投产使用的环境保护“三同时”制度，实行环境工程监理。项目建成后，要按规定申请试生产和竣工环境保护验收，经验收合格后，项目方可正式投入运行。

四、委托临汾市环保局、曲沃县环保局对本项目进行“三同时”监督检查和日常管理工作。

山西省环境保护厅

2015年3月17日

抄送：临汾市环保局，曲沃县环保局，山西省环境保护技术评估中心，山西省环境科学研究院。

ANNEX II ISO CERTIFICATION

ISO 14001 certification

ISO 9001 certification

管理体系认证证书

兹证明

山西立恒钢铁集团股份有限公司

组织机构代码：74601277-X

地址：山西省临汾市曲沃县高显镇西白集村　　邮编：043400

质量管理体系符合

GB/T 19001-2008 / ISO 9001：2008

本证书覆盖范围

普通炼钢用生铁、常用普通碳素钢和热轧光圆钢筋的生产

（有许可要求时在许可证范围内）

初次认证日期：2008 年 12 月 10 日　　本次发证日期：2016 年 01 月 18 日

有　效　期：2014 年 12 月 08 日至 2017 年 12 月 07 日

证　书　号：04514Q20865R2L　　总　经　理：郑宇兵

IAF　CNAS　中国认可 国际互认 管理体系 MANAGEMENT SYSTEM CNAS C045-M

北京大陆航星质量认证中心股份有限公司

地址：北京市海淀区玉渊潭甲12号七层　　邮编：100143

OHSAS 18001 certification

中经认证
注册号：04416S20475R0L

职业健康安全管理体系
认证证书

兹证明

山西立恒钢铁集团股份有限公司

组织机构代码：74601277-X
注册地址：曲沃县高显镇西白集村
审核地址：山西省临汾市曲沃县高显镇西白集村

职业健康安全管理体系符合
GB/T 28001-2011/OHSAS 18001:2007 标准

该体系覆盖范围

炼钢用生铁、普通碳素结构钢坯、
钢筋混凝土用热轧光圆钢筋生产的相关职业健康安全管理

颁证日期：2016年07月19日　　有效期至：2019年07月18日

北京中经科环质量认证有限公司　　总经理：

日　期：2016年07月19日

公众号　证书查询

中国认可
管理体系
MANAGEMENT SYSTEM
CNAS C044-M

Initial Environmental Examination (Draft)

November 2017

People's Republic of China: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility (Smart Industrial Zone Development Subproject)

Prepared by China Energy Conservation and Environmental Protection Group for the Asian Development Bank

CURRENCY EQUIVALENTS

(as of 7 November 2017)

Currency unit	–	yuan (CNY)		
CNY1.00	=	$0.1514	or	€0.1299
$1.00	=	CNY6.6045	or	€0.8578
€1.00	=	CNY7.6995	or	$1.1658

ABBREVIATIONS

ADB	Asian Development Bank
AP	Affected Person
AQI	Air Quality Index
CCHP	Combined cooling, heat and power
CECEP	China Energy Conservation and Environmental Protection Group
EA	Executing Agency
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EMS	Environmental Monitoring Station
EPB	Environmental Protection Bureau
ESMS	Environment and Social Management System
FSR	Feasibility Study Report
GDP	Gross Domestic Product
GHG	Green House Gas
GIP	Good International Practice
GRM	Grievance Redress Mechanism
IA	Implementing Agency
IEE	Initial Environmental Examination
IT	Interim Target
MAC	Maximum Acceptable Concentration
MEP	Ministry of Environmental Protection
MSDS	Material Safety Data Sheet
NG	Natural Gas
PCR	Physical Cultural Resources
PPE	Personnel Protective Equipment
PPTA	Project Preparatory Technical Assistance
PRC	People's Republic of China

PV	Photovoltaic
SPS	Safeguard Policy Statement, ADB
TA	Technical Assistance
WB	World Bank
WHO	World Health Organization

WEIGHTS AND MEASURES

BOD_5	Biochemical Oxygen Demand, five days
$CaCO_3$	Calcium Carbonate
cm	Centimeter
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
dB(A)	A-weighted sound pressure level in decibels
DO	Dissolved Oxygen
kg	Kilogram
km	Kilometer
kWh	Kilowatt Hour
Leq	Equivalent Continuous Noise Level
m	Meter
m/s	Meters per Second
m^2	Square Meters
m^3	Cubic Meters
mg/l	Milligrams per Liter
mg/m^3	Milligrams per Cubic Meter
$\mu g/m^3$	Micrograms per Cubic Meter
NO_x	Nitrogen Oxides
^oC	Degrees Celsius
O_3	Ozone
pH	A measure of the acidity or alkalinity of a solution
PM	Particulate Matter
PM_{10}	Particulate Matter smaller than 10 micrometers
$PM_{2.5}$	Particulate Matter smaller than 2.5 micrometers
SO_2	Sulfur Dioxide
t/h	Tons per Hour
TSP	Total Suspended Particulates
tce	Ton of coal equivalent

NOTES

(i) In this report, "$" refers to US dollars.

This initial environmental examination is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature. Your attention is directed to the “terms of use” section of the ADB website.

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, the Asian Development Bank does not intend to make any judgments as to the legal or other status of any territory or area.

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EXECUTIVE SUMMARY

A. Introduction

1. This is the Initial Environmental Examination (IEE) report for the Smart Industrial Zone Development Subproject of the proposed People's Republic of China (PRC): Air Quality Improvement in the Greater Beijing–Tianjin–Hebei (BTH) Region—Regional Emission-Reduction and Pollution-Control Facility. [1]

2. This subproject creates a microenergy grid network consisting of six sub-microenergy grids, including incorporation of renewable energy technology and energy storage technology. In doing so, it addresses energy production and supply issues under various resource circumstances, while meeting a range of customers' demands. It further optimizes energy utilization by allowing for energy trading between the subgrids, and an islanded interconnection with the regional grid for bidirectional trade of power.

B. Policy, Legal and Administrative Framework for Environmental Impact Assessment

3. The environmental impact assessment (EIA) procedures have been established in the PRC for over 20 years. Domestic EIA studies are required to be undertaken by relevant PRC environmental laws and regulations. National and local legal and institutional frameworks for EIA review and approval ensure that proposed projects are environmentally sound, designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environment, health, social, or safety hazards.

4. Following ADB's Safeguard Policy Statement (SPS 2009), an Environmental and Social Management System (ESMS) for the Financial Intermediation Loan (FIL) has been formulated to provide the screening, categorization, and review procedures for subproject selection. In implementing this FIL, subprojects should follow the screening and categorization procedures set out in the ESMS. The subproject has been classified as environment category B following SPS 2009 and the ESMS, and an IEE including an environment monitoring plan (EMP) is required.

C. Implementation Arrangements

5. Integrated Electronic Systems Lab Co., Ltd (iESLab) will be the subborrower for this ADB FIL and responsible for day-to-day management during project preparation and implementation. China Energy Conservation and Environmental Protection Group (CECEP) will be the executing agency (EA) and the implementing agency (IA) and responsible for overall guidance and supervision during subproject preparation and implementation.

D. Description of the Environment

1. Location and Topography

6. The subproject is in Sun Village, High-Tech Zone, Jinan City of Shandong Province. Jinan City, with a total area of 10,356 km^2, is located in the northwest of the north shore of the Yellow River, bordering Hebei Province in north. It is located at east longitude 115°45'~117°36', northern

[1] The greater BTH region comprises Beijing and Tianjin municipalities, the provinces of Hebei, Henan, Liaoning, Shandong, Shanxi, and Inner Mongolia Autonomous Region.

latitude 36°24 '~38°00'. It is near the Dezhou City in south and Binzhou City in east.

7. Jinan City occupies a transition zone between the northern foothills of the Taishan Massif to the south-southeast and the Yellow River Valley to the north and northwest. Karst aquifers in limestone formations sloping down from the south to the north give rise to many artesian springs in the city center as well as in surrounding areas. Within the subproject area the topography is generally flat.

2. Meteorology and Climate

8. Jinan has a temperate continental climate with four distinct seasons. It is dry in the spring, hot and rainy in the summer, cool in the autumn, and dry and cold in the winter. The average annual temperature in Jinan is 16.6°C; the average summer average temperature is 26°C and the maximum recorded summer temperature was 42.7°C. The average temperature in the 41 coldest month of winter is below 0°C, and the lowest maximum recorded temperature is -19.5°C. The annual average precipitation in Jinan from 1950–2011 was 685 mm and 65.9% of this occurs in June, July, and August.

3. Water Resources

9. Annual average water resource of Jinan City is 1.748 billion m^3. The per capita water resource is only 292 m^3.

4. Ecological and Sensitive Resources

10. The subproject site is located in Jinan Hi-tech Industrial Development Zone. Surrounding land uses include industrial, mixed commercial and residential areas with little or no vegetation cover. There are no known rare or endangered flora or fauna, parks, nature reserves or areas with special national, regional or local ecological significance within or adjacent to the subproject site.

5. Socioeconomic Conditions

11. Jinan is the political, economic, cultural, scientific, educational, and financial center of the province, and has been designated with sub-provincial administrative status since 1994.

12. In 2016, the city's GDP was CNY653.61 billion, of which the primary sector accounted for 4.9% or CNY32.03 billion; the secondary sector accounted for 36.2% or CNY236.61 billion; and the tertiary sector accounted for 58.9% or CNY384.98 billion.

6. Physical Cultural Resources

13. Jinan is an accredited famous historic and cultural city for its long-standing history and culture. Historic sites include Chengziya Longshan Culture Site, Guo's Ancestral Temple of Han Dynasty at Xiaotangshan, Four Gates Pagoda of Sui Dynasty, Dragon and Tiger Pagoda of Tang Dynasty, Nine Tops Tower, and Luozhuang Han Tomb.

14. Jinan has a rich history. However, the subproject activities are all in the Jinan Hi-tech Industrial Development Zone. There are no known physical cultural resources (PCRs) in the subproject site.

E. Anticipated Impacts and Mitigation Measures

15. Anticipated positive and negative environmental impacts of the proposed project were assessed based on the domestic Feasibility Study Report (FSR) in 2016; a technical due diligence review of the FSR undertaken by ADB PPTA specialists; public consultations led by the subborrower and assisted by ADB PPTA consultants; and site visits, surveys and consultations undertaken by ADB PPTA consultants.

16. Pre-construction, construction, and operation phases were considered separately. The results of the assessment indicate that during the pre-construction phase environmental issues are very limited, and are mostly associated with ensuring appropriate incorporation of mitigation measures into the subproject design.

17. Potential negative environmental impacts during construction phase are short-term and localized, and are associated with soil erosion, construction noise, fugitive dust, disruption of traffic and community services, and risks to worker health and safety. These can be effectively mitigated through good construction and health and safety practices.

18. Potential negative impacts during operation phase are associated with solid waste, wastewater, noise, and health and safety risks to workers and community. These can be effectively mitigated through good operation and health and safety practices.

19. Potential positive operation phase impacts are significant and long-term, and are associated with emissions reductions compared to equivalent power production from coal-fired power plants. Specifically, the subproject could replace 19,470.1 tons of coal equivalent (tce), which is equivalent to 48,171.2 tons of carbon dioxide (CO_2), 280.6 tons of sulfur dioxide (SO_2),124.1 tons of nitrogen oxide (NO_X), and 369.4 ton of particulate matter (PM). The subproject also includes various energy systems such as water energy storage, small wind turbine, and middle-temperature solar thermal system, which could provide knowledge on how to integrate different energy resources into the microenergy grid.

F. Analysis of Alternatives

20. The electrical power demand in the PRC and in Shandong Province has been increasing due to the growth of economic activities. Coal has provided 64% of the primary energy consumed and 76% of electricity generation in the PRC.[2] This high proportion of fossil fuel consumption, driven by the increasing demand for energy to support rapid economic growth in the last three decades, has caused serious environmental problems. One way to mitigate this is to increase the share of renewable energy in the energy consumption structure.

21. If the subproject is not implemented, electricity from a traditional coal-fired power plant will be required to meet the increasing demand for electricity in Jinan. Implementation of the subproject will: (i) improve energy consumption structure; (ii) significantly reduce coal consumption; (iii) improve air quality; and (iv) reduce GHG emissions. It will also provide valuable experience in developing microenergy grid to meet the increasing energy demand. Its experience on mitigating some of the technology risks associated with microenergy grid will be valuable as well.

[2] 2016 China Statistical Yearbook. http://www.stats.gov.cn/tjsj/ndsj/2016/indexeh.htm.

G. Information Disclosure and Public Consultations

22. Once the domestic EIA is completed, Jinan Environmental Protection Bureau (EPB) will post it on its website as part of the EIA review and approval process. In addition, the subborrower will also post the domestic EIA and this IEE report on its website.

23. The subborrower undertook one public consultation in May 2017 in which information was presented on the subproject status, potential environmental impacts and proposed mitigation measures. Participants were asked to complete a questionnaire. A total of 45 questionnaires were distributed. 100% of the respondents work and live within a 5-km radius of the subproject; 100% of respondents knew the subproject either from other people or information signs, and 97.8% of respondents indicated that they were already familiar with the subproject benefits after the introduction the subproject. The top two environment issues respondents identified in their neighborhoods are air quality (77.8%) and solid waste (68.9%). Groundwater quality, dust and noise were identified as the top three issues during both the construction and operation phases. However, most participants also indicated that potential air, waste water, solid waste and noise impacts can be appropriately mitigated.

24. Overall support for the subproject is very strong; 88.9% of the respondents indicated that the subproject will improve local economic development; 93.3% indicated that the subproject will improve quality of life; and 97.8% of respondents indicated that they support the proposed subproject.

H. Grievance Redress Mechanism

25. A subproject-level grievance redress mechanism (GRM) has been established to receive and facilitate resolution of complaints the subproject during the construction and operation phases. The GRM includes procedures for receiving grievances, recording/documenting key information, and evaluating and responding to the complainants in a reasonable timeframe. Any concerns raised through the GRM will be addressed quickly and transparently, and without retribution to the affected persons (AP).

I. Environmental Management Plan (EMP)

26. A comprehensive EMP has been developed to ensure: (i) implementation of identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of monitoring and reporting against the performance indicators; and (iii) compliance with the PRC's relevant environmental laws, standards and regulations and the ADB's SPS 2009. The EMP includes an environment monitoring plan (EMoP) to monitor the environmental impacts of the subproject and assess the effectiveness of mitigation measures, and a capacity building and training program focused on health, safety, and environment. Organizational responsibilities and budgets are clearly identified for implementation, monitoring and reporting. The EMP is presented in Appendix I.

J. Conclusion

27. Through the environmental assessment process, it is concluded that the subproject has: (i) selected appropriate technologies to improve energy structure and reduce emissions of pollutants; (ii) identified potential negative environment impacts and established mitigation measures; (iii) received public support from the subproject beneficiaries and affected people; (iv) established subproject-level GRM procedures; and (v) prepared a comprehensive EMP including

environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

28. Overall, any minimal adverse environmental impacts associated with the subproject can be prevented, reduced, or minimized through the appropriate application of mitigation measures. It is therefore recommended that: (i) the subproject is classified as environment category B; and (ii) the subproject will be supported by ADB, subject to the implementation of the commitments contained in the EMP and allocation of appropriate technical, financial and human resources by the subborrower to ensure these commitments are effectively and expediently implemented.

I. INTRODUCTION

A. The Subproject

1. The Smart Industrial Zone Development Subproject is located in Jinan High-Tech Industrial Development Zone, Sun Village, Jinan City, Shandong Province. This subproject will create a microenergy grid network consisting of six sub-microenergy grids, including incorporation of renewable energy technology and energy storage technology. In doing so, it addresses energy production and supply issues under various resource circumstances, while meeting a range of customers' demands. It further optimizes energy utilization by allowing for energy trading between the subgrids, and an islanded interconnection with the regional grid for bidirectional trade of power.

2. iESLab is the subborrower which is responsible for daily operation and equipment maintenance of the subproject.

B. Introduction of Subborrower

3. iESLab is a new high technology enterprise in the PRC. The main business of iESLab include smart grid, smart gas, smart water, and smart energy and information security. It is also a leading automation and information solution provider. iESLab is a publicly listed company on the Shenzhen Stock Board for small and medium-sized enterprises in 2010. In 2015, the revenue of the company reached nearly CNY1.5 billion.

4. iESLab Energy Co., Ltd (iESLab Energy), a wholly-owned subsidiary of iESLab, focuses on consulting, planning, designing, operation, maintenance, and investment in fields such as energy internet, microenergy grid, new energy, energy conservation management, etc., and on research and development, production and sales of related software and hardware. In April 2015, based on the technology and strategic study on energy internet and microenergy grid, iESLab Energy built the first microenergy grid demonstration project nationwide in Suncun Industrial Park, Jinan Hi-tech Industrial Development Zone, Shandong Province. The demonstration project consists of a 400-kiloWatt (kW) roof-top photovoltaic (PV) power generation system (including monocrystalline silicon and polycrystalline silicon units); 2x1, 200 kW gas-based combined cooling, heat and power (CCHP) system; 4,000 refrigeration ton measured in hours (RTH) chilled water storage system; and 5 kW wind power generator. A built-in energy management system for smart micro-grids will coordinate the multi-energy technologies to form a flexible and resilient microenergy grid. Under the smart-grid management system, the PV power generation system can operate up to 1,174 hours per year in full load, which is 10% higher than the average availability hour of 1,080 hours for PV power generation in Shandong province, providing a solution to address the current solar curtailment issue. In contrast, due to the direct control of regional power grid, the roof-top PV power generation system built in China CNR Corporation Limited, which is adjacent to iESLab Energy, operates at only 839 hours per year in full load under the same solar resource. The smart-grid energy management system explores the microenergy grid's operation and management mechanism under multi-energy technologies in various modes. It helps gain construction and management experience of microenergy grid projects, as well as technical accumulation and practical management experience for scaled-up microenergy grid construction. With the increasing need for development of smart city infrastructure concurrent with emissions reduction, the construction of microenergy grids is expected to grow rapidly in future. A microenergy grid construction and operation industry, and related equipment manufacturing industry are already emerging.

C. Report Purpose

5. ADB's environmental safeguard requirements are specified in SPS 2009. The subproject has been screened and classified as Environment Category B, requiring an IEE including an EMP.

D. Approach to report Preparation

6. This report has been prepared based on a domestic feasibility study report (FSR); a technical due diligence review of the FSR undertaken by Asian Development Bank (ADB) project preparatory technical assistance (PPTA) consultants; public consultations with key stakeholders and affected persons; and site visits, surveys and consultations undertaken by ADB PPTA environmental consultants.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

7. This IEE has been prepared in accordance with both the PRC national and local environmental legal and institutional framework and environmental assessment requirements, and applicable ADB policies, requirements and procedures.

A. PRC Environmental Legal Framework

8. The environmental protection and management system in the PRC consists of a well-defined hierarchy of regulatory, administrative and technical institutions. At the top level the People's Congress of the PRC has the authority to pass and revise national environmental laws; the Ministry of Environmental Protection (MEP) under the State Council promulgates national environmental regulations; and MEP either separately or jointly with the Administration of Quality Supervision, Inspection and Quarantine issues national environmental standards. Provincial and local governments can also issue provincial and local environmental regulations and guidelines in accordance with the national ones. In addition, national and local five-year environmental protection plans form an important part of the legal framework.

9. Key applicable PRC environmental laws are listed in **Table 1**. The implementation of environmental laws is supported by a series of associated regulations summarized in **Table 2**.

Table 1: Applicable PRC environmental laws

No.	Title of the Law	Year Issued/Updated
1	Environmental Protection Law	2015
2	National Environmental Impact Assessment Law	2003
3	Water Law	2002
4	Water Pollution Prevention and Control Law	2008
5	Air Pollution Prevention and Control Law	2000
6	Noise Pollution Prevention and Control Law	1999
7	Solid Waste Pollution Prevention and Control Law	2005
8	Water and Soil Conservation Law	2011
9	Land Administration Law	2004
10	Flood Control Law	1998
11	Forest Law	1998
12	Grassland Law	2013
13	Prevention and Control of Desertification	2002
14	Wild Fauna Protection Law	2004
15	Wild Flora Protection Law	1996
16	Agricultural Law	2003
17	Urban and Rural Planning Law	2008
18	Energy Conservation Law	2016

Source: ADB PPTA consultants.

10. In addition to environmental laws and regulations, there are occupational health and safety laws and regulations the subborrower must comply with, including the *PRC Safety Production Law* (2014), *State Administrative Regulations of Safety Production* (2003), and *PRC Prevention and Control of Occupational Diseases Law* (2011).

Table 2: National Administrative Regulations

No.	Regulation	Year Issued/Updated
1	Environmental Protection Management Regulations on Construction Project	2015
2	The PRC Basic Farmland Protection Ordinance	1998
3	The PRC Air Pollution Prevention and Control Law Implementation Rules	1997
4	The PRC Water Pollution Prevention and Control Law Implementation Rules	2000
5	The PRC Forestry Law Implementation Rules	2000
6	The PRC Water and Soil Conservation Law Implementation Rules	1993
7	The PRC Land Management Regulations Implementation Rules	1999
8	The PRC Wild Plant Protection Ordinance	1997
9	Notification of National Key Function Zoning issued by the State Council	2010
10	The PRC River Management Ordinance	1988
11	The Decision on Several Environmental Protection Issues	1996
12	The National Ecological and Environmental Protection Platform	2000
13	The State Council Decision on Deepening Reform and Strict Land Management	2004

Source: ADB PPTA consultants.

B. PRC Environmental Impact Assessment Framework

11. EIA procedures have been established in the PRC for over 20 years. Article 16 of the PRC *Law on Environmental Impact Assessment* (2003)[1] stipulates that an EIA document is required for any capital construction project producing significant environmental impacts. Projects are classified into three categories:

(i) **Category A** projects with significant adverse environmental impacts, for which a full EIA report is required;
(ii) **Category B** projects with adverse environmental impacts which are of a lesser degree and/or significance than those of Category A, for which a simplified tabular EIA report is required; and
(iii) **Category C** projects unlikely to have adverse environmental impacts, for which an EIA registration form is required.

12. A full EIA report for category A and a simplified tabular EIA report for category B are similar to ADB's EIA and IEE reports, respectively. The registration form of an EIA is similar to an ADB Category C project.

13. Applicable PRC environmental management and assessment guidelines are summarized in **Table 3**. In 2008, MEP issued "Management Guideline on EIA Categories of Construction Projects" (revised 2015). The Guideline provides detailed EIA requirements for 23 sectors and 199 subsectors based on the subproject's size, type (e.g., water resources development, agriculture, energy, waste management, etc.), and site environmental sensitivity (e.g., protected nature reserves and cultural heritage sites).

14. MEP's "Guideline on Jurisdictional Division of Review and Approval of EIAs for Construction Projects" (2009) defines which construction project EIAs require MEP review and

[1] *National Environmental Impact Assessment Law*, published on Oct. 28, 2002 and implemented in Sep 1, 2003.

approval, and which EIAs are delegated to the provincial EPBs.

Table 3: Applicable PRC environmental management and assessment guidelines

No.	Guideline	Code and/or Year Issued/Updated
1	Guideline for Technical Review of EIA on Construction Projects	HJ 616-2011
2	Management Guideline on EIA Categories of Construction Projects	2008
3	Further Enhance the Management of EIA and Preventing Environmental Risks	2012
4	Guideline on Jurisdictional Division of Review and Approval of EIAs for Construction Projects	2009
5	Guideline on EIA Categories of Construction Projects	2015
6	Interim Guideline on Public Consultation for EIA	2006
7	Technical Guidelines for EIA – General Program	HJ 2.1-2011
8	Technical Guideline for EIA – Atmospheric Environment	HJ 2.2-2008
9	Technical Guideline for EIA – Surface Water	HJ/T 2.3-1993
10	Technical Guideline for EIA – Acoustic Environment	HJ 2.4-2009
11	Technical Guideline for EIA – Groundwater Environment	HJ 610-2011
12	Technical Guideline for EIA – Ecological Impact	HJ 19-2011
13	Technical Guidelines for Environmental Risk Assessment for Construction Projects	HJ/T 169-2004

EIA = environmental impact assessment.
Source: ADB PPTA consultants.

C. Subproject Domestic EIA Report

15. The subproject was classified as environment category B under the PRC National EIA Law and Jinan Environmental Protection Bureau (EPB) requirements. A tabular-type domestic EIA Report will be prepared by the subborrower and submitted to the Jinan EPB for approval. The domestic EIA will be reviewed by the Jinan EPB. The EIA report will be revised based on EPB's comments, after which the Jinan EPB will approve the report.

D. Relevant International Agreements

16. The PRC has signed a number of international agreements regarding environmental and biological protection. Those which have potential application to the subproject are listed in **Table 4.**

Table 4: Applicable international agreements

No.	Agreement	Year	Purpose
1	Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat	1975	Preventing the progressive encroachment on and loss of wetlands for now and the future
2	Convention Concerning the Protection of the World Cultural and Natural Heritage	1986	Conserving cultural and natural heritage sites.
3	Convention on Biological Diversity	1993	Conservation and sustainable use of biodiversity.
4	UN Framework Convention on Climate Change	1994	Stabilizing GHG concentrations in the atmosphere at a level that will prevent anthropogenic induced climate change.

No.	Agreement	Year	Purpose
5	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification	1996	Fighting against desertification and mitigating the effects of drought.
6	Kyoto Protocol	2002	Controlling emissions of anthropogenic GHGs in ways that reflect underlying national differences in GHG emissions, wealth, and capacity to make the reductions.
7	Stockholm Convention on Persistent Organic Pollutants	2004	Safeguarding human health and the environment from POPs, ascertaining sound management of stockpiles and wastes that contain POPs, and taking measures to reduce or eradicate releases from intentional production and use of POPs.
8	Paris climate agreement	2015	Dealing with greenhouse gas emissions mitigation, adaptation and finance starting in the year 2020.

GHG = greenhouse gas, POP = persistent organic pollutants.
Source: ADB PPTA consultants.

E. Applicable PRC Environmental Quality Standards

17. The environmental quality standard system that supports the implementation of the environmental protection laws and regulations in the PRC is classified into two categories by function: ambient environmental standards and pollutant emission/discharge standards. Standards applicable to the subproject are presented in **Table 5**, and key standards are further elaborated below.

1. Ambient Air Quality Standards

18. Ambient air quality limits are intended to indicate safe exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Limits are given for one or more specific averaging periods, typically one-hour average, 24-hour average, and/or annual average. The PRC's recently updated *Ambient Air Quality Standards (*GB3095-2012) has two classes of limit values; Class 1 standards apply to special areas such as natural reserves and environmentally sensitive areas, and Class 2 standards apply to all other areas, including urban and industrial areas. The PRC standards for Class 2 areas are applicable for the subproject.[2]

2 On 29 February 2012, the China State Council passed the roadmap for ambient air quality standards with the aim of improving the living environment and protecting human health. The Ambient Air Quality Standards (GB 3095-2012) prescribes the first-ever limits for $PM_{2.5}$. It also modified the previous area classifications by combining Class III (special industrial areas) with Class II (residential, mixed use areas).

Table 5: Applicable PRC environmental standards

No.	Standard	Code/Date
1	Ambient Air Quality Standards	GB 3095-2012
2	Groundwater Quality Standards	GB/T 14848-93
3	Surface Water Quality Standards	GB 3838-2002
4	Environmental Quality Standards for Noise	GB 3096-2008
5	Soil Quality Standards	GB15618-1995
6	Noise Standards for Construction Site Boundary	GB 12523-2011
7	Noise Standards for Industrial Enterprises at Site Boundary	GB 12348-2008
8	Emission standards for odor pollutants	GB 14554-93

Source: ADB PPTA Consultant, 2017.

19. The World Health Organization (WHO) Air Quality Guidelines are recognized as international standards and are adopted by the World Bank Group's Environment, Health and Safety Guidelines (*EHS Guidelines)*. In addition to guideline values, interim targets (IT) are given for each pollutant by the WHO as incremental targets in a progressive reduction of air pollution. The WHO guidelines and corresponding PRC standards are presented in **Table 6**.

20. From a review of **Table 6** it can be observed that:

- For total suspended particulates (TSP), there are PRC standards but no corresponding WHO guidelines.
- For particulate matter with diameter less than 10 micrometers (PM_{10}), PRC Class 2 annual average and 24-hour average standards meet WHO IT-1 guidelines (there are no 1-hour average standards or guidelines for either PRC or WHO).
- For particulate matter with diameter less than 2.5 micrometers ($PM_{2.5}$), PRC Class 2 annual and 24-hour standards meet WHO IT-1 guidelines (there are no 1-hour standards or guidelines for either PRC or WHO).

Table 6: **PRC ambient Air Quality Standards and WHO ambient air quality guidelines (mg/m^3)**

Standard	TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	O_3	CO
WHO Ambient Air Quality Guidelines							
Annual mean	--	0.020	0.010	--	0.040	--	--
Annual mean IT-1	--	0.070	0.035	--	--	--	--
24-hr mean	--	0.050	0.025	0.020	--	--	--
24-hr mean IT-1	--	0.150	0.075	0.125	--	--	--
8-hr mean	--	--	--	--		0.100	--
8-hr mean IT-1	--	--	--	--		0.160	--
1-hr mean	--	--	--	--	0.200		0.030
1-hr mean IT-1	--	--	--	--	--		--
PRC Ambient Air Quality Standard (Class 2)							
Annual mean	0.200	0.070	0.035	0.060	0.040	--	--
24-hr mean	0.300	0.150	0.075	0.150	0.100	--	0.004
8-hr mean	--	--	--	--	--	0.160	--
1-hr mean	--	--	--	0.500	0.200	0.200	0.010

CO = carbon monoxide, mg/m^3 = milligram per cubic meter, $PM_{2.5}$ = particulate matter with diameter less than 2.5 micrometers, PM_{10} = particulate matter with diameter less than 10 micrometers, NO_x = nitrogen oxide, O_3 = ozone, SO_2 = sulfur dioxide, TSP = total suspended particulates.
Source: WHO Air Quality Guidelines (2006) in IFC *EHS Guidelines* (2007), and PRC GB 3095-2012.

- For SO_2, WHO only has a 24-hour average guideline (0.125 mg/m^3), which is slightly lower than the PRC standard (0.150 mg/m^3). However, SO_2 levels are low

in the subproject area, and the subproject will only contribute low levels of SO_2, so the very minor difference is inconsequential.

- For NO_2, the PRC standard is equivalent to the WHO annual average guidelines, there is no WHO 24-hour average guideline; and the 1-hour average PRC standard is equivalent to the WHO guideline.

21. Overall the PRC standards show a high degree of equivalency to the WHO guidelines or IT-1 values, and are adopted for use in this IEE report.

2. Combine Cooling, Heat and Power (CCHP) Plant Emissions

22. **Table 7** presents the relevant PRC national and Shandong Province gas turbine and gas boiler emission standards compared with relevant international standards (*EHS Guidelines*). The PRC standards are more stringent than the *EHS Guidelines*, and the most stringent of the national and provincial standards are applicable to the subproject.

Table 7: **Relevant PRC Natural Gas Fired and/or Fueled Boiler, Turbine and Engine Emission Standards and Relevant International Guidelines**

Parameter	***Emission Standards of Air Pollutants from Coal-Burning, Oil-Burning and Gas-Fired Boilers*** (Table 3 of GB 13271-2014)	***Emission Standards of Air Pollutants from Coal-Burning, Oil-Burning and Gas-Fired Boilers in Shandong Province*** (Table 2 of DB 37/2374-2013)	EHS Guidelines for Boilers	Comparison
Stack Height	Stack height is determined according to the requirements in the approved EIA, and must be > 8 m.	Stack height is determined according to the requirements in the approved EIA, and must be > 8 m.	Design stack height according to Good International Practice (GIP) to avoid excessive ground level concentrations and minimize impacts.	PRC standard meets GIP
PM	20 mg/Nm^3	10 mg/Nm^3	NA	No EHS guideline.
SO_2	50 mg/Nm^3	100 mg/Nm^3	NA	No EHS guideline.
NO_x	150 mg/Nm^3	250 mg/Nm^3	240 mg/Nm^3	PRC standard is more stringent than the EHS guidelines

EHS = environment health, and safety, mg/Nm^3 = milligram per cubic meter, NA = not applicable, NOx = nitrogen oxide, SO_2 = sulfur dioxide, PM = particulate matter, PRC = People's Republic of China.
Source: PRC Emission Standards of Air Pollutants from Coal-Burning, Oil-Burning and Gas-Fired Boilers (GB 13271-2014) and Emission Standards of Air Pollutants from Coal-Burning, Oil-Burning and Gas-Fired Boilers in Shandong Province (DB 37/2374-2013), and World Bank 2007.

3. Fugitive Particulate Matter Emission

23. Fugitive emission of particulate matter such as dust from construction sites is regulated under PRC's *Air Pollutant Integrated Emission Standard* (GB 16297-1996), which sets 120 mg/m^3 as the maximum allowable emission concentration and ≤ 1.0 mg/m^3 as the concentration limit at the boundary of construction sites, with no specification on the particular matter's particle diameter. There is no equivalent standard recommended in the *EHS Guidelines,* and the PRC standard is adopted for use in this IEE report.

4. Surface Water

24. PRC's *Surface Water Ambient Quality Standard* (GB3838-2002) defines five water quality categories for different environmental functions. For example, Category I is the best, such as water at sources of rivers and National Nature Reserves. Category V is the worst quality, suitable only for agricultural and scenic water uses. Based on information collection and site visit, Category V water quality standard (see **Table 8**) is applicable for the surface water near the subproject site which is Yangjia River. There are no applicable EHS guidelines or target for water quality in this context, and the PRC standard is adopted for use in this IEE report.

Table 8: Applicable surface standard

No.	Parameter	Category V Standard (mg/l, pH excluded)
1	pH	6-9
2	Dissolved Oxygen	2
3	COD_{Mn}	15
4	COD_{Cr}	40
5	BOD_5	10
6	NH_3-N	2.0
7	TP	0.4
8	TN	2.0
9	Copper	1.0
10	Zinc	2.0
11	Fluoride	1.5
12	Selenium	0.02
13	Arsenic	0.1
14	Total Mercury	0.001
15	Cadmium	0.01
16	Hexavalent Chromium	0.1
17	Lead	0.1
18	Cyanide	0.2
19	Volatile Phenol	0.1
20	Sulfide	1.0
21	Petroleum	1.0
22	Anionic surfactant	0.3
23	Coliforms	40000

BOD5 = 5-day biochemical oxygen demand, CODcr = chemical oxygen demand, CODMn = permanganate index, mg/l = milligram per liter, NH_3-N= ammonia nitrogen; pH = potential of hydrogen, TP = Total Phosphorus; TN = Total Nitrogen.
Source: PRC's Surface Water Ambient Quality Standards (GB3838-2002)

5. Groundwater

25. PRC's *Groundwater Water Ambient Quality Standards* (GB/T14848-93) also defines a number of water quality categories for different environmental functions. As groundwater is primarily used for irrigation, the Category III standard is applicable (**Table 9**). There is no equivalent standard recommended in the *EHS Guidelines,* and the PRC standard is adopted for use in this IEE report.

Table 9: Applicable groundwater standards

No	Parameter	Unit	Category III Standard
1	pH	-	6.5-8.5
2	COD_{Mn}	mg/l	3.0
3	Sulfate	mg/l	250
4	Chloride	mg/l	250
5	Volatile Phenols	mg/l	0.002
6	Total hardness ($CaCO_3$)	mg/l	450
7	Nitrate NO_{3-}	mg/l	20
8	Nitrite NO_{2-}	mg/l	0.02
9	NH_3-N	mg/l	0.2
10	Molybdenum	mg/l	0.1
11	Cyanide	mg/l	0.05
12	Cadmium	mg/l	0.01
13	Chromium VI	mg/l	0.05
14	Arsenic	mg/l	0.05
15	Zinc	mg/l	1.0
16	Fluoride	mg/l	1.0
17	Lead	mg/l	0.05
18	Iron	mg/l	0.3
19	Manganese	mg/l	0.1
20	Copper	mg/l	1.0
21	Selenium	mg/l	0.01
22	Total coliforms	/L	3.0

COD_{Mn} = permanganate index; demand; mg/l = milligram per liter, NO_{3-} = nitrate; NO_{2-} = nitrite; NH_3-N= ammonia nitrogen, pH = potential of hydrogen.
Source: PRC's Groundwater Water Ambient Quality Standard (GB/T14848-93)

6. Wastewater Discharge

29. **Table 10** presents the relevant PRC wastewater discharge standards. The *EHS Guidelines* indicate that wastewater discharged to public or private wastewater treatment systems should: meet the pretreatment and monitoring requirements of the sewer treatment system into which it discharges; not interfere, directly or indirectly, with the operation and maintenance of the collection and treatment systems, or pose a risk to worker health and safety, or adversely impact characteristics of residuals from wastewater treatment operations; and be discharged into municipal or centralized wastewater treatment systems that have adequate capacity to meet local regulatory requirements for treatment of wastewater generated from the subproject.

30. The subproject will discharge wastewater to the municipal sewer systems for treatment at Xiaoqing River municipal wastewater treatment plant. The wastewater discharges will be required to meet Class B maximum acceptable concentrations (MACs) in *Wastewater Quality Standards for Discharge to Municipal Sewers* (CJ 343-2010), and the WWTP discharges are required to meet Class 1A of *Discharge Standards of Pollutants for Municipal Wastewater Treatment Plants*

(GB 18918-2002).

Table 10: PRC *Wastewater Quality Standards for Discharge to Municipal Sewers*

No	Pollutant	Maximum acceptable concentration (MAC) mg/L (except pH and chromacity)
		Class B
1	pH	6.5–9.5
2	SS	400
3	COD	500
4	Ammonia nitrogen	45
5	TDS	2000
6	Chromacity	70
7	BOD	350
8	Total phosphorus	8

BOD = biochemical oxygen demand, COD = chemical oxygen demand, pH = potential of hydrogen, SS = suspended solid, TDS = total dissolved solid.
Source: PRC's Wastewater Quality Standards for Discharge to Municipal Sewers (CJ 343-2010)

7. Noise

26. **Table 11** presents the relevant PRC *Urban Noise Standards* compared with relevant international guidelines from the WHO (as presented in the *EHS Guidelines*). Category I and II standards are applicable to the subproject area. The classes within the standards are not directly comparable, but the PRC Category I standards are equivalent to WHO Class I standards. Category II is utilized in this IEE report.

Table 11: PRC *Environmental Quality Standards for Noise* and relevant international guidelines

PRC Standards Leq dB(A)			International Standards One Hour Leq dB(A)		Comparison
Category	**Day** 06-22h	**Night** 22-06h	**Day** 07-22h	**Night** 22-07h	
0: Areas needing extreme quiet, such as special health zones	50	40	WHO Class I: residential, institutional, educational: 55 WHO Class II: industrial, commercial: 70	WHO Class I: Residential, institutional, educational: 45 WHO Class II: Industrial, Commercial: 70	Classes are not directly comparable, but PRC Class II standards exceed WHO Class II standards. PRC standards are utilized in this report.
I: Mainly residential; and cultural and educational institutions	55	45			
II: Mixed residential, commercial and industrial areas	60	50			
III: Industrial areas	65	55			
IV: Area on both sides of urban trunk roads	70	55			

dB(a) = A-weighted decibels, Leq = equivalent continuous noise level, PRC = People's Republic of China, WHO = World Health Organization.
Source: PRC standard GB3096-2008 and World Bank EHS Guidelines

27. **Table 12** presents the relevant PRC and international standards (US EPA, there no such WHO or *EHS Guidelines* standards) for on-site construction noise. The PRC standards are more

stringent than international guidelines, and are utilized in this IEE report.

Table 12: PRC *Noise Emission Standards for Construction Site Boundary* and relevant international guidelines

Day Leq dB(A)	Night Leq dB(A)	International Standards Leq dB(A)	Comparison
70	55	US EPA: 85 (day, 8-hour exposure)	PRC standards meet or more stringent than international standards

dB(a) = A-weighted decibels, Leq = equivalent continuous noise level, PRC = People's Republic of China, US EPA = US Environmental Protection Agency.
Source: PRC standard GB12523-2011 and World Bank EHS guideline.

28. During operation noise at site boundaries should comply with Class II of the PRC *Industrial Enterprise Boundary Noise Emission Standard* (GB12348-2008) (**Table 13**).

Table 13: PRC *Noise Emission Standards for Industrial Enterprise Boundary*

Standard Type	Standard Value Leq dB(A)	
	Day	Night
Class 2	60	50

dB(a) = A-weighted decibels, Leq = equivalent continuous noise level.
Source: PRC standards GB12348-2008.

F. Applicable ADB Policies, Regulations and Requirements

29. The major applicable ADB policies, regulations, requirements and procedures for EIA are the *Safeguard Policy Statement* (SPS, 2009) and the *Environmental Safeguards–A Good Practice Sourcebook* (2012), which jointly provides the basis for this EIA. The SPS promotes good international practice as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*. The policy is underpinned by the ADB Operations Manual for the SPS (OM Section F1, October 2013).

30. The SPS establishes an environmental review process to ensure that projects undertaken as part of programs funded through ADB loans are environmentally sound, are designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environment, health, social, or safety hazards.

31. At an early stage in the project cycle, typically the project identification stage, ADB screens and categorizes proposed projects based on the significance of potential project impacts and risks. A project's environment category is determined by the category of its most environmentally sensitive component, including direct, indirect, induced, and cumulative impacts. Project screening and categorization are undertaken to:

(i) reflect the significance of the project's potential environmental impacts;
(ii) identify the type and level of environmental assessment and institutional resources required for the safeguard measures proportionate to the nature, scale, magnitude and sensitivity of the proposed project's potential impacts; and,
(iii) determine consultation and disclosure requirements.

32. ADB assigns a proposed project to one of the following categories:

(i) **Category A.** Proposed project is likely to have significant adverse environmental

impacts that are irreversible, diverse, or unprecedented; impacts may affect an area larger than the sites or facilities subject to physical works. A full EIA including an EMP is required.

(ii) **Category B**. Proposed project's potential environmental impacts are less adverse and fewer in number than those of category A projects; impacts are site-specific, few if any of them are irreversible, and impacts can be readily addressed through mitigation measures. An initial environmental examination (IEE), including an EMP, is required.

(iii) **Category C**. Proposed project is likely to have minimal or no adverse environmental impacts. No EIA or IEE is required although environmental implications need to be reviewed.

(iv) **Category FI**. Proposed project involves the investment of ADB funds to, or through, a financial intermediary.

33. Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility was categorized by ADB as FI. Following the screening and categorization procedures set out in the ESMS, the subproject has been classified by CECEP as environment category B and thus an IEE with an EMP is required.

34. SPS 2009 requires a number of additional considerations, including: (i) project risk and respective mitigation measures and project assurances; (ii) project-level grievance redress mechanism; (iii) definition of the project area of influence; (iv) physical cultural resources damage prevention analysis; (v) climate change mitigation and adaptation; (vi) occupational and community health and safety requirements (including emergency preparedness and response); (vii) economic displacement that is not part of land acquisition; (viii) biodiversity conservation and natural resources management requirements; (ix) provision of sufficient justification if local standards are used; (x) assurance of adequate consultation and participation; and (xi) assurance that the EMP includes an implementation schedule and measurable performance indicators. These requirements, which may not be covered in the domestic EIA, have been considered, and all applicable environmental requirements in SPS 2009 are covered in this IEE.

35. During the design, construction, and operation phases of a project, SPS 2009 also requires the borrower to follow environmental standards consistent with good international practice (GIP), as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*.[3] The *EHS Guideline*s contain discharge effluent, air emissions, and other numerical guidelines and performance indicators as well as prevention and control approaches that are normally acceptable to ADB and are generally considered to be achievable at reasonable costs by existing technology. When host country regulations differ from these levels and measures, the borrower/subborrower is to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower/subborrower is required to provide justification for any proposed alternatives.

3 *World Bank Group, Environmental, Health, and Safety Guidelines*, April 30, 2007, Washington, USA. http://www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

III. PROJECT DESCRIPTION

A. The Subproject

36. This subproject is based on an existing microenergy grid demonstration project and expands to include various renewable energy technologies and energy storage technology. It essentially broadens the application of the microenergy grid, addresses energy production and supply issue under various resource circumstances, and at the same time meets a range of customers' demands. The proposed microenergy grid project consists of six enterprise-level sub micro-grids, which manage and control the energy production and consumption of each enterprise. The six subgrids then form a microenergy grid that could trade energy among the enterprises based on the energy production and consumption features of each enterprise, and could connect to the regional grid to conduct bidirectional power trade.

37. **PV power generation**. It mainly utilizes monocrystalline and polycrystalline silicon modules. The nominal outputs of both modules are qualified with national mainstream products. The PV power generation system consists of solar panel (module), controller, and inverter. The inverter is capable to collect information automatically.

38. **Gas-based CCHP**. The subproject utilizes direct-fired internal combustion engine plus lithium bromide hot-chilled water unit using exhaust waste gas and hot water. Waste heat recovery from gas and cylinder sleeve water provides heat to the internal combustion engine. It recovers waste heat from gas to produce chilled/hot water for cooling/heating supply by sending high-temperature gas produced from power generator to lithium bromide hot-chilled water absorption unit. Based on the economic effectiveness and energy use, the subproject deploys a direct-fired engine for operation.

39. **Energy storage system with lithium iron phosphate (LIP) cell**. The energy storage system uses LIP cell as the cathode material, which is more secure and coherent with long recycling period and higher charging (discharging) efficiency of more than 98.5%.

40. **Compressed-air energy storage system**. The system makes use of a generator at off-peak time to compress the air into a sealed container using air compressor. The compressed air will be discharged to drive the turbine to produce electricity.

41. **Air conditioning (AC) chilled water storage system**. The system uses refrigerant at off-peak time during the night and stores the cooling energy in the form of low-temperature chilled water. During peak hours in daytime, the chilled water is pumped out to supply cooling to shift the load, increase the efficiency of primary energy utilization, reduce AC operation cost and improve the AC quality. The area covered by this system takes up 26,000 m^2. In 2016, the annual electricity consumption for the cooling period (4 months from June to September) was 145,396 kWh in total.

42. **Linear Fresnel solar thermal heating system**. The system uses arrays of mirrors as reflectors to reflect sunlight onto compound parabolic collectors (CPC), and then the CPC collect thermal energy to solar vacuum tubular collectors to produce medium-high temperature steam that could be used for power generation and heating supply.

43. **Air source heat pump**. The technology utilizes air to obtain low-temperature heat source. Through the condenser or evaporator from traditional AC equipment, the heat is extracted or

released by/from the air by heat exchange. The energy is therefore transferred into the building by recycling system to meet residents' demands for hot water, radiant floor heating and AC operation.

B. Subproject Rational

44. Jinan City is one of the cities with severe air pollution in the Greater BTH region. It is urgent that Jinan needs to develop clean energy and energy storage methods to mitigate the severe air pollution issue. The existing energy system in Jinan is a large-scale grid driven by coal-fired power plants. However, the expansion of the existing coal-based power system to meet the increased demand is not an option as Jinan has been experiencing significant pollution problems in the winter heating seasons including hazy skies and high levels of fine particulates. Thus, other alternatives to meet the growing power demand are urgently required.

45. Instead of a conventional grid, the subproject aims to build a microenergy grid, including PV power generation, gas-based CCHP, different energy storage system, linear Fresnel solar thermal heating system and air source heat pump. The microenergy grid is more flexible allowing the use of different clean and renewable energy sources.

46. The development of energy internet is a key strategy during the PRC's 13th Five Year Plan period (2016-2020). The subproject is to accelerate smart development in all fields and segments of the energy industry, including (i) the development of energy production and application equipment; (ii) enhancing energy monitoring, energy measuring, dispatching and intelligent management system; and (iii) construction of an energy internet that integrates and coordinates among energy production, energy transmission, energy consumption and energy storage using various energies. As a key area for the development of the PRC's energy industry, in conjunction with power sector reform, smart microgrid can be rapidly developed. The energy management center of microenergy grids could be deployed extensively in areas facing serious wind and solar curtailment to enhance renewable energy consumption. It could also be applied to build energy internet with cities, parks (schools) and new towns in eastern China where the demand centers are located, to greatly improve energy efficiency and broadly deploy clean and low-carbon energy supply.

C. Key Project Features

47. The core technology of the subproject is the energy management center of microenergy grid (regional energy internet center). It is the central pivot of the microenergy grid and is based on a comprehensive energy data management platform. The energy management center builds up a distributed control model through distributed smart PCs, and designs a hierarchical control mode based on different operation targets at various levels, such as micro-grid, court, feeder line and distribution network, etc., to realize a multi-level control mode of "local control–level control–overall control."

48. With the optimal design of a microenergy grid framework and coordination among distributed energies, the energy management center of the microenergy grid could make the microenergy grid system flat, with the equipment digitalized, the energies complementary, the supply and demand decentralized, the data transparent, the information parallel, and the trade liberal. This in turn enables personalized energy customization, improves customer's energy consumption locally, reduces the volatility of renewable energy power generation, and achieves the utmost local consumption of renewable energy. By efficient coordination and smart control of various types of energies (wind, solar, gas, cooling, heating, electricity, etc.) within the micro-grid,

the energy management center could coordinate system performance among the micro-grids and between the micro-grids and main grid, therefore increase the efficiency of energy utilization, meet the demand of energy users, improve energy supply quality and enhance the reliability of energy supply. By reasonably planning and optimal integration of storage and energy-saving technologies, the energy management center could greatly reduce users' energy consumption, energy cost and energy loss during energy conversion. By reducing the difference between peak and valley consumptions of the energy in demand side, the energy management center could reduce the designed capacity of the energy in supply side, thereby optimizing supply side investments and greatly increasing the annual energy supply hours and the equipment utilization rate.

49. The Energy Management Center of the microenergy grid is responsible for energy coordination and dispatching within and among the sub microenergy grids. **Figure 1** shows the structure of the proposed microenergy grid's energy management center. In the microenergy grid system, all the elements under the system are assigned with different tasks and the whole system depends on the cooperative operation of each sub microenergy grid. For instance, the energy storage unit within the subgrid needs to not only maintain its individual state-of-charge and output range, but also obey the overall coordination of the subgrid, and participate in the subgrid's voltage and frequency regulation; meanwhile, the subgrid will maintain internal power balance and participate in energy dispatching in the middle-voltage network. In this way, energies among several industrial zones are interconnected. It not only increases the energy efficiency among sub microenergy grids and reduces energy cost, but also raises clean energy consumption ratio and reduce the curtailment greatly. The specific components to be constructed and/or installed under the proposed subproject are shown in **Table 14**.

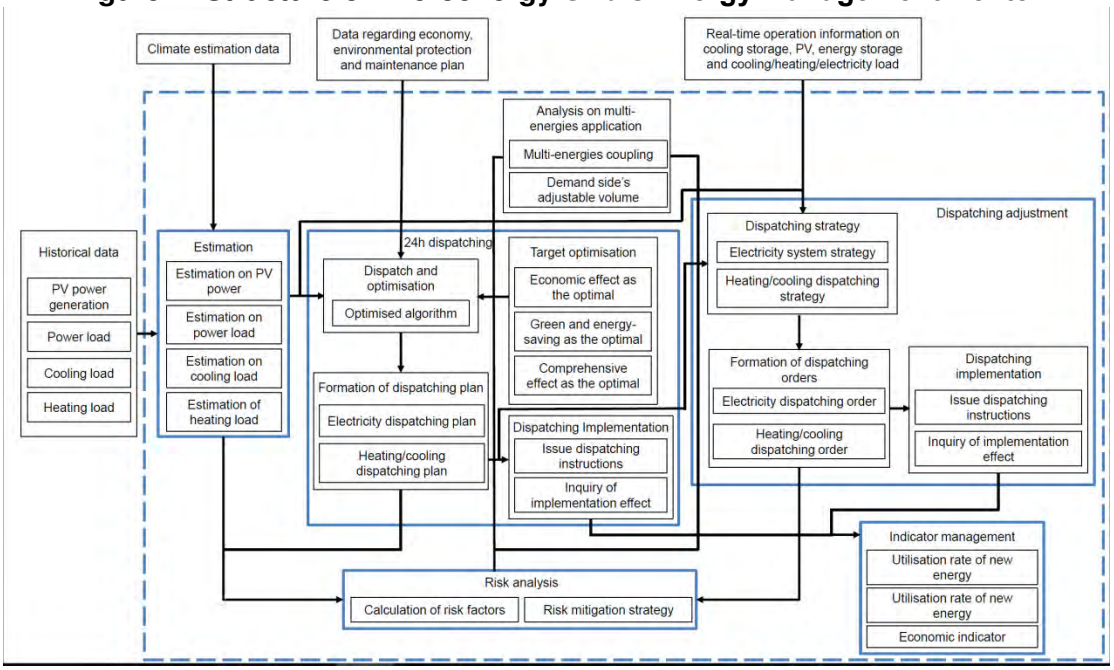
Table 14: Components to be constructed and/or installed

Component	**Content of construction**
Sub microenergy grid of iESLab industrial park	3 MW PV power generation system (400 kW completed); 2×1,200 kW gas-based CCHP system (completed); 1MWh energy storage system with Lithium Iron Phosphate (LIP) cell; 0.5 MWh compressed-air energy storage system; 4,000 RTH air conditioning (AC) chilled water storage system (completed); 3,000 m^2 Linear Fresnel solar thermal heating system; 6.9 MW air source heat pump; Energy management system of sub microenergy grid (completed).
Sub microenergy grid of Shandong Fin CNC Machine	1 MW PV power generation system; 0.5 MW air source heat pump; Energy management system of sub microenergy grid.
Sub microenergy grid of China CNR in Jinan Hi-tech industrial zone	5.9 MW PV power generation system (completed); 1 MWh energy storage system with LFP cell; Energy management system of sub microenergy grid.
Sub microenergy grid of Inspur industrial parks	1.8 MW PV power generation system; 2 MWh energy storage system with LFP cell; 2.4MW gas-based CCHP system; 8,000 RTH AC chilled water storage system; 3 MW air source heat pump; Energy management system of sub microenergy grid.

Sub microenergy grid of Qingqi Suzuki Motorcycle industrial park	5.9 MW PV power generation system; 1 MWh energy storage system with LIP cell; Energy management system of sub microenergy grid.
Sub microenergy grid of Shandong Xinhua bookstore Group logistic center	3.7 MW PV power generation system; 1 MWh energy storage system with LIP cell; Energy management system of sub microenergy grid.
Energy management center of microenergy grid	Management system of energy management center; Energy trading platform; Data center room of microenergy grid's energy management center.

CCHP = combined cooling, heat and power, kW = kilowatt, m^2 = square meter, MW = megawatt, MWh = megawatt per hour, PV = photovoltaic, RTH = refrigeration ton measured in hours.

Figure 1: Structure of Microenergy Grid's Energy Management Center



50. Microenergy grid has the distinct features as shown below:

i) **Complementary application of multi-energies**. By the comprehensive cascade usage of renewable energies and fossil energies, to achieve the coordinative development among energy efficiency, energy environment, energy structure and energy security; and, to promote a sustainable energy system, thereby realize the integrated innovation and demonstration of energy conservation, environmental protection and renewable energy technologies. To address the technical barriers in applying and dispatching various renewable energies together and improve the performance of the system, the subproject focuses on key technologies, such as distributed power generation and heating supply technology by complimentary application of multi-renewable energies, performance control and smart distributed energy supply technology. The subproject also provides a platform for verification and promotion of advanced technologies by developing complementary distributed energy and microenergy demonstration projects.

ii) **Integrated optimization**. This subproject has many demonstration effects including (i) building up a distributed CCHP pilot project with complementary application of clean fuels and renewable energies such as solar and wind energy; (ii) creating an innovative technology by integrating distributed energy system with complementary energy application, energy cascade use and active control; (iii) exploring a way in energy complimentary applications combining clean fuels and renewable energies to promote smart microenergy grid; and (iv) build up a distributed energy system demonstration project with dual objectives of energy conservation and environmental protection. By implementing this project, key technologies such as (i) complementary energy application, power supply and distribution of alternating current and direct current, and energy optimal dispatching and management will be mastered; (ii) demonstration system on microenergy grid with complementary application of multi-energies will be established; and (iii) grid's friendly-access and highly efficient operation will be achieved under the scaled-up development of microenergy grid and distributed renewable energy will be realized.

iii) **Grid-friendliness with high penetration rate**. This subproject will allow more fluctuating renewable energy to the power distribution network, and the establishment of regional power grid that integrates renewable energy power's generation, transmission, storage and consumption with high penetration rate. Meanwhile, the regional power grid is designed with strong regulation ability: (i) enabling friendly interaction with public grid, (ii) stabilizing fluctuation caused by renewable energy, and (iii) mitigating peak-valley difference of power grid and replace or partly replace peak-shaving power. When the regional power grid is operating together with public grid, the power trade and trading period can be controlled, and it is favorable to regulate the voltage and frequency within the microenergy grid.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Location

51. The subproject will be implemented at Sun Village, High-Tech Zone, Jinan City of Shandong Province. Jinan is the capital of Shandong Province.

B. Shandong Province Overview

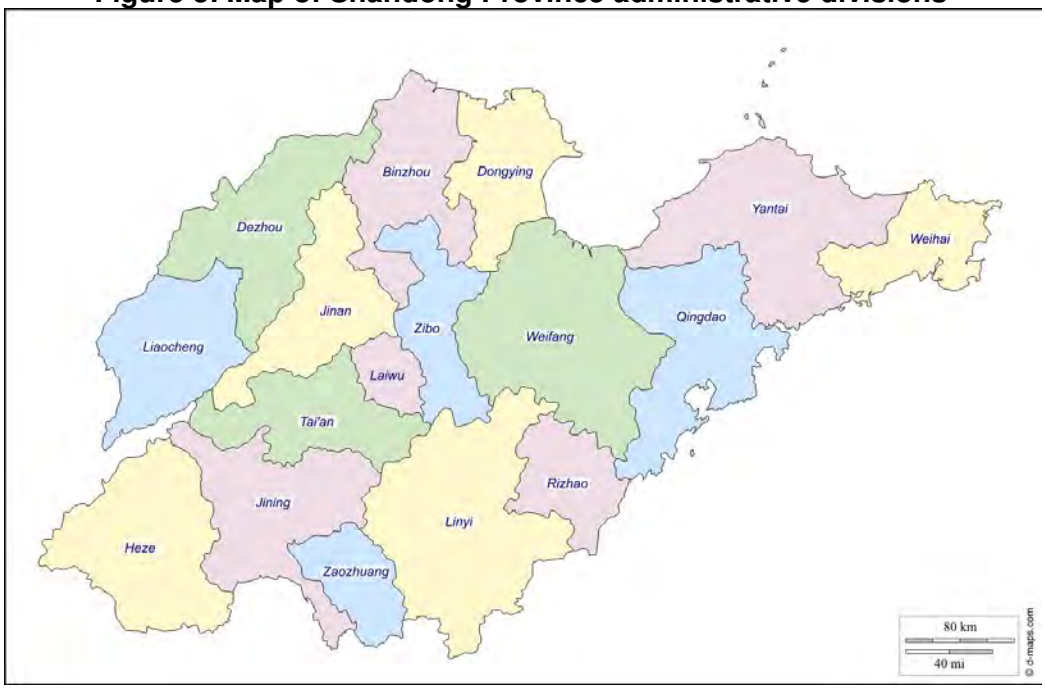
52. Shandong is a coastal province, and is part of the East China region (**Figure 2**). Neighboring provinces are Anhui, Hebei, Henan, and Jiangsu.

Figure 2: Shandong Province in China

Source: https://en.wikipedia.org/wiki/Shandong

53. Shandong is divided into 17 prefecture-level divisions including two sub-provincial cities. The 17 prefecture-level divisions of Shandong are subdivided into 137 county-level divisions (51 districts, 28 county-level cities, and 58 counties). Those are in turn divided into 1,941 township-level divisions (1,223 towns, 293 townships, two ethnic townships, and 423 subdistricts).

Figure 3: Map of Shandong Province administrative divisions



Source: http://d-maps.com

54. In 2016, the population of the province was 99.47 million. The land area is 157,100 km^2 and the length of coastline is 3,100 km. Shandong has a temperate climate, with hot, rainy summers and dry, cold winters. Mean annual temperature is 10.5°C–13.5°C; the average temperature in July is 24°C–27°C, while the temperature in January is -4°C–1°C. Mean annual precipitation is 550–950 mm, increasing from northwest to southeast. The province is divided into four topographical zones: (i) Northwestern Shandong Plain, formed by deposits of the Yellow River; (ii) Jiaolai Plain, between central-south Shandong and Jiaodong hilly regions, bounded by bays in the north and south and traversed by the Jiaolai, Weihe and Dagu rivers; (iii) Central-South Shandong hilly area, with elevations >1,000 m above sea level; and (iv) Jiaodong Hilly Area, the main part of the Shandong Peninsula.

55. Shandong ranks first among the PRC provinces in the agriculture production of a variety of products, including cotton and wheat, as well as gold mining. Other important crops include tobacco, sorghum and maize, as well as peanuts, for which the province is especially well-known, producing nearly a quarter of the country's total. Shandong is also a significant producer of fruit. The province also has extensive deposits of natural gas, iron, diamonds, and bauxite deposits. In 2016, the total GDP of the province was CNY6.70082 trillion and per capita GDP was CNY67,706.

56. Shandong is one of the leading provinces driving the economic development in the PRC. However, it is facing increasing pressure to reduce its energy consumption and emissions in light of PRC's objective for achieving 40%–45% carbon intensity reduction by 2020 compared to 2005 levels. Shandong was included in the first three provinces to implement province-wide circular economy.

57. The Yellow River passes through Shandong's western areas, entering the sea along Shandong's northern coast; in its traversal of Shandong it flows on a levee, higher than the surrounding land, and dividing western Shandong into the Hai River watershed in the north and the Huai River watershed in the south. The Grand Canal of China enters Shandong from the

northwest and leaves on the southwest. Weishan Lake is the largest lake in the province. Shandong Peninsula has a rocky coastline with cliffs, bays, and islands; the large Laizhou Bay, the southernmost of the three bays of Bohai Sea, is located to the north, between Dongying and Penglai; Jiaozhou Bay, which is much smaller, is to the south, next to Qingdao. The Miaodao Islands extend northwards from the northern coast of the peninsula.

58. The province has 30.58 billion m^3 of water resources and 307.4 m^3 per capita in 2016. The groundwater resources of Shandong are large, but are being exploited at an unsustainable rate. The demand for groundwater resources will continue to increase in the future with rising population and higher temperatures predicted in climate change scenarios.

C. Site Physical Resources

59. **Jinan City.** As shown in **Figure 4**, Jinan City is located in the middle part of Shandong Province between longitude 116°11'-117°44'E and latitude 36°02-37°31'N, approximately 400 km south of the national capital of Beijing. It borders Liaocheng to the southwest, Dezhou to the northwest, Binzhou to the northeast, Zibo to the east, Laiwu to the southeast and Tai'an to the south.

Figure 4: Jinan City, Shandong Province

60. **Topography**. Jinan City occupies a transition zone between the northern foothills of the Taishan Massif to the south-southeast of the city and the Yellow River Valley to the north and northwest. Karst aquifers in limestone formations sloping down from the south to the north give

rise to many artesian springs in the city center as well as in surrounding areas. Within the subproject area the topography is generally flat. (**Figure 5**).

Figure 5: Jinan Topography

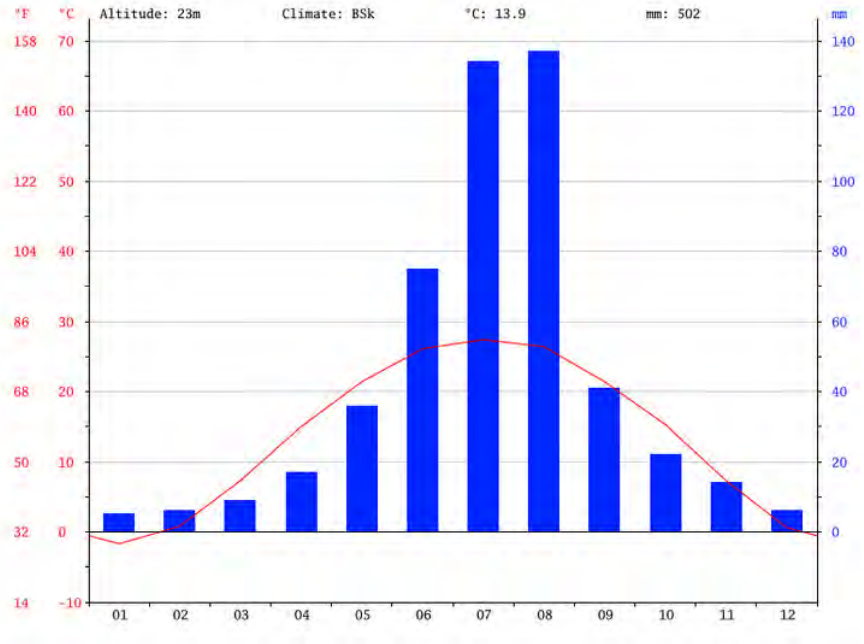
Source: Google map, 2017

61. **Hydrogeology.** Jinan lies on the south shore of the Yellow River, and it is the main river in the subproject area. With an estimated length of 5,464 km, the Yellow River is the second-longest river in Asia, and the sixth-longest river system in the world. It originates in the Bayan Har Mountains in Qinghai province of western China, it flows through nine provinces and enters into the Bohai Sea near Dongying in Shandong province. It has a watershed area of 742,443 km^2. The Xiaoqing River is the other main river in Jinan. Originating west of Jinan, it is 220 km long and has a watershed area of 10,336 km^2. It flows south of, and roughly parallel to, the Yellow River, in Jinan passing through Huaiyin, Tianqiao, and Licheng Districts, and also enters into the Bohai Sea. It is fed by a series of tributaries flowing north through the urban areas of Jinan. In recent years, it has become contaminated as a result of industrial waste water and domestic sewage discharges. The Yellow River is 19 km away from the subproject site in northwest direction.

62. **Meteorology and Climate.** Jinan has a temperate continental climate with four distinct seasons. It is dry in the spring, hot and rainy in the summer, cool in the autumn, and dry and cold in the winter. The average annual temperature in Jinan is 16.6°C, the average summer average temperature is 26°C and the maximum recorded summer temperature was 42.7°C. The average temperature in the 41 coldest month of winter is below 0°C, and the lowest maximum recorded

temperature is -19.5°C (**Figure 6**).

Figure 6: Average Temperature Profile of Jinan

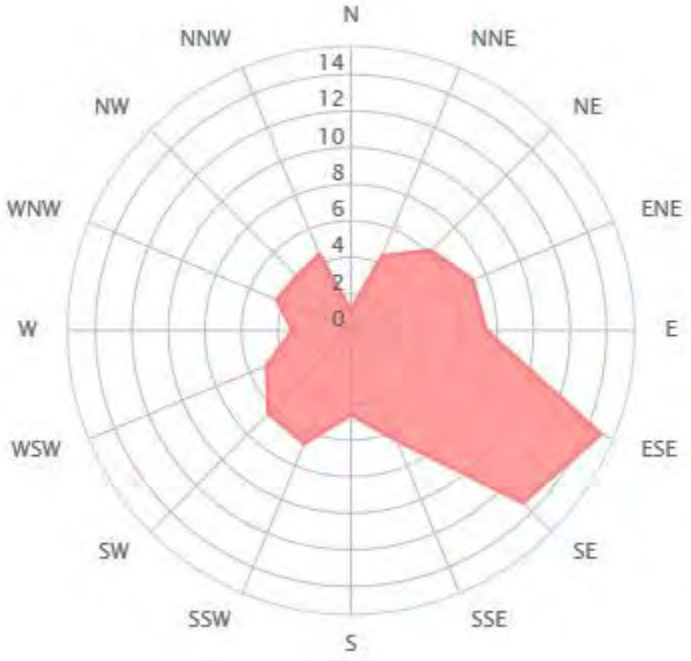


Source: https://en.climate-data.org/location/2259/

63. **Precipitation.** The average annual precipitation in Jinan from 1950-2011 is 685 mm, with a recorded maximum of 1,160 mm and a minimum of 320.7 mm. In winter months, precipitation is low (average 20–25 mm/month), and 65.9% of this occurs in June, July, and August. The annual average humidity is 58%.

64. The dominate wind direction is from the SE. (**Figure 7**).

Figure 7: Jinan Wind Rose



Source: https://www.windfinder.com/windstatistics/jinan

65. **Sunshine and humidity.** Sunshine hours of Jinan in 2016 were 2,617 hours, or 60.6% of the annual daytime hours.

66. **Frost-free Days.** There is an average of 178 frost free days per year. The first frost typically occurs in the first 10 days of October, and the last frost day is typically in the first 10 days of March.

67. **Surface water—rivers and reservoirs**. Surface water resource in the subproject area is presented in **Error! Reference source not found.**. Yangjia River in **Error! Reference source not found.** is a branch of Xiaoqing River. Yangjia River is 150 m away from the subproject site in east. Water reservoirs in Jinan include the Queshan, Yeuqing, and Jinxiuchuan. There are no reservoirs in the subproject impact zone.

Figure 8: Water resources near the subproject area

Note: ★ means the Solar PV location
Source: Google map and FSR

68. **Groundwater and springs.** Jinan is well known for its artesian karst springs and lakes, and is referred to as the Spring City. Daming Lake, located in the historical city center, is the largest lake in Jinan, and one of the city's main natural and cultural landmarks. Fed by the artesian karst springs, the lake maintains a constant water level and temperature throughout the entire year. Other key karst artesian springs include Batou, Heihu, Wulong and Zhenzhu, and in total there are more than 70 named springs in Jinan.

69. Annual average water resource of Jinan City is 1.748 billion m^3. The per capita water resource is only 292 m^3.

70. **Baseline data.** According to Jinan's Environmental Quality Bulletin (2016), urban air quality in Jinan has improved compared with 2015, but pollution levels remain high. The quality of drinking water sources is good but surface water quality has not improved. The acoustic environmental quality is relatively good.

D. Environmental Monitoring

71. Because domestic EIA is under preparation at the time of this IEE preparation, environmental quality assessment of the subproject site was undertaken by PPTA consultant.

1. Air Quality Monitoring

72. Air quality monitoring data from Jinan EPB's air quality monitoring station was collected over a 7-day period in mid-April 2017. Monitoring was undertaken for a minimum of 18 hours per day, allowing 24 hour averaging periods for SO_2, NO_2, $PM_{2.5}$ and PM_{10}. The results are presented in **Table 15**. The data show that all parameters except 24-hour average PM_{10} concentration on 25 April 2017 were in compliance with the relevant PRC ambient air quality standard, Class II of *Ambient Air Quality Standards (*GB3095-2012).

73. It is noted that site specific air quality monitoring will be undertaken during domestic EIA preparation.

Table 15: Air quality monitoring results (ug/m^3)

Date	24-hr mean PM_{10}	24-hr mean $PM_{2.5}$	24-hr mean SO_2	24-hr mean NO_2
19 April 2017	112	34	13	48
20 April 2017	97	30	11	36
21 April 2017	111	49	11	40
22 April 2017	107	40	13	32
23 April 2017	108	38	15	22
24 April 2017	146	55	21	41
25 April 2017	176	71	38	63
Limit	**150**	**75**	**150**	**80**

NO_2 = nitrogen dioxide, $PM_{2.5}$ = particulate matter with diameter less than 2.5 micrometers, PM_{10} = particulate matter with diameter less than 10 micrometers, SO_2 = sulphur dioxide.
Source: www.aqistudy.cn/historydata/monthdata.php?city=%E6%B5%8E%E5%8D%97

2. Surface Water

74. The surface water body near the subproject site is Yangjia River (**Figure 8Error! Reference source not found.**), which is 150 m away in east direction. Yangjia River is a branch of Xiaoqing River.

75. Urban sections of the Xiaoqing River and its tributaries are primarily used as a source of landscape water, while the Huanxiangdian section downstream as well as its tributary are agricultural water, all of which should comply with Class V standard of the *Surface Water Environmental Quality Standard* (GB3838—2002).

76. According to Jinan Environmental Bulletin (2016), a total of 21 sections of Yellow, Xiaoqing and Tuhai rivers are monitored on a monthly basis for 26 parameters. The majority Xiaoqing River tributaries in Jinan City in 2016 were not in compliance with relevant standards, primarily for COD and NH_3-N.

3. Ground water

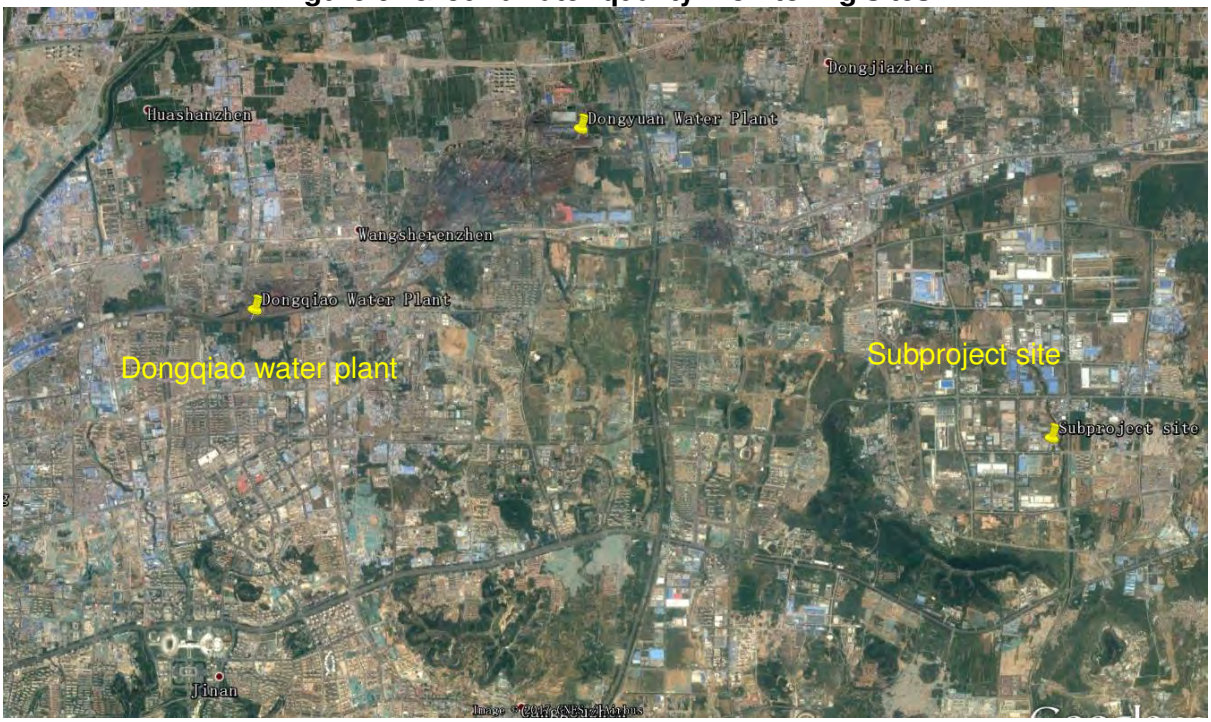
77. According to Jinan Environmental Bulletin (2016), in 2016, 39 parameters were monitored at the Dongjiao and Dongyuan Water Plants, both of which utilize groundwater as a source of drinking water. (**Figure 9**) The Dongjiao Water Plant achieved the Class III standard of *Underground Water Quality Standard* (GB/T 14848—93). Compared with 2015 ammonia nitrogen and fluoride concentrations decreased slightly while total hardness, sulfate, permanganate index, nitrate nitrogen and electrical conductivity increased slightly. The Dongyuan Water Plant also achieved the Class III standard, and compared with 2015 the permanganate index decreased slightly while total hardness, sulfate, ammonia nitrogen, nitrate nitrogen, fluoride concentration and electric conductivity increased slightly (**Table 16**).

Table 16: Monitoring results of groundwater at water supply plants (unit: μg/L)

Name	Year	pH	Total hardness	Sulfate	Permanganate index	Nitrate nitrogen	Nitrite nitrogen	Ammonia Nitrogen	Fluoride
Dongjiao water supply plant	2015	7.39	405	89.58	0.69	9.35	ND	0.026	0.282
	2016	7.43	378	77.54	0.62	8.80	ND	0.030	0.284
Dongyuan water supply plant	2015	7.40	387	90.00	0.64	10.80	ND	0.028	0.255
	2016	7.47	382	89.26	0.65	10.39	ND	0.027	0.251
Limit		6.5-8.5	≤450	≤250	≤3.0	≤20	≤0.02	≤0.2	≤1.0

ND = not detected, μg/L = milligram per liter, pH = potential of hydrogen.
Source: Jinan Environmental Bulletin (2016)

Figure 9: Groundwater quality monitoring sites



4. Noise

78. Daytime and nigh-time noise monitoring was not undertaken at subproject site. During the site visit in March 2017, PPTA consultants found that main noise activities near the subproject site are residential and industrial activities and vehicles. The distance between two nearby industrial plants is more than 500 m and noise impact is very small. No excessive noise levels were experienced at the time of the site visit.

79. It is noted that ambient noise monitoring will be undertaken during domestic EIA preparation.

E. Ecological Resources

80. The subproject is located in existing industrial zone, there are no known ecological and/or sensitive resources in or near the subproject site.

1. Flora and Fauna

81. Natural vegetation is sparse and concentrated in the southern and eastern mountain area of Jinan. In the vast loess hilly area, the forest coverage rate is lower. Shrub and grass coverage are poor. Dominant flora in the subproject area is natural and artificial secondary vegetation being repeatedly destruction. Also, there are some artificial afforestation such as Pinus tabulaeformis, Platycladus orientalis, Robinia pseudoacacia, elm, poplar, and walnut, apple, hawthorn, persimmon, and other economic forest.

2. Flora and Fauna at Subproject Sites

82. The subproject site is in existing highly developed industrial zone with little or no vegetation cover (**Figure 10**). There are no known rare or endangered flora or fauna, parks, nature reserves or areas with special national, regional or local ecological significance within or adjacent to the subproject site.

Figure 10: Subproject site conditions

(i) Residential areas near subproject site

(ii) Road across subproject site

(iii) Yangjia River near subproject site

3. Parks and Protected Areas

83. There are no parks or protected areas in or near subproject site.

4. Sensitive Receptors

84. Sensitive receptors for air quality, surface water and noise impacts in the subproject site were determined utilizing remote sensing and ground surveys. **Table 17** and **Figure 12** present sensitive areas (air quality and noise). The surface water body near the subproject site is presented in **Figure 8Error! Reference source not found.**.

Table 17: Sensitive areas (air quality, noise and surface water)

Sensitivity	Area	Direction	Distance (m)	Function	Standard
Air quality	Sun Village	E	650	Residential Area	Category II
	Dongdunqiu Village	SE	460	Residential Area	Category II
Noise	Sun Village	E	650	Residential Area	Category II
	Dongdunqiu Village	SE	460	Residential Area	Category II
Surface water	Yangjia River	E	150	Landscape	Category V

E = east, m = meter, SE = southeast.

Figure 12: Sensitive areas near the subproject site (air quality and noise)

F. Socio-economic and Cultural Resources

1. Jinan City

85. Jinan city is comprised of 6 districts (Lixia, Shizhong, Huaiyin, Tianqiao, Licheng and Changqing); 3 counties (Pingyin, Jiyang, and Shanghe); and a county level city (Zhangqiu) (**Figure 113**). The city has a total area of 8,177 km^2.

86. Total population was 6,328,300 by the end of 2016 (**Table 18**).

Figure 13: Map of Jinan City administrative divisions

Source: https://en.wikipedia.org/wiki/Jinan

Table 18: Data on Jinan City administrative divisions

Subdivision	Land Area (km²)	Population (2016)	Population Density (persons/km²)
Lixia District	100.87	627,400	6,220
Shizhong	280.33	617,600	2,203
Huaiyin	151.56	409,900	2,705
Tianqiao	258.71	516,700	1,997
Licheng	1,303.88	971,800	745
Changqing	1,208.54	559,800	463
Zhangqiu	1,721.29	1,029,700	598
Pingyin	715.18	374,700	524
Jiyang	1,097.15	578,100	527
Shanghe	1,163.19	641,400	551

Source: Jinan Statistical Bureau, 2016

87. There are 49 ethnicities in Jinan including Hui, Mongolian, and Manchu. However, the ethnic minorities only account for 1.84% of the total population while the rest is Han ethnicity. None of them will be affected by the subproject.

2. Economy

88. Jinan is the political, economic, cultural, scientific, educational, and financial center of the province, and has been designated with sub-provincial administrative status since 1994.

89. In 2016, the city's GDP was CNY653.61 billion, of which the primary sector accounted for 4.9% or CNY32.03 billion; the secondary sector accounted for 36.2% or CNY236.61 billion; and the tertiary sector accounted for 58.9% or CNY384.98 billion.

3. Transportation

90. Jinan has a well-developed railway, highway and aviation transportation network, and has become an important hub connecting with eastern, northern, central and western regions of the PRC.

91. Jinan is one of the 45 national arterial hubs of the highway network. Jinan's own highway network is highly developed with multiple national highways, including highway 104, 305, 309, 220, Jiqing Expressway, and Jingfu Expressway, and provincial highways running through it. Currently a half-day traffic circle is being established with Jinan in the center and connections to all cities within the province.

92. Jinan is on the Beijing-Shanghai Railway and Jiaozhou-Jinan Railway; Jinan-Handan Railway is connected with Beijing-Kowloon Railway and Beijing-Guangzhou Railway (two major trunk railways). The Beijing-Shanghai high speed railway has already been in operation.

4. Physical Cultural Resources

93. Jinan is an accredited famous historic and cultural city for its long-standing history and culture unique natural landscape. Historic sites include Chengziya Longshan Culture Site, Guo's Ancestral Temple of Han Dynasty at Xiaotangshan, Four Gates Pagoda of Sui Dynasty, Dragon and Tiger Pagoda of Tang Dynasty, Nine Tops Tower and Luozhuang Han Tomb. However, the subproject activities are all in highly developed and modified industrial and urban environments. There are no known physical cultural resources (PCRs) in subproject sites.[4]

[4] Physical cultural resources are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings and may be above or below ground or under water. Their cultural interest may be at the local, provincial, national, or international level. Within the Project area these could include: Funeral site: graves, cemeteries, shrines, stupas.

(i) Religious buildings: Temples or Pagodas, complete or ruins.
(ii) Religious objects: Buddhist images or sculpture.
(iii) Sacred sites: sacred caves, forest, hills or cliffs.
(iv) Historical sites or objects: artifacts, tools, relics, memorials.
(v) Spirit sites: sites residents believe are occupied by a spirit (house, tree, stone, etc.).

V. ANTICIPATED IMPACTS AND MITIGATION MEASURES

2. Anticipated positive and negative environmental impacts of the proposed subproject were assessed based on the domestic FSR (2016); a technical due diligence review of the FSR undertaken by ADB PPTA specialists; public consultations led by the subborrower and assisted by ADB PPTA consultants; and site visits, surveys and consultations undertaken by ADB PPTA consultants.

3. Pre-construction, construction, and operation phases were considered separately. The results of the assessment indicate that during the pre-construction phase environmental issues are very limited, and are mostly associated with ensuring appropriate incorporation of mitigation measures into the subproject design.

4. Potential negative environmental impacts during the construction phase are short-term and localized, and are associated with construction noise, fugitive dust, disruption of traffic and community services, and risks to worker health and safety. Potential negative operation phase impacts are associated with boiler emissions, waste and wastewater, noise, and health and safety risks to workers.

94. Potential positive operation phase impacts are significant and long-term, and are associated with emissions reductions compared to equivalent power and heat production from coal-fired boilers.

A. Pre-Construction Phase Measures to be Implemented During Detailed Design

1. Siting and Land Acquisition

95. The subproject will not entail any permanent or temporary physical displacement or economic displacement. This is because:

(i) Roof leasing agreements for PV power generation system were already signed; and
(ii) Other components will be implemented in existing premises of the subborrower. Land acquisition has been completed by the subborrower.

96. Overall, the subproject will not result in any involuntary land acquisition, resettlement or physical displacement. There will be no loss of personal property, structures, crops, trees or other assets. There are also no potential adverse impacts on disadvantaged or vulnerable groups, including the poor, women and children, and Indigenous Peoples.

2. Mitigation Measures and Monitoring during Detailed Design

97. Mitigation measures to be adopted during detailed design to minimize the impacts are as follows:

(i) **Detailed Design.** Environmental mitigation measures indicated in this IEE, EMP, and domestic EIA will be incorporated into the detailed design.
(ii) **Bidding Documents and Contracts.** Environmental mitigation measures indicated in this IEE, EMP, and domestic EIA will be included in contracts for civil works and equipment installations. All contractors will be required to strictly comply with the EMP.

(iii) **Environmental monitoring.** The environmental monitoring program (EMoP, see **Table 3** in **Appendix I**) will be incorporated into the design to ensure that environmental impacts are closely monitored and activities of the subproject construction and operation are closely supervised against the PRC environmental laws, regulations and standards, SPS 2009, and subproject EMP, and approved domestic EIA.

3. Grievance Redress Mechanism

98. In accordance with the Grievance Redress Mechanism (GRM) presented in Chapter VIII of the IEE, a staff member from subborrower will be assigned overall responsibility for the GRM; GRM training will be provided for subborrower and GRM access points; and the GRM access point phone numbers, fax numbers, addresses, and emails will be disclosed to the public.

4. Training and Capacity Building

99. An institutional strengthening and training program will be delivered by environmental consultants/experts (see **Table 4** in **Appendix I**). The training will focus on ADB's and PRC's environmental, health and safety laws, regulations and policies; implementation of the EMoP; GRM; and international good EHS practices. Training will be provided to the subborrower, relevant staff and contractors and the construction supervision company.

5. Permitting

100. All necessary construction permits will be obtained from the relevant authorities.

B. Anticipated Environmental Impacts and Mitigation Measures during Construction Phase

1. Erosion and Spoil

101. During the site visit, PPTA consultant found that supporting facilities of the subproject like boiler room, ground water storage tank, and smart meters for power, heat and water consumption have already been built. Construction activities such as land leveling, excavation and filling activities will not be included in the subproject. Then erosion and spoil will not be produced by the subproject during the construction phase.

2. Wastewater

102. Inappropriate disposal of domestic wastewater (from construction workers) or construction wastewater (from drainage of washing construction equipment and vehicles, and oil-containing wastewater from machinery repairs) may cause soil or groundwater resources contamination.

103. These impacts can be mitigated through typical good wastewater management practices:

(i) Existing sanitary facilities will be provided for construction workers. Existing toilets are already equipped with septic tanks in accordance with PRC standards. Domestic wastewater will be treated in the septic tanks to meet relevant national standard and discharged to municipal sewer;

(ii) Areas where construction equipment is being washed will be equipped with water collection basins and sediment traps. The wastewater will be collected and discharged to municipal sewer; and

(iii) Maintenance of construction equipment and vehicles will not be allowed on site so as to reduce wastewater generation.

3. Air Pollution

104. Anticipated sources of air pollution from construction activities include: (i) dust generated from loading, hauling and unloading; (ii) dust generated from disturbed and uncovered construction areas, especially on windy days; (iii) dust generated by the movement of vehicles and heavy machinery on unpaved access and haul roads; and (vi) emissions from construction vehicles (gaseous CO and NO_2) and heavy diesel machinery and equipment.

105. Without appropriate mitigations, construction phase activities may generate significant localized total suspended particulate (TSP)[5] levels, with worst case conditions occurring in clear weather without watering.

106. To reduce air quality impacts during the construction period, the following air quality management measure will be implemented:

(i) Water will be sprayed on active construction sites including where fugitive dust is being generated on a daily basis, and more frequently during windy days;
(ii) Construction activities will be halted during high wind events;
(iii) Transport vehicles will be limited to low speeds in construction sites;
(iv) Loads will be covered during truck transportation to avoid spillage or fugitive dust generation. Fine materials will be transported in fully contained trucks;
(v) Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds;
(vi) Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical;
(vii) Store petroleum or other harmful materials in appropriate places and cover to minimize fugitive dust and emission; and
(viii) Provide regular maintenance to vehicles in order to limit gaseous emissions (to be done off-site).

4. Noise Impacts

107. During the construction phase noise and vibration will be generated by on-site construction activities using heavy equipment and by the transport of construction materials and equipment. Noise source during construction phase is considered a point noise source, and the predictive model is as follows:

$$L_i = L_0 - 20\lg\frac{R_i}{R_0} - \Delta L$$

Where, L_i and L_0 are equipment noise sound levels at R_i and R_0, respectively, ΔL is additional decrement produced by barriers, vegetation and air.

108. For the impact of multiple construction machines on a location, sound level superposition

[5] Airborne particles or aerosols that are less than 100 micrometers are collectively referred to as TSP.

uses the following formula:

$$L = 10 \lg \Sigma 10^{0.1 \times L_i}$$

109. A significant increase in localized noise is expected during construction. Noise will be from construction activities including equipment unload and installation and other heavy machinery, as well as noise from goods and material transportation.

110. These noise impacts will occur in mostly inhabited urban areas. Though noise levels may be high, the impacts will be temporary and localized, and can be further mitigated.

111. To ensure construction activities meet PRC noise standards and to protect workers and adjacent residents, the following mitigation measures will be implemented:

(i) Construction activities, and particularly noisy ones, are to be limited to reasonable hours during the day and early evening. Construction activities will be strictly prohibited during the nighttime (22:00 h to 07:00 h). Exceptions will only be allowed in special cases, and only after getting approval of the surrounding residents, local EPB and other relevant departments;
(ii) When undertaking construction planning, simultaneous high-noise activities will be avoided, and high noise activities will be scheduled during the day rather than evening hours. Similarly, construction site will be planned to avoid multiple high noise activities or equipment from operating at the same location;
(iii) Low-noise equipment will be selected as much as possible. Equipment and machinery will be equipped with mufflers and will be properly maintained to minimize noise;
(iv) Noise personnel protective equipment (PPE) will be provided to workers;
(v) Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and high traffic times;
(vi) Vehicles transporting construction materials or waste will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals; and
(vii) Special attention will be paid to protect sensitive sites near the subproject site: high noise construction activities will be positioned as far away from sensitive sites as possible.

5. Solid Waste

112. Solid waste generated in the construction phase will include construction and domestic waste. Construction wastes include various waste packing materials and waste generated during equipment installation and cleaning. An estimated of 0.5 kg/day per worker of domestic waste will be generated from construction workers. Inappropriate waste storage and disposal could affect soil, groundwater, and surface water resources, and hence, public health and sanitation.

113. The following solid waste management measure will be implemented:

(i) Wastes will be reused or recycled to the extent possible;
(ii) Littering by workers will be prohibited;
(iii) Existing domestic waste containers will be used for domestic waste collection at work sites. Domestic waste will be collected on a regular basis by the local sanitation departments and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements;

(iv) Construction waste dumpsters will be provided at all work sites. Construction waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements;
(v) There should be no final waste disposal on site. Waste incineration at or near the site is strictly prohibited; and
(vi) Contractors will be held responsible for proper removal and disposal of any significant residual materials, wastes, and contaminated soils that remain on the site after construction.

6. Hazardous and Polluting Materials

114. Inappropriate transportation, storage, use and spills of petroleum products and hazardous materials can cause soil, surface and groundwater contamination. To prevent this, the following mitigation measures will be implemented:

(i) A hazardous material handling and disposal protocol that includes spill emergency response will be prepared and implemented by contractors;
(ii) Storage facilities for fuels, oil, chemicals and other hazardous materials will be within secured areas on impermeable surfaces provided with dikes, and at least 300 m from drainage structures and important water bodies. A standalone site within the storage facility will be designated for hazardous wastes;
(iii) Signs will be placed at chemicals and hazardous materials storage sites to provide information on type and name of chemicals and hazardous materials;
(iv) Suppliers of chemicals and hazardous materials must hold proper licenses and follow all relevant protocols and PRC regulations and requirements; and
(v) A Shandong EPB certificated third hazardous waste treatment company (the certificated companies list can be found in http://gfc.sdein.gov.cn/dtxx/201703/t20170317_305495.html) will be hired to collect, transport, and dispose of hazardous materials in accordance with relevant PRC regulations and requirements.

7. Impacts to Flora and Fauna

115. Typical construction impacts on flora and fauna include removal of vegetation and disruption of the ecosystem during construction. If present, rare or endangered flora or fauna may also be impacted. However, the subproject construction site is located in urban environments with little or no vegetation cover other than recently established grasses and shrubs. Based on site visits, there is no known rare or endangered flora or fauna, parks, nature reserves or areas with special ecological significance which will be impacted by the subproject. Impacts on flora or fauna are thus expected to be minimal and short-term. Nonetheless, to address potential impacts:

(i) A greening plan will be implemented. Site vegetation plans will be developed at subproject site using appropriate native species; and
(ii) Any existing vegetated areas impacted by the subproject will be restored post-construction using appropriate native species.

8. Impacts on Community Disturbance and Safety

116. Project construction activities have the potential to cause community disturbance such as traffic congestion or delays, and public safety risks from heavy vehicles and machinery traffic. Mitigations will be implemented to address traffic and other community disturbance issues.

(i) Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and high traffic times;

(ii) Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals; and
(iii) Signs will be placed at construction sites in clear view of the public, warning people of potential dangers such as moving. All sites will be made secure, discouraging access by members of the public through appropriate fencing whenever appropriate.

9. Occupational and Community Health and Safety

117. Construction may cause physical hazards to workers and community from noise and vibration, dust, handling heavy materials and equipment, falling objects, work on slippery surfaces, fire hazards, chemical hazards such as toxic fumes and vapors, and others.

118. Contractors will implement adequate precautions to protect the health and safety of their workers:

(i) Each contractor will implement the relevant construction phase EHS plan;
(ii) Identify and minimize the causes of potential hazards to workers and community. Implement appropriate safety measures;
(iii) Provide training to workers on occupational health and safety, emergency response, especially with respect to using potentially dangerous equipment and storage, handling and disposal of hazardous waste;
(iv) Ensure that all equipment is maintained in a safe operating condition;
(v) Provide appropriate PPE to workers;
(vi) Provide procedures for limiting exposure to high noise or heat working environments in compliance with PRC noise standards for construction sites (GB 12523-2011); and
(vii) Ensure regular safety meetings with staff.

10. Physical Culture Resources

119. Based on site visits there are no known cultural heritage or archaeological sites at or near the component sites. However, construction activities have the potential to disturb unknown underground cultural relics. To address this issue, a construction phase chance find procedure will be established and activated if any chance finds of PCRs are encountered:

(i) construction activities will be immediately suspended if any PCRs are encountered;
(ii) destroying, damaging, defacing, or concealing PCRs will be strictly prohibited in accordance with PRC regulations;
(iii) the local Cultural Heritage Bureau will be promptly informed and consulted; and,
(iv) construction activities will resume only after thorough investigation and with the permission of the local Cultural Heritage Bureau.

C. Anticipated Operation Phase Impacts and Mitigation Measures

120. The subproject may cause some adverse environmental impacts during operation including air pollution from natural gas combustion, noise from project operation, use of water, production of wastewater and solid wastes, and fire and safety hazards.

1. Air Pollution

121. The primary emission to air is exhaust gas from gas-fired boiler. To minimize emissions

and associated impacts, the subproject will implement the follow measures:

(i) Low NOx natural gas-fired boiler with design emission levels that are in compliance with the most stringent PRC national standards (see **Table 7**). Natural gas generally produces negligible quantities of particulate matter and sulfur oxides, and levels of nitrogen oxides are about 60% of those from plants using coal (without emission reduction measures). Natural gas-fired plants also release lower quantities CO_2.

2. Wastewater

122. The subproject will use municipal water as domestic water and production water. Wastewater will be produced from canteens and toilet facilities. Production wastewater will include wastewater from boiler system, water storage tank and PV panel cleaning.

123. To address production and domestic wastewater:

(i) Wastewater from canteen will be treated by oil-separator, and discharged to municipal sewer combined with domestic wastewater; and
(ii) Production wastewater will be discharged to municipal sewer system and then treated at Xiaoqing River Wastewater Treatment Plant.

3. Solid Waste

124. The subproject will generate a domestic waste and production waste. Production waste will include waste resin and waste lithium battery. If not properly managed this waste can cause visual and environmental impacts. To mitigate this risk, the following measures will be implemented:

(i) Domestic waste bins will be provided and domestic waste will be routinely collected by the local sanitation department for recycling, if possible, or final disposal at an approved waste disposal site;
(ii) No permanent on-site solid waste disposal will be permitted at project site;
(iii) No burning of wastes will be permitted at project site; and
(iv) Waste resin and waste lithium battery will be collected, transported and treated by a Shandong EPB certificated third hazardous waste treatment company (the certificated companies list can be found in http://gfc.sdein.gov.cn/dtxx/201703/t20170317_305495.html).

4. Noise

125. Noise sources during operation will mainly be from noise from pumps, PV power generation equipment, gas boiler, transformer, etc. To mitigate noise impacts the subproject will:

(i) Low-noise equipment will be used as far as possible, and noise reduction measures such as noise elimination, shock absorption, insulated enclosures and sound dampening materials on exterior walls will be implemented;
(ii) All equipment will be properly maintained to minimize noise;
(iii) Appropriate noise PPE will be provided to the workers who are likely to be exposed to high noise level environments; and
(iv) Layout for subproject site will be reasonable planned to reduce noise.

5. Occupational and Community Health and Safety

126. Plant operation poses risks to workers and community. Accidental release of chemicals and hazardous materials may present health and safety risks to workers and community. Natural gas also presents fire, burn and explosive hazards.

127. To minimize risks associated with leaks of natural gas:

(i) All natural gas works will be in compliance with relevant PRC building code requirements, including the *Code for Design of City Gas Engineering* (GB 50028-2006) and *Regulation on Electric Apparatus Design for Explosion and Fire Risk Environment* (GB50058-92);
(ii) Subproject site will be equipped with flammable gas detection, alarm and fire suppression systems. Electrical devices within the explosion risk area will be safely equipped;
(iii) Gas pipelines will be grounded and equipped with anti-lightning devices where applicable; and
(iv) All gas related devices will be colored and equipped with warning signs.

128. To mitigate potential health and safety risks to workers and community, the following measures will be taken:

(i) Operation phase EHS plans will be developed and implemented. Workers will be trained regularly on their implementation, and community will be informed;
(ii) PPE including goggles, gloves, safety shoes, will be provided to workers;
(iii) Provide training to workers on occupational health and safety, and emergency response;
(iv) Natural gas systems will be designed in compliance with relevant PRC fire, health and safety standards. Fire compartments will be established based on the fire risks and fire-resistant buildings/structures will include fire-proof doors and windows;
(v) Fire-alarm and suppression systems will be installed and tested regularly to ensure it functions properly;
(vi) Control measures will be strictly undertaken to ensure the discharge, exhaust and safety relief of flammable fuels in enclosed systems; and
(vii) No unauthorized personnel will be allowed into gas-fired facilities.

6. Emergency Response Plan

129. An emergency risk and response plan applicable to all gas related facilities will be established in accordance with the "National Environmental Emergency Plan" (24 January 2006) and other relevant PRC laws, regulations and standards and will include measures in the World Bank EHS guidelines with respect to occupational and community health and safety.

D. Anticipated Positive Operation Phase Impacts

1. The subproject integrates various technologies to form a micro-grid and supply electricity, heat and cooling to the region. The conventional boiler, electric air conditioning and thermal power plant are reference cases for energy savings and pollutant mitigation calculation:

- **PV power generation.** This project will operate 21.3MW PV power to generate 25.01 GWh per year.[6] Considering the transmission loss of the power grid and the loss of the low voltage distribution network, PV power generation can replace

[6] Capacity factor is 0.134 or 1,174 operating hours per year in full load.

28.76 GWh thermal power generation. It will save 10,209.9 tce[7] and reduce CO_2, SO_2, NO_X, and PM at 21,853.0,[8] 13.6, 12.4, and 2.6 ton respectively.[9]

- **Gas-based tri-generation system.** The tri-generation system consumes 1 m^3 natural gas to generate 3.8 kWh electricity and 4 kWh heating/cooling with the power generating efficiency of 35%.[10] If the electricity and heat is supplied by a reference system which includes a gas-fired power plant with the same of generating efficiency of 35% and a coal-fired boiler, the reference system will consume additional 0.6555 kgce of bituminous coal with the boiler efficiency of 75%. Assuming the tri-generation system consume 5.7 million m^3 natural gas[11] to generate 22.8GWh heating/cooling, the reference system would consume 3,736.3 tce coal more. This component can save 3,736.3 tce of energy and reduce emissions of CO_2, SO_2, NO_x, and PM at 9,792.6, 43.2, 26.4, and 79.5 ton respectively.
- **Air source heat pump.** The 14.3 MW air source heat pump could supply space heating, hot water and cooling if it operates year around. The total heating supply is 107.3 GWh which consumes 13,181 tce of coal if coal-fired boiler was used.[12] Assuming the energy efficiency of the heat pump is 500%, it consumes 21.45 GWh electricity (or 6,756.8 tce) from the grid annually. The project saves 6,424.3 tce energy. This component indirect emissions of CO_2, SO_2, NO_x, and PM is 1,130.5, 7.5, 3.0, and 9.2 tons respectively while the reference case emissions are 34,543.3, 228.2, 93.2, and 280.3 tons respectively.[13] This component will reduce emissions of CO_2, SO_2, NO_x, and PM at 18,245.5, 218.1, 83.9, and 278.4 tons respectively.
- **Linear Fresnel system.** The solar resource in Jinan area is about 4,647.57 MJ/m^2 per year. Assuming the heat collecting efficiency is 68% for this liner Fresnel system, the 3,000 m^2 heat collector will supply 9,482 GJ heat to the heat pipelines. 646 tons of bituminous coal could be consumed if the heat was supplied by a coal-fired boiler. There are no emissions from the project. This component will save 431.3 tce of energy and reduce emissions of CO_2, SO_2, NO_x, and PM at 1,130.5, 7.5, 3.0, and 9.2 tons respectively.
- **Energy storage system.** The energy storage system will help the peak shaving and therefore improve the curtailment of the renewable energy and optimize the power grid in Jinan. This component will save 9,858.0 tce of energy and reduce emissions of CO_2, SO_2, NO_x, and PM at 25,824.8, 83.8, 73.0, and 9.2 tons respectively.[14]

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[7] According to the China Power Sector Annual Development Report 2016 issued by CEC (China Electricity Council), the average coal consumption of thermal power plant per kWh supplied to the grid is 315 gce/kWh. This number will be used for calculating energy savings when electricity saved.

[8] NDRC issues CO_2 emission per kWh every year for CDM project development. The carbon emission factor of North China Grid is 0.7598 t-CO_2/MWh in 2015.

[9] According to the China Power Sector Annual Development Report 2016 issued by CEC (China Electricity Council), the PM, SO_2, and NOx emission factor of thermal power generation was 0.09, 0.47, and 0.43 g/kWh respectively in 2015.

[10] The research is conducted by Sino-French Energy Services. http://www.cqgas.cn:9888/zfny/energy/151.

[11] The system will operate 4500 hour at full load and power generation efficiency is 38% in average.

[12] Assuming efficiency of coal-fired boiler 75%.

[13] Coal-fired boiler with wet scrubber, bituminous coal with S content of 0.8% and ash content of 20%. The emission factor of CO_2, SO_2, NOx, and PM is 1.75 ton, 11.56 kg, 4.72 kg, and 14.2 kg per ton of coal.

[14] Coal saved from this component is estimated at 318 gce/kWh based on the “Thirteenth Five Year Plan”. Emission factors used are as following: CO2 is 2.62t/t SCE, SO2 is 8.5 kg / tce, and NOx is 7.4 kg/t SCE based on the "Comprehensive Energy Consumption Calculation General Rules" GB2589-81 "," China Resources Bureau, and "New Energy Demonstration City Evaluation Index System and Description’.

Table 19: Projected Emission Reductions

Energy category	Standard coal replaced (t)	Emission reduced			
		CO_2 (t)	SO_2 (t)	NO_X (t)	PM (t)
PV	10,209.9	21,853.0	13.6	12.4	2.6
Gas-based tri-generation	3,736.3	9,792.6	43.2	26.4	79.5
Linear Fresnel system	431.3	1,130.5	7.5	3	9.2
Air source heat pump	6,424.3	18,245.5	218.1	83.9	278.4
Energy storage system	9,858.0	25,824.8	83.8	73.0	15.8
Total	30,659.8	76,846.4	366.2	198.7	385.5

CO_2 = carbon dioxide, NO_x = nitrogen oxide, PM = particulate matter, PV = photovoltaic, SO_2 = sodium dioxide, t = ton, tri-generation = combined cooling, heating and power system.

131. The energy management center is the core operational control mechanism of a micro energy grid, which enables it to function under varying dynamic load scenarios. With good environmental benefits, the project could replace 30,659.8 tce, which is equivalent to 76,846.4 tons of CO_2, 366.2 tons of SO_2,198.7 tons of NO_X and 385.5 ton of PM. The project also includes various energy systems such as water energy storage, small wind turbine and middle-temperature solar thermal system, which could provide knowledge on how to integrate different energy resources into the micro-energy grid.

VI. ANALYSIS OF ALTERNATIVES

132. An analysis of subproject alternatives was undertaken during the feasibility stage to determine the most financially and technically feasible way of achieving the subproject objectives while minimizing environmental and social impacts.

A. No Project Alternative

133. The electrical power demand in the PRC and Shandong Province has been increasing due to the growth of economic activities. Coal has provided 64% of the primary energy consumed and nearly 76% of electricity generation in the PRC.[15] This high proportion of fossil fuel consumption, driven by the increasing demand for energy to support rapid economic growth in the last three decades, has raised serious environmental concerns. One way to mitigate this is to increasing the share of renewable energy in the overall energy supply.

134. If the subproject is not implemented, electricity from a traditional coal-fired power plant will be required to meet the increasing demand for electricity in Jinan. The expansion in coal-fired power plants in the PRC has caused large increase in CO_2, the major GHG responsible for climate change, as well emissions of SO_2, TSP, PM_{10}, and NO_x. The subproject will improve air quality and significantly reduce coal consumption and GHG emissions. It will also provide valuable experience and mitigate some of the technology risks associated with microenergy grid. Successful demonstration will help lead to market acceptance and large scale microenergy grid deployment in the PRC. Therefore, the “no project” alternative is considered not acceptable.

B. Project siting

135. Jinan City is one of the cities with severe air pollution in the greater BTH region. It is urgent that Jinan develops clean energy and energy storage methods to mitigate the severe air pollution issue. The existing energy system in Jinan is a large-scale grid driven by coal-fired power plants. However, the expansion of the existing coal-based power system to meet the increased demand is not an option as Jinan has been experiencing significant air pollution problems in the winter heating seasons including hazy skies and high levels of particulates. Thus, other alternatives to meet the growing power demand are urgently required.

136. Instead of a conventional grid, the subproject aims to build a microenergy grid, including PV power generation, gas-based CCHP, different energy storage system, linear Fresnel solar thermal heating system and air source heat pump. The microenergy grid is more flexible allowing the use of different clean and renewable energy sources.

C. Overall Alternative Analysis

137. Based on the analysis of alternatives, the subproject has selected the most appropriate energy source, energy storage method and energy management system.

[15] 2016 China Statistical Yearbook. http://www.stats.gov.cn/tjsj/ndsj/2016/indexch.htm

VII. INFORMATION DISCLOSURE AND PUBLIC CONSULTATION

A. PRC and ADB Requirements for Disclosure and Public Consultation

1. PRC Requirements

138. Relevant provisions in the PRC *Environmental Impact Assessment Law* (2003) and the *Regulations on the Administration of Construction Project Environmental Protection* (No. 253 Order of the State Council, 1998) require that an EIA study for a construction project shall solicit opinions from affected residents, as well as other organizations and concerned stakeholders. However, the requirements for public consultation are different for various sectors and projects. For an environmental Category A project, a full EIA report is required including two rounds of public consultations, while for a Category B project only a simplified tabular EIA is required without the need for public consultation.

139. The "Provisional Regulations on Public Participation in Environmental Impact Assessment" (2006) promulgated by State Environmental Protection Administration further improved the legislation of public participation in EIA in the PRC. It provides detailed requirements for the public participation process, including information disclosure standards, consultation methods, and public enquiry process. It is significant since it was the first document clearly regulating public participation in the EIA in the PRC.[16]

140. In 2014, MEP released "Guiding Opinions on Promoting Public Participation in Environmental Protection" (2014, No. 48) which defines public participation as 'citizens, legal persons and other organizations' voluntary participation in environmental legislation, enforcement, judicature and law obedience, and the development, utilization, protection and transformation activities related to environment.'

141. The public disclosure and consultation process undertaken during the preparation of the domestic EIA will be undertaken in compliance with the relevant PRC requirements, including the "Provisional Regulations on Public Participation in Environmental Impact Assessment" (2006) and the "Guiding Opinions on Promoting Public Participation in Environmental Protection" (2014, No. 48).

2. ADB Requirements

142. ADB's SPS 2009 has specific requirements for information disclosure and public consultation. Information disclosure involves delivering information about a proposed project to the general public and to affected communities and other stakeholders, beginning early in the project cycle and continuing throughout the life of the project. Information disclosure is intended to facilitate constructive engagement with affected communities and stakeholders over the life of the project.

143. The SPS requires that borrowers take a proactive disclosure approach and provide relevant information from environmental assessment documentation directly to affected peoples and stakeholders. In addition, in order to make key documents widely available to the general public, the SPS requires submission to ADB for posting on the ADB website as follows:

16 Wang Ya Nan, 2012. *Public Participation in EIA, SEA and Environmental Planning in China.* Environmental Impact Assessment Research Centre.

(i) a draft full EIA (including the draft EMP) at least 120 days prior to ADB Board consideration for Category A projects, and/or environmental assessment and review frameworks before project appraisal, where applicable;
(ii) the final EIA/IEE;
(iii) a new or updated EIA/IEE, EMP and corrective action plan prepared during project implementation, if any; and
(iv) environmental monitoring reports.

144. ADB's SPS 2009 also requires that the borrower carry out consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Consultations should include presentations on environmental impacts, benefits and mitigation measures, the project GRM, and ADB's Accountability Mechanism. For category A projects, such consultations should include consultations both at an early stage of EIA field work and when the draft EIA report is available.

B. Project Information Disclosure

145. The domestic EIA is still being prepared. Once the domestic EIA is completed, Jinan EPB will post the domestic EIA report on its website. The information will include:

(i) project name and project summary information;
(ii) name and contact information of the subproject proponent;
(iii) name and contact information of the institute responsible for preparing the EIA;
(iv) potential project environmental impacts and mitigation measures;
(v) key conclusions of the EIA report;
(vi) a link to download an abridged version of the EIA report; and,
(vii) contact information and a request for questions, suggestions and feedback from the public.

146. The subborrower will post the domestic EIA and this IEE report on its website, and CECEP will also post the domestic EIA and this IEE on its designated website for FIL.

147. In addition, this IEE will be disclosed on the ADB's website.

C. Public Consultation

148. During the preparation of domestic EIA and this IEE report, public consultation was held by the subborrower from 2–5 May 2017, according to ADB SPS 2009 requirements. A public consultation information notice was posted in the residential areas on 1 May 2017. The notice provided basic project information and invited residents near the subproject areas to attend the public consultation (**Figure 14** and **Figure 15**).

Figure 14: Public consultation notice in nearby residential areas

149. During the public consultant process, information was presented about the subproject status, potential environmental impacts and proposed mitigation measures. Participants were also asked to complete a questionnaire (**Table 20**). A total of 45 questionnaires were distributed and 45 were retrieved, a recovery rate of 100%. A sample completed questionnaire is presented in **Appendix II**, while **Table 22** presents a summary of the questionnaire results.

150. 100% of the respondents work and live within a 5 km radius of the subproject; 100% of respondents knew the subproject either from other person or information signs, and 97.8% of respondents indicated that they were already familiar with the subproject benefits after the introduction of the subproject. The top two environment issues respondents identified in their neighborhoods are air quality (77.8%) and solid waste (68.9%). Groundwater quality, dust and noise were identified as the top three issues during both the construction phase and the operation phase. However, most participants also indicated that potential air, waste water, solid waste and

noise impacts can be appropriately mitigated.

151. The overall support for the subproject is very strong with 44 out of 45 people or support rate of 97.8%; 88.9% of the respondents indicated that the subproject will improve local economic development; 93.3% indicated that the subproject will improve quality of life.

Figure 15: Public consultation photographs (2017)

Table 20: Project public consultation questionnaire (2017)

Name		**Sex**		**Age**	
Nationality		**Education level**		**Occupation**	
Company		**Title**		**Contact numbe**	
1. What is the main environment pollution near your living areas in your opinion (multiple choice)? A. Surface water B. Ambient air C. Noise D. Ground water E. Solid waste F. Others					
2. Do you know this project? A. Yes B. No					
3. If you know this project, project information is obtained by which way? A. Internet B. Newspaper C. Information signs D. Other person E. Other					
4. Distance between your working place and project site A. <1 km B. 1-3 km C. 3-5 km D. > 5km					
5. Distance between your house and project site A. <1 km B. 1-3 km C. 3-5 km D. > 5km					
6. Do you understand this project like project information, project component, project benefit etc,? A. Yes B. No C. Not clear					
7. Do you understand environment impacts of this project? A. Yes B. No C. Not clear					
8. What is environmental issue of highest concern during construction period? A. Surface water B. Ambient air C. Noise D. Dust/PM E. Ground water F. Solid waste G. Traffic problems H. Ecological environment I. Others					
9. What is environmental issue of highest concern during operation period? A. Surface water B. Ambient air C. Noise D. Dust/PM E. Ground water F. Solid waste G. Ecological environment H. Others					
10 Based on construction phase mitigation measures proposed in EIA, do you accept the impacts to environment?					
10.1 Ambient air (PM, dust included) A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.2 Noise A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.3 Surface water A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.4 Groundwater A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.5 Solid waste A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.6 Ecological environment A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.7 Other (traffic problem and inconvenient by project construction) A. Accept B. Barely accept C. Do not accept D. Have no idea					
11 Based on operation phase mitigation measures proposed in EIA, do you accept the impacts to environment?					
11.1 Ambient air (PM, dust included) A. Accept B. Barely accept C. Do not accept D. Have no idea					
11.2 Noise A. Accept B. Barely accept C. Do not accept D. Have no idea					
11.3 Surface water A. Accept B. Barely accept C. Do not accept D. Have no idea					
11.4 Groundwater A. Accept B. Barely accept C. Do not accept D. Have no idea					
11.5 Solid waste A. Accept B. Barely accept C. Do not accept D. Have no idea					

11.6 Ecological environment A. Accept B. Barely accept C. Do not accept D. Have no idea
12. Do you think construction of this project can improve local economic development or not? A. Yes B. No C. Not clear
13. Do you think whether construction of this project can improve your living quality? A. Yes B. No C. Not clear
14. After comprehensive analysis of project advantages and disadvantages, do you agree with the construction of this project? A. Yes B. No C. Not clear
Suggestions or requirements of the project:
Suggestions or requirements for environment protection of the project:
Project information *(a project summary was provided here), anticipated pollution control measures and environment benefits.*

Table 21: Summary data on questionnaire respondents

Parameter	Indicator	No.	%
Sex	Male	31	68.9
	Female	14	31.1
Age	Below 30	4	8.9
	31-40	19	42.2
	41-50	16	35.6
	Above 50	6	13.3
Nationality	Han people	45	100.0
	Other	0	0.0
Education Level	Primary School or Below	2	4.4
	Junior school	12	26.7
	High school, including technical secondary school	14	31.1
	Bachelor degree or above, including junior college	17	37.8
Occupation	Farmer	10	22.2
	Employee	14	31.1
	Freelancer	13	28.9
	Self-employed entrepreneurs	8	17.8

Table 22: Public consultation questionnaire results.

Question	Item	No	% (shading denotes highest ranked)
1. What is the main environment pollution near your living areas in your opinion (multiple choice)	Surface water	0	0
	Ambient air	35	77.8
	Noise	1	2.2
	Ground water	0	0
	Solid waste	31	68.9
	Other	0	0
2. Do you know this project?	Yes	45	100
	No	0	0
3. If you know this project, project information is obtained by which way?	Internet	0	0
	Newspaper	0	0
	Information signs	7	15.6
	Other person	38	84.4

Question	Item	No	% (shading denotes highest ranked)
	Other	0	0
4. Distance between your working place and project site	<1 km	0	0
	1-3 km	34	75.6
	3-5 km	11	24.4
	> 5km	0	0
5. Distance between your house and project site	<1 km	0	0
	1-3 km	37	82.2
	3-5 km	8	17.8
	> 5km	0	0
6. Do you understand project information, project component, project benefit etc,?	Yes	44	97.8
	No	1	2.2
	Not clear	0	0
7. Do you understand environment impacts of this project?	Yes	44	97.8
	No	0	0
	Not clear	1	2.2
8. What are environmental issues of highest concern during construction period?	Surface water	5	11.1
	Ambient air	8	17.8
	Noise	11	24.4
	Dust/PM	16	35.6
	Ground water	14	31.1
	Solid waste	6	13.3
	Traffic problems	6	13.3
	Ecological environment	3	6.7
	Other	0	0
9. What are environmental issues of highest concern during operation period?	Surface water	7	15.6
	Ambient air	4	8.9
	Noise	19	42.2
	Dust/PM	14	31.1
	Ground water	10	22.2
	Solid waste	5	11.1
	Ecological environment	3	6.7
	Other	0	0
10 Based on construction phase mitigation measures proposed in EIA, do you accept the impacts to environment?			
10.1 Ambient air (PM and dust is included)	Accept	42	93.3
	Barely accept	1	2.2
	Do not accept	0	0
	Have no idea	2	4.4
10.2 Noise	Accept	43	95.6
	Barely accept	1	2.2
	Do not accept	0	0
	Have no idea	1	2.2
10.3 Surface water	Accept	41	91.1
	Barely accept	2	4.4
	Do not accept	1	2.2
	Have no idea	1	2.2

Question	Item	No	% (shading denotes highest ranked)
10.4 Groundwater	Accept	42	93.3
	Barely accept	0	0
	Do not accept	0	0
	Have no idea	3	6.7
10.5 Solid waste	Accept	40	88.9
	Barely accept	2	4.4
	Do not accept	0	0
	Have no idea	3	6.7
10.6 Ecological environment	Accept	44	97.8
	Barely accept	1	2.2
	Do not accept	0	0
	Have no idea	0	0
10.6 Other (traffic problem and inconvenient by project construction)	Accept	43	95.6
	Barely accept	0	0
	Do not accept	0	0
	Have no idea	2	4.4
11 Based on operation phase mitigation measures proposed in EIA, do you accept the impacts to environment?			
11.1 Ambient air (PM and dust is included)	Accept	44	97.8
	Barely accept	0	0
	Do not accept	0	0
	Have no idea	1	2.2
11.2 Noise	Accept	43	95.6
	Barely accept	0	0
	Do not accept	0	0
	Have no idea	2	4.4
11.3 Surface water	Accept	41	91.1
	Barely accept	3	6.7
	Do not accept	0	0
	Have no idea	1	2.2
11.4 Groundwater	Accept	42	93.3
	Barely accept	3	6.7
	Do not accept	0	0
	Have no idea	0	0
11.5 Solid waste	Accept	43	95.6
	Barely accept	0	0
	Do not accept	0	0
	Have no idea	2	4.4
11.6 Ecological environment	Accept	45	100
	Barely accept	0	0
	Do not accept	0	0
	Have no idea	0	0
12. Do you think whether construction of this project can improve local economic development or not?	Yes	40	88.9
	No	2	4.4
	Not clear	3	6.7
13. Do you think whether construction of this project can improve your living quality or not?	Yes	42	93.3
	No	0	
	Not clear	3	6.7

Question	Item	No	% (shading denotes highest ranked)
14. After comprehensive analysis about advantages and disadvantages of this project, do you agree with the construction of this project?	Yes	44	97.8
	No	0	0
	Not clear	1	2.2

152. The results in **Table 22** show that there is a very high degree of understanding of, and support for the subproject from employees, freelancers, residents and farmers living and working near the subproject site. There are some concerns that the subproject may potentially have negative impacts on the surface water, noise and air, but there is also a very high confidence in the mitigation measures that are to be adopted by the subproject. Overall there was strong (97.8%) support for the subproject construction.

A. Future Consultation Activities

153. The subborrower will continue to conduct regular community liaison activities during the construction and operations phases if needed, including the implementation of the GRM (Chapter VIII). Ongoing consultation will ensure that public concerns are understood and dealt with in a timely manner.

VIII. GRIEVANCE REDRESS MECHANISM

D. Introduction

154. A project grievance can be defined as an actual or perceived project related problem that gives ground for complaint by an AP. As a general policy, a Project Management Office (PMO) will be established by the subborrower and it will work proactively toward preventing grievances through the implementation of mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. In addition, as the subproject has strong public support and will not involve any involuntary land or property acquisition or resettlement, significant grievance is unlikely to happen. Nonetheless, during construction and operation it is possible that unanticipated impacts may occur if the mitigation measures are not properly implemented, or unforeseen issues arise. In order to address complaints if or when they arise, a subproject-level GRM has been developed in accordance with ADB requirements and GRM requirements as specified in the ESMS for CECEP. A GRM is a systematic process for receiving, recording, evaluating, and addressing AP's project-related grievances transparently and in a reasonable timeframe.

E. ADB's GRM Requirements

155. SPS 2009 requires a project to establish a GRM to receive and facilitate resolution of AP's concerns and complaints about the project's environmental performance during construction as well as operation phases of the project. The GRM should be scaled to the risks and adverse impacts of the project; should address affected people's concerns and complaints promptly, using an understandable and transparent process; should be readily accessible to all sections of the community at no cost and without retribution; and, should not impede access to the PRC's judicial or administrative remedies.

F. Current GRM Practices in the PRC

156. At the national level, a framework to address grievance has been established. State Council Decree No. 431 "Regulations on Letters and Visits" (January 2005) establishes a complaint mechanism at all levels of government, and safeguards the complainants from any retaliation. The MEP Decree No. 34 "Environmental Letters and Visits System" provides specific guidelines to establish a system and address environmental complaints. When APs are affected by project activities, they may complain to the contractors and the project company by themselves or through their community organizations, or complain directly to local EPBs. If the issue is not resolved they may take legal action, though that is typically considered as a last option.

G. Subproject Level GRM

157. The objective of the subproject GRM is to prevent and address community concerns, reduce risks, and assist the subproject to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the subproject level GRM has been designed to (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the subproject; (ii) demonstrate concern about community members and their environmental well-being; and (iii) prevent and mitigate any adverse environmental impacts on communities caused by subproject implementation and operations. The GRM will be accessible to all members of the community.

158. The overall approach of the GRM is to deal with grievances at a local level first in an efficient manner, and escalate to higher level of authority if the grievance cannot be resolved. The designated person from the PMO will be responsible for implementation of the GRM. The PMO will be the key contact point for residents, businesses, government departments and other stakeholders who may require information about the subproject or who have an issue they would like to discuss.

159. The GRM will be implemented through five steps, advancing to the next level only if the grievance was unable to be redressed at the previous level.

(i) **Step 1**: If a concern arises, the AP should try to resolve the issue of concern either directly with the contractor or with the contactor via GRM access points (community leaders, neighborhood organizations, PMO, local EPB) during the construction phase, and/or the operator during the operation phase. If the concern is resolved successfully no further follow-up action is required. Nonetheless, the contractor (during construction) and/or the operator (during operation) shall record any complaint and actions taken to resolve the issues and report the results to the PMO. If no solution is found within 10 working days or if the AP is not satisfied with the suggested solution under Step 1, proceed to Step 2. The AP may also skip Step 1 and directly file the complaint with the PMO.

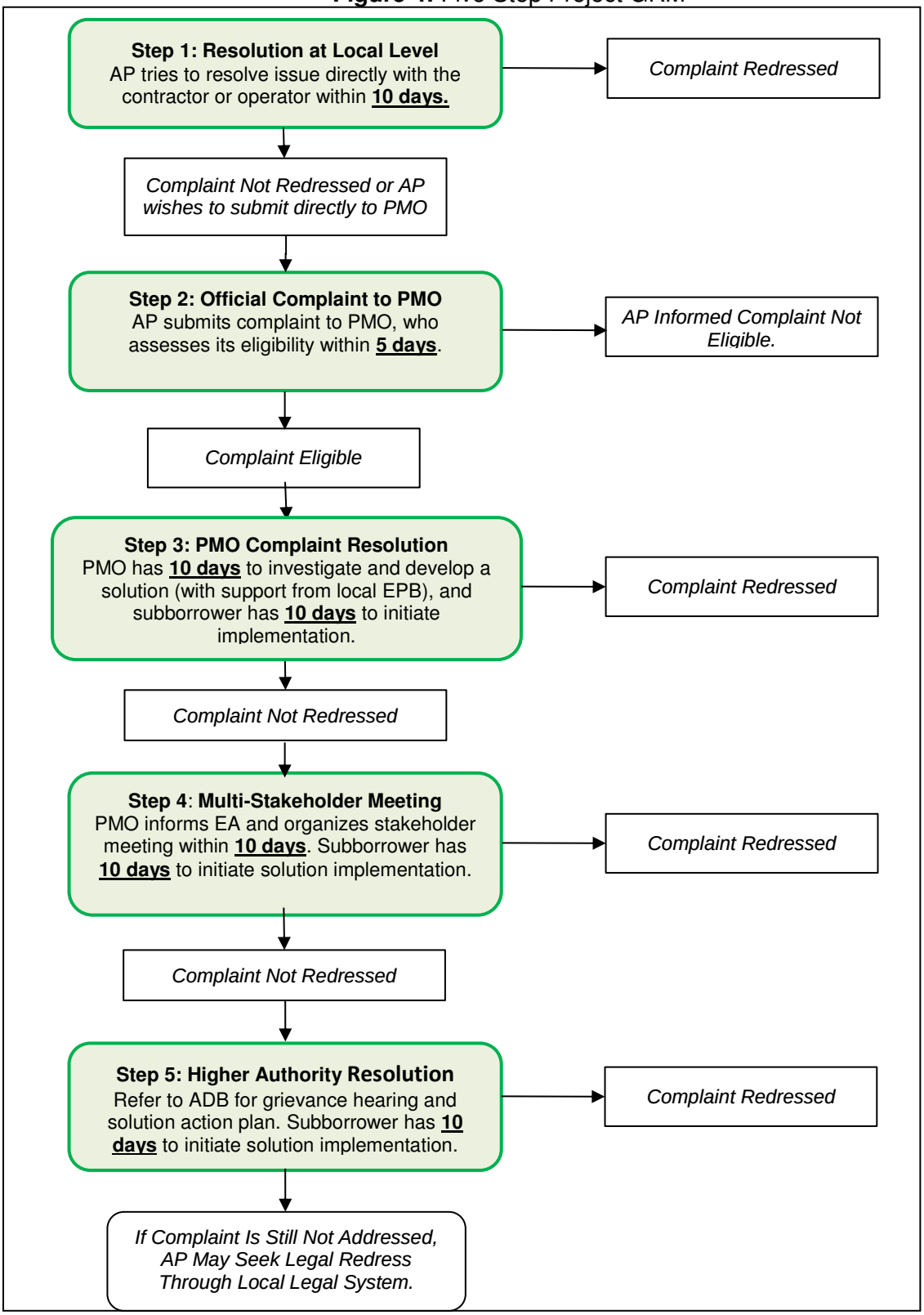
(ii) **Step 2:** The AP will submit the grievance to the PMO, who will record the grievance, assess its eligibility and report back to the AP within 5 working days. If the grievance is eligible, proceed to Step 3.

(iii) **Step 3:** The PMO will investigate the complaint, and consult with the subborrower, local EPB, and other stakeholders as appropriate to identify a solution. The PMO will give a clear reply to the AP within 10 working days with the suggested solution, and the subborrower will ensure that implementation of the agreed-upon redress solution begins within 10 working days. If no solution is found or if the complainant is not satisfied with the suggested solution under Step 3, proceed to Step 4.

(iv) **Step 4:** The PMO will inform CECEP the grievance, and will organize a multi-stakeholder meeting within 10 days, where all relevant stakeholders, including the complainant, CECEP, subborrower, and local EPB, can discuss the issue. The multi-stakeholder meeting will aim to find a solution acceptable to all, and identify responsibilities and an action plan. The subborrower will ensure that the implementation of agreed-upon redress solution begins within 10 working days of the completion of the multi-stakeholder meeting.

(v) **Step 5:** If the complainant is still not satisfied with the suggested solution under Step 4, the grievance will be directed to ADB. ADB will direct the EA to organize a hearing process and shall determine a solution acceptable to all. Based on the hearing results, an action plan shall be developed and the subborrower will ensure that the implementation of the agreed-upon redress solution begins within 10 working days of the completion of the hearing.

Figure 4: Five Step Project GRM



AP = affected person, EPB = environmental protection bureau, PMO = project management office.

IX. CONCLUSIONS

160. This is the IEE report for Smart Industrial Zone Development subproject of proposed PRC: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility. This subproject creates a microenergy grid network consisting of 6 sub-micro energy grids, including incorporation of renewable energy technology and energy storage technology. In doing so, it addresses energy production and supply issues under various resource circumstances, while meeting a range of customers' demands. It further optimizes energy utilization by allowing for energy trading between the subgrids, and an islanded interconnection with the regional grid for bidirectional trade of power. The subproject also includes various energy systems such as water energy storage, small wind turbine and middle-temperature solar thermal system, which could provide knowledge and experience on how to integrate different energy resources into the microenergy grid.

161. The subproject will bring significant positive environmental benefits. The subproject will reduce the emission of greenhouse gases and other air pollutants in Jinan City. When compared to the equivalent production of power through traditional coal-fired sources, once operational the subproject will: (i) result in annual energy savings equivalent to 19,470.1 tons of standard coal, thereby providing a global public good by avoiding the annual emission of 48,171.2 tons of carbon dioxide (CO_2), a greenhouse gas; (ii) improve local air quality through the estimated annual reduction of emissions of sulfur dioxide (SO_2) by 280.6 tons, nitrogen oxides (NO_x) by 124.1 tons, and PM by 369.4 tons.

162. The Subproject has: (i) selected appropriate technologies to reduce the emission of pollutants; (ii) identified potential negative environment impacts and appropriately established mitigation measures; (iii) received public support from the subproject beneficiaries and affected people; (iv) established effective project GRM procedures; and (v) prepared a comprehensive EMP including environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

163. Based on the analysis conducted it is concluded that the subproject will result in significant positive socioeconomic and environmental benefits, and will not result in significant adverse environmental impacts that are irreversible, diverse, or unprecedented. Overall, any minimal adverse environmental impacts associated with the subproject can be prevented, reduced, or minimized through the appropriate application of mitigation measures. It is therefore recommended that:

(i) the subproject is classified as environment category B; and
(ii) the subproject be supported by ADB, subject to the implementation of the commitments contained in the EMP and allocation of appropriate technical, financial and human resources by the subborrower to ensure these commitments are effectively and expediently implemented.

Appendices

Appendix I: Environmental Management Plan

Appendix II: Questionnaire sample

X. APPENDIX I: ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

1. This EMP is for Smart Industrial Zone Development subproject of the proposed PRC: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—CECEP's Regional Emission-Reduction and Pollution-Control Facility. This subproject creates a microenergy grid network consisting of 6 sub-micro energy grids, including incorporation of renewable energy technology and energy storage technology. In doing so, it addresses energy production and supply issues under various resource circumstances, while meeting a range of customers' demands. It further optimizes energy utilization by allowing for energy trading between the subgrids, and an islanded interconnection with the regional grid for bidirectional trade of power. The subproject also includes various energy systems such as water energy storage, small wind turbine and middle-temperature solar thermal system, which could provide knowledge and experience on how to integrate different energy resources into the microenergy grid.

2. The objectives of the EMP are to ensure (i) implementation of the identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of monitoring and reporting; and (iii) the subproject compliance with the PRC's relevant environmental laws, standards and regulations and ADB's SPS 2009. Organizational responsibilities and budgets are clearly identified for implementation, monitoring and reporting.

3. The EMP is to be implemented in all phases of the subproject cycle, including design, pre-construction, construction, and operation. In the detailed design stage the EMP will be used by the design institute for incorporating mitigation measures into the detailed designs. The EMP will be updated at the end of the detailed design, as needed.

4. The EMP will be included as a separate annex in all bidding and contract documents. The contractors will be informed of their obligations to implement the EMP, and to provide for EMP implementation costs in their bids for project works. The EMP is presented in **Table 1**.

Table 1 Environmental Management Plan

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
Pre-construction						
Transportation and mobilization of construction materials and equipment	Dust generation during vehicle movement	i. Construction material (sand/soil) should be covered while transportation. ii. Water to be sprinkled as needed. iii. Emissions from vehicles and equipment should comply with national standards.	Air quality	PRC ambient air quality standards	Subborrower	Subproject design
	Noise generation	i. Movement of vehicles should be restricted during day time. ii. Noise levels from vehicles and equipment to comply with noise standards.	Noise levels	PRC noise standards	Subborrower	Subproject design
Construction phase						
Subproject construction	Wastewater - surface and groundwater contamination from construction wastewater and domestic water	– Existing sanitary facilities will be provided for construction workers. Existing toilets are already equipped with septic tanks in accordance with PRC standards. Domestic wastewater will be treated in the septic tanks and discharged to municipal sewer. – Areas where construction equipment is being washed will be equipped with water collection basins and sediment traps. Wastewater will be collected and discharged to municipal sewer. – Maintenance of construction equipment and vehicles will not be allowed on site to reduce wastewater generation.	Project construction site	PRC's Ambient Surface Water Quality Standards (GB3838-2002)	Contractor, subborrower, CECEP	Whole construction stage
Transportation of construction materials and subproject construction	Increase in air pollution–dust, vehicle emissions	– Water will be sprayed on active construction sites including where fugitive dust is being generated on a daily basis, and more frequently during windy days. – Construction activities will be halted during high wind events. – Transport vehicles will be limited to low speeds in construction sites. – Loads will be covered during truck transportation to avoid spillage or fugitive dust generation. Fine materials will be transported in fully contained trucks. – Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds.	Project construction site	PRC's Air Pollutant Integrated Emission Standards (GB 16297-1996)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		– Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical. – Store petroleum or other harmful materials in appropriate places and cover to minimize fugitive dust and emission. – Provide regular maintenance to vehicles in order to limit gaseous emissions (to be done off-site).				
Mechanized construction and vehicle movement	Increase in noise levels	– Construction activities are to be limited to reasonable hours during the day and early evening. Construction activities will be strictly prohibited during the nighttime (22:00 h to 07:00 h). Exceptions will only be allowed in special cases, and only after getting approval of the surrounding residents, local EPB and other relevant departments. – Simultaneous high-noise activities will be avoided, and high noise activities will be scheduled during the day rather than evening hours. Similarly, construction site will be planned to avoid multiple high noise activities or equipment from operating at the same location. – Low-noise equipment will be selected as much as possible. Equipment and machinery will be equipped with mufflers and will be properly maintained to minimize noise. – Noise PPE will be provided to workers. – Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and high traffic times. – Vehicles transporting construction materials or waste will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals. – Special attention will be paid to protect sensitive sites near the subproject site: High noise construction activities will be positioned away from sensitive sites as possible.	Project construction site	PRC's Noise Standards for Construction Site Boundary (GB 12523-2011)	Contractor, subborrower, CECEP	Whole construction stage
Subproject construction	Solid waste generation	– Wastes will be reused or recycled to the extent possible. – Littering by workers will be prohibited. – Existing domestic waste containers will be used for domestic waste collection at work sites. Domestic waste will be collected on a regular basis by the local sanitation departments and transported for recycling, reuse, or disposal at a licensed landfill. – Construction waste dumpsters will be provided at all work sites. Construction waste will be collected on a regular basis	Project construction site	PRC's Standards for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB 18599-2011)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfills. – There should be no final waste disposal on site. Waste burning at or near the site is strictly prohibited. – Contractors will be held responsible for proper removal and disposal of any significant residual materials, wastes, and contaminated soils that remain on the site after construction.				
Subproject construction	Hazardous and Polluting Materials	– A hazardous material handling and disposal protocol that includes spill emergency response will be prepared and implemented by contractors. – Storage facilities for fuels, oil, chemicals and other hazardous materials will be within secured areas on impermeable surfaces provided with dikes, and at least 300 m from drainage structures and important water bodies. A standalone site within the storage facility will be designated for hazardous wastes. – Signs will be placed at chemicals and hazardous materials storage sites to provide information on type and name of chemicals and hazardous materials. – Suppliers of chemicals and hazardous materials must hold proper licenses and follow all relevant protocols and PRC regulations and requirements. – A Shandong EPB certificated company will be hired to collect, transport, and dispose of hazardous materials.	Project construction site	PRC's General Specifications of Engineering and Technology for Hazardous Waste Disposal (HJ 2042 -2014)	Contractor, subborrower, CECEP	Whole construction stage
Removal of vegetation	Flora and Fauna	– A greening plan will be implemented. Site vegetation plans will be developed at subproject site using appropriate native species. – Any existing vegetated areas impacted by the subproject will be restored post-construction using appropriate native species.	Project construction site	NA	Contractor, subborrower, CECEP	Whole construction stage
Vehicle movement and other construction activities	Community disturbance and safety	– Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and high traffic times. – Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals. – Signs will be placed at construction sites in clear view of the public, warning people of potential dangers such as moving. All sites will be made secure, discouraging access by	Project construction site	NA	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		members of the public through appropriate fencing whenever appropriate.				
Subproject construction	Workers occupational health and safety	– Each contractor will implement the relevant construction phase EHS plan. – Identify and minimize the causes of potential hazards to workers. Implement appropriate safety measures. – Provide training to workers on occupational health and safety, emergency response, especially with respect to using potentially dangerous equipment and storage, handling and disposal of hazardous waste. – Ensure that all equipment is maintained in a safe operating condition. – Provide appropriate PPE to workers. – Provide procedures for limiting exposure to high noise or heat working environments in compliance with the PRC noise standards for construction sites (GB 12523-2011). – Ensure regular safety meetings with staff.	Project construction site	NA	Contractor, subborrower, CECEP	Whole construction stage
Subproject construction	Damage to PCRs	– Construction activities will be immediately suspended if any PCRs are encountered; – Destroying, damaging, defacing, or concealing PCRs will be strictly prohibited in accordance with PRC regulations; – Local Cultural Heritage Bureau will be promptly informed and consulted; and, – Construction activities will resume only after thorough investigation and with the permission from the local Cultural Heritage Bureau.	Project construction site	NA	Contractor, subborrower, CECEP	Whole construction stage
Operation phase						
Boiler operation	Air pollution	– Low NOx natural gas-fired boiler with design emission levels that are in compliance with the most stringent PRC national standard.	Project operation site	PRC's Emission Standards of Air Pollutants from Coal-Burning, Oil-Burning and Gas-Fired Boilers (GB 13271-2014)	Subborrower, CECEP	Whole operation stage
Subproject operation	Surface and groundwater contamination from waste	– Wastewater from canteen will be treated by oil-separator, and discharged to municipal sewer combined with domestic wastewater. – Production wastewater will be discharged to municipal sewer	Project operation site	PRC's Integrated Sewage Discharge Standard	Subborrower, CECEP	Whole operation stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
	water discharge	system and then treated at Xiaoqing River Wastewater Treatment Plant.		(GB8978-1996)		
Subproject operation	Solid waste	– Domestic waste bins will be provided and domestic waste will be routinely collected by the local sanitation department for recycling, if possible, or final disposal at an approved waste disposal site. – No permanent on-site solid waste disposal will be permitted at project site. – No burning of wastes will be permitted at project site. – Waste resin and waste lithium battery will be collected, transported and treated by a Shandong EPB certificated third hazardous waste treatment company.	Project operation site	PRC's Standards for pollution control on the storage and disposal site for general industrial solid wastes (GB 18599-2011)	Subborrower	Whole operation stage
Subproject operation	Increase in noise levels	– Low-noise equipment will be used as far as possible, and noise reduction measures such as noise elimination, shock absorption, insulated enclosures and sound dampening materials on exterior walls will be implemented. – All equipment will be properly maintained in order to minimize noise. – Appropriate noise PPE will be provided to the workers who are likely to be exposed to high noise level environments. – Layout for subproject site will be reasonable planned to reduce noise.	Project operation site	PRC's Industrial Enterprise Boundary Noise Emission Standard (GB12348-2008)	Subborrower	Whole operation stage
Subproject operation	Occupational and community health and safety	– All natural gas works will be in compliance with relevant PRC building code requirements. – Subproject site will be equipped with flammable gas detection, alarm and fire suppression systems. Electrical devices within the explosion risk area will be safety equipped. – Gas pipelines will be grounded and equipped with anti-lightning devices where applicable. – All gas related devices will be colored and equipped with warning signs. Operation phase EHS plans will be developed and implemented and workers will be trained regularly on their implementation. – PPE including goggles, gloves, safety shoes, will be provided to workers. – Provide training to workers on occupational health and safety, and emergency response. – Natural gas systems will be designed in strict compliance with relevant PRC fire, health and safety standards. Fire	Project operation site	Code for Design of City Gas Engineering (GB 50028-2006) and Regulation on Electric Apparatus Design for Explosion and Fire Risk Environment (GB50058-92).	Subborrower	Whole operation stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		compartments will be established based on the fire risks and fire-resistant buildings/structures will include fire-proof doors and windows. – Fire-alarm and suppression systems will be installed and tested regularly to ensure it functions properly. – Control measures will be strictly undertaken to ensure the discharge, exhaust and safety relief of flammable fuels in enclosed systems. – No unauthorized personnel will be allowed into gas-fired facilities.				

CECEP = China Energy Conservation and Environmental Protection Group, EHS = environment health and safety, EPB = environmental protection bureau, m = meter, NA = not applicable, NO_x = nitrogen oxide, PPE = personnel protective equipment, PCR = physical cultural resources, PRC = People's Republic of China.

B. Implementation Arrangements

5. CECEP will be the executing agency (EA) and the implementing agency (IA). CECEP Huayu Fund Management Co. Ltd. (CECEP Huayu) will manage the loan. CECEP will establish a Project Management Office (PMO) including an Environment Officer and a Social Officer.

6. CECEP will retain an environment expert if needed to provide support to the PMO in mitigation implementation, environmental monitoring, reporting, and addressing any environment related issues that arise including grievances. The environmental expert will also support contractors in developing Contractor Environmental Management Plans (CEMPs) and associated subplans prior to construction and operation.

7. The PMO Environment Officer will be responsible for regular internal inspections of mitigation measures at the construction site, in accordance with EMoP. A third party environmental monitoring entity will be engaged by the subborrower and will undertake construction and operation phase ambient environmental monitoring per EMoP.

8. The contractor will be responsible for implementing relevant mitigation measures during construction. Following the award of each construction contract, the contractor will prepare the CEMP and associated subplans which detail the means by which the contractor will comply with the EMP. The contractor will identify a lead focal point for environmental issues (e.g., Chief Site Engineer) to implement the CEMP and take all reasonable measures to minimize the impact of construction activities on the environment. The contractor will also submit monthly environmental report to the PMO on EMP implementation, including the EMoP. The contractor is also required to report any spills, accidents, and grievances received, and any actions taken. CECEP will visit the subproject site regularly to ensure the EMP and EMoP are implemented properly. CECEP will review the semi-annual and annual environmental monitoring reports submitted by the subborrower and consolidate them with the reports from other subborrowers. CECEP will submit the consolidated semi-annual and annual environmental monitoring reports to ADB as specified in the ESMS.

9. ADB will conduct due diligence of environment issues during the subproject review missions. ADB will review the semi-annual and annual environmental monitoring reports submitted by CECEP and disclose them on its website. If the PMO fails to meet safeguard requirements described in the EMP, CECEP/ADB will seek corrective measures and advise the PMO on items in need of follow-up actions.

10. The subproject implementation organization and the roles and responsibilities of the participating agencies are presented in **Table 2**. The subproject implementation arrangements are presented in **Figure 1**.

Table 2: Project implementation and management organizations

Organization	Role and Responsibility
CECEP	- Will serve as the EA/IA and project contact point for ADB. - Responsible for coordinating project implementation activities among government agencies such as finance bureau, development and reform commission, environmental protection bureau, water resources bureau, agriculture and forestry bureau, livestock and land resource bureau. - Coordinating the activities of and meeting the requirements of the ADB visiting missions.
CECEP Huayu	On behalf of the executing agency, a PMO will be including a safeguard unit with suitably qualified and experienced full time staff. PMO will be responsible for all project organization and implementation activities, including the following: - Formulating the subproject management and operating procedures, implementation plans, and budgets. - Ensuring project's compliance with loan and project agreements and with the safeguards requirements as specified in the ESMS. - Managing the activities of the design institutes, procurement agents, and consultants in accordance with government and ADB regulations. - Communicating and coordinating with concerned offices and with external contacts. - Taking part in capacity development and training. - Overseeing the implementation of different project outputs. - Monitoring the subproject's physical and financial progress and compliance with project's reporting requirements, ensuring project progress reports are prepared and submitted to ADB on time. - Addressing complaints received from APs. - Organizing project acceptance verification. - Coordinating the activities of and meeting the requirements of ADB review missions. - Supervising the implementation of EMP and EMoP. - Conducting regular site visits and safeguard review missions in accordance with the requirements set forth in the ESMS. - Preparing and submitting consolidated semi-annual and annual environmental monitoring reports as required by the ESMS to ADB. - Requiring subborrowers to prepare corrective action plans in the event of noncompliance with EMP or EMoP.
Subborrower	Main responsibilities include: - Contracting and administering contractors and suppliers. - Supervising construction and monitoring quality control. - Ensuring compliance with EMP, EMoP, engaging external environmental safeguard consultant if needed. - Monitoring project's physical and financial progress and preparing regular progress reports to the PMO. - Testing and commissioning of completed project facilities. - Identifying and implementing O&M arrangements. - Coordinating with and assisting the PMO in developing project management procedures and detailed implementation plan, and monitoring achievement thereof. - Arranging the commissioning of the constructed facilities. - Preparing progress reports for submission to the executing agency and/or PMO. - Preparing semi-annual and annual environmental monitoring reports and submitting to PMO.
Environmental Monitoring Company	A qualified independent environmental monitoring company will be recruited to implement the ambient monitoring portion of the EMoP.

Organization	Role and Responsibility
ADB	Responsible for the following: - Providing the EA/IA and PMO with guidance to ensure smooth project implementation and achieve the desired development impacts and their sustainability. - Conducting regular review missions. - Monitoring the implementation of EMP and EMoP. - Monitoring status of compliance with loan and project covenants, including safeguards. - Reviewing environmental monitoring reports and disclosing them on ADB website. - Regularly updating the subproject information documents for public disclosure at ADB web site, including the safeguards documents. - Requiring CECEP Huayu to develop corrective action plan for any non-compliance issues.

ADB = Asian Development Bank, AP = affected person, CECEP = China Energy Conservation and Environmental Protection Group, CECEP Huayu = CECEP Huayu Fund Management Co. Ltd., EA = executing agency, EMP = Environmental Management Plan, EMoP = environmental monitoring plan, ESMS = environmental and social management system, IA = implementing agency, O&M = operation and maintenance, PMO = project management office.

C. Potential Impacts and Mitigation Measures

11. The potential impacts of the subproject during pre-construction, construction and operation have been identified and appropriate mitigation measures developed (Chapter V of the IEE and **Table 1** of Appendix).

D. Environment Monitoring Plan

12. An EMoP to monitor the environmental impacts of the subproject and assess the effectiveness of mitigation measures is presented in **Table 3.** The EMoP includes both compliance inspection undertaken by the PMO Environment Officer, and ambient air, noise, and wastewater monitoring undertaken by the third party environmental monitoring entity. Ambient monitoring will be conducted in compliance with relevant PRC regulations, methods and technical specifications.

13. The data and results of environmental compliance inspection and monitoring activities will be used to assess: (i) the extent and severity of actual environmental impacts against the predicted impacts and baseline data collected before the subproject implementation; (ii) performance or effectiveness of environmental mitigation measures or compliance with pertinent environmental rules and regulations; (iii) trends in impacts; (iv) overall effectiveness of EMP implementation; and (v) the need for additional mitigation measures and corrective actions if non-compliance is observed.

E. Institutional Strengthening and Capacity Building

14. The institutional strengthening and capacity building focuses on the safeguard requirements of relevant PRC laws and regulations and the ADB SPS 2009. The training will focus on the ADB SPS 2009; PRC safeguard requirements; development and implementation of EHS plans during construction and operation; implementation of the EMP, the EMoP, and the GRM; and worker and community health and safety issues and measures (**Table 4).**

Table 3: Environmental Monitoring Plan (EMoP)

Subject	Parameter	Location	Frequency	Implemented by	Supervised by
A. Construction Phase					
Air Pollution	Ambient dust monitoring (TSP, PM_{10}, $PM_{2.5}$)	Construction site	Quarterly during construction stage	Third party environmental monitoring entity	PMO/CECEP
	Compliance inspection of implementation of air pollution control measures	Construction site	Monthly during construction stage	Subborrower	PMO/CECEP
Wastewater	Compliance inspection of implementation of wastewater management measures	Construction site	Monthly during construction stage	Subborrower	PMO/CECEP
Noise	Ambient noise monitoring (day and night Leq dB[A])	Construction site	Quarterly during construction stage	Third party environmental monitoring entity	PMO/CECEP
Solid Waste	Compliance inspection of implementation of solid waste management measures	Waste collection and disposal sites	Monthly during construction stage	Subborrower	PMO/CECEP
Hazardous and Polluting Materials	Compliance inspections of implementation of hazardous materials management measures	Storage facilities for fuels, oil, chemicals, and other hazardous materials. Vehicle and equipment maintenance areas.	Monthly during construction stage	Subborrower	PMO/CECEP
Flora and Fauna	Compliance inspection of land clearing to ensure mitigation measures are being implemented	Construction site	Monthly during construction stage	Subborrower	PMO/CECEP
Socioeconomic Impacts	Compliance inspection of implementation of traffic control measures	Construction site roads. Transportation routes.	Monthly during construction stage	Subborrower	PMO/CECEP
	Compliance inspection of implementation of	Construction site	Monthly during construction stage	Subborrower	PMO

Subject	Parameter	Location	Frequency	Implemented by	Supervised by
	Occupational and Community Health and Safety measures and an Emergency Response Plan				
B. Operation Phase					
Air pollutants generated from operation	Emission monitoring (PM, SO_2, NOx)	Exhaust stacks	Semi-annually	Third party environmental monitoring entity	CECEP
Wastewater	Compliance inspection during operation phase of waste water management measures implementation	Project site	Semi-annually	Subborrower	CECEP
Solid Waste	Compliance inspection during operation phase of solid waste management measures implementation	Project site	Semi-annually	Subborrower	CECEP
Hazardous and Polluting Materials	Compliance inspection during operation phase of hazardous materials management	Project site	Semi-annually	Subborrower	CECEP
Health and Safety and Emergency Response	Compliance inspection during operation phase occupational of and community health and safety management measures and an Emergency Response Plan implementation	Project site	Semi-annually	Subborrower	CECEP

ADB = Asian Development Bank, EMP = environmental management plan, GRM = grievance redress mechanism, NO_x = nitrogen oxide, PM = particulate matter, PMO = project management office, PRC = People's Republic of China, SO_2 = sulfur dioxide.

Table 4: Institutional strengthening and training program

Training Topic	Trainers	Attendees	Contents	Times	Days	# Persons	Budget (USD)
Construction Phase Environment, Health and Safety Training	Qualified environment experts	Contractors, PMO, subborrower	**ADB and PRC laws, regulations and policies** – ADB's safeguard policy statement – Project applicable PRC environmental, health and safety laws, policies, standards and regulations – International environmental, health and safety management practice in civil irrigation and drainage construction **GRM** – GRM structure, responsibilities, and timeframe – Types of grievances and eligibility assessment **Implementation of Construction Phase EMP** – Impacts and mitigation measures – Monitoring and reporting requirements – Non-compliance and corrective actions	3 (once prior to start of construction, and then once during years 2 to 3)	2	30	**Training Development** Fixed costs: $2,000 per course delivery x 3 = $ 6,000
Operation Phase Environment, Health and Safety Plan Training	Qualified environment experts	PMO, subborrower	**ADB and PRC laws, regulations and policies** – ADB's safeguard policy statement – Project applicable PRC environmental, health and safety laws, policies, standards and regulations – International environmental, health and safety management practice in civil irrigation and drainage operation **GRM** – GRM structure, responsibilities, and timeframe – Types of grievances and eligibility assessment **Implementation of Operation Phase EMP** – Impacts and mitigation measures – Monitoring and reporting requirements – Non-compliance and corrective actions	3 (once prior to start of operation, and then once during years 2 and 3)	2	30	**Training Development** Fixed costs: $2,000 per course delivery x 3 = $6,000
			Total	**6**		**60**	**$12,000**

F. Reporting Requirements

15. The subborrower will submit a semi-annual environmental monitoring reports during construction phase and annual reports during operation phase to CECEP on the implementation and compliance with EMP, including information on all spills, accidents, grievance received, and appropriate actions taken.

16. CECEP will review these reports and consolidate them with the environmental monitoring reports from other subborrowers and submit to ADB.

17. The environmental reporting requirements are summarized in the **Table 5**.

Table 5: Reporting Requirements

Report	Prepared by	Submitted to	Frequency
A. Construction Phase			
EMP compliance, spills and accidents	Subborrower	CECEP	Semi-annually
Environmental monitoring reports	Subborrower	CECEP	Semi-annually
B. Operation Phase			
Environmental monitoring report	Subborrower	CECEP	Annually

CECEP = China Energy Conservation and Environmental Protection Group, EMP = environmental management plan.

G. Performance Indicators

18. Performance indicators (**Table 6**) have been developed to assess the implementation of the EMP. These indicators will be used to evaluate the effectiveness of environmental management.

Table 6: Performance Indicators

No.	Description	Indicators
1	Staffing	(i) PMO established with appropriately qualified staff including Environment Officer. (ii) Appropriately qualified environmental expert recruited if needed. (iii) Third party environmental monitoring entity engaged.
2	Budgeting	(i) Environment mitigation cost during construction and operation is sufficiently and timely allocated. (ii) Environment monitoring cost is sufficiently and timely allocated. (iii) Budget for capacity building is sufficiently and timely allocated.
3	Monitoring	(i) Compliance monitoring is conducted by subborrower as per EMoP. (ii) Construction phase and operation phase ambient and effluent monitoring is conducted by third party environmental monitoring entity.
4	Supervision	(i) EA reviews the implementation of EMP; (ii) ADB reviews consolidated environmental monitoring reports.

No.	Description	Indicators
5	Reporting	(i) Semi-annual environmental monitoring reports during construction phase and annual reports operation phase prepared by the subborrower are submitted to CECEP.
6	Capacity Building	(i) Training on ADB safeguard policy, EMP implementation, and GRM is provided during subproject implementation.
7	Grievance Redress Mechanism	(i) GRM contact persons are designated at all subborrower and the PMO, and GRM contact information disclosed to the public before construction. (ii) All complains are recorded and processed within the set time framework in the GRM of this IEE.
8	Compliance with PRC standards	(i) Project complies with the PRC's environmental laws and regulations and meets all required standards.

ADB = Asian Development Bank, CECEP = China Energy Conservation and Environmental Protection Group, EMP = environmental management plan, EMoP = environmental monitoring plan, GRM = grievance redress mechanism, IEE = initial environmental examination, PMO = project management office, PRC = People's Republic of China.

H. Estimated Budget for EMP Implementation

19. The estimated budget for EMP implementation of the subproject is presented in **Table 7**. Costs are presented for mitigation implementation, ambient monitoring, capacity building, implementation support if needed, and GRM implementation. The costs do not include salaries of PMO staff.

I. Mechanisms for Feedback and Adjustment

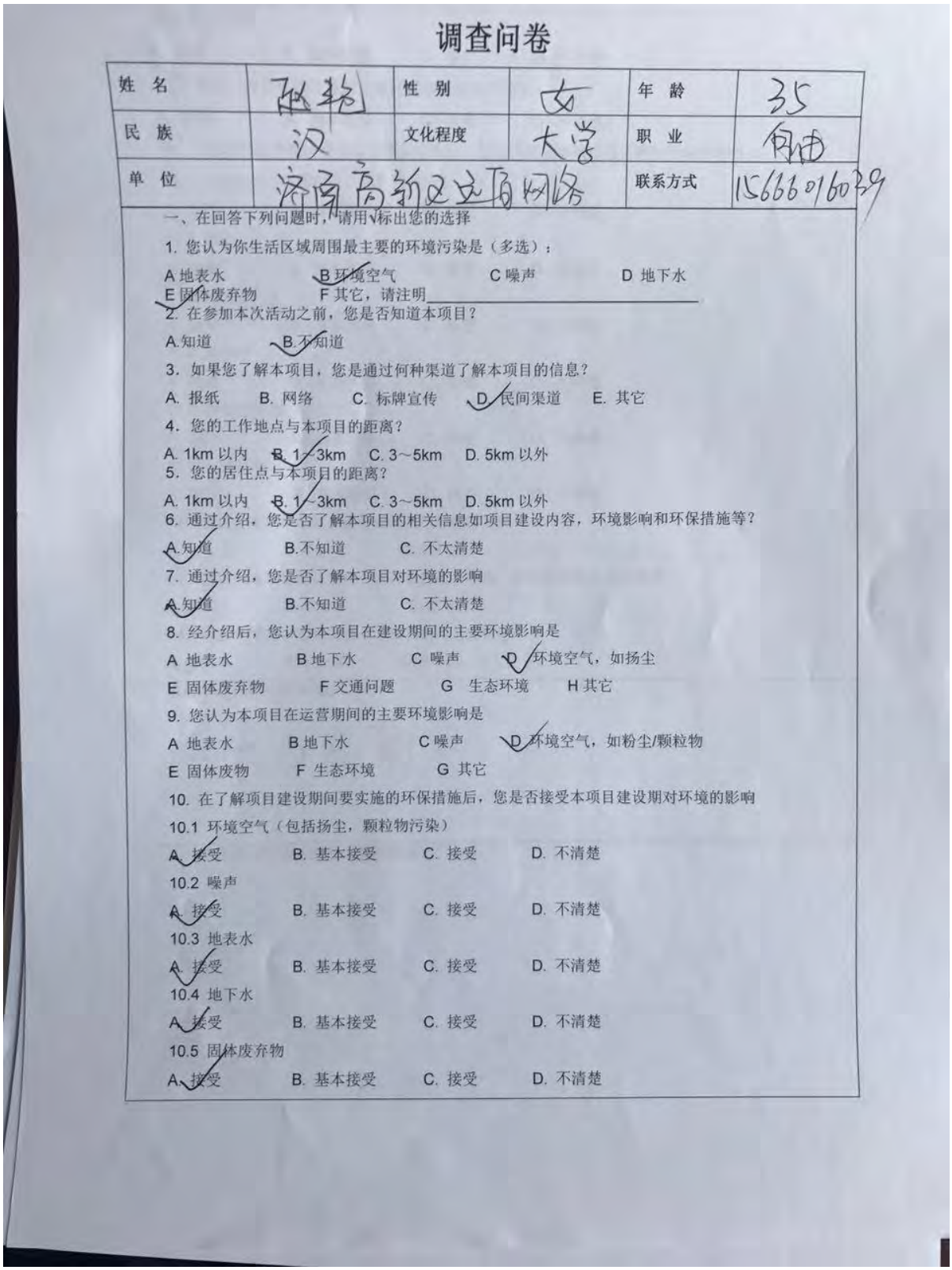
20. The effectiveness of mitigation measures and monitoring plans will be evaluated through a feedback reporting system. If, during compliance inspections and monitoring, substantial deviation from the EMP is observed, PMO will consult with CECEP and propose appropriate corrective action plan.

21. Any major EMP adjustments will be subject to ADB review and approval and ADB may require additional environmental assessment and, if necessary, further public consultation. The revised EMP with ADB confirmation is subject to reposting on the ADB's website as the ADB public communications policy requires. The revised EMP will be passed on to the contractor for implementation.

Table 7: Estimated Budget for Implementing EMP

Construction Phase							
1. Ambient Monitoring	**Unit**	**Unit Cost**	**# Times**		**$**	**CNY**	**Source of Funds**
Air - TSP	Quarterly	$ 300	6	$	1,800	¥12,256	Counterpart Financing
Noise	Quarterly	$ 200	6	$	1,200	¥8,171	
Subtotal				***$***	***3,000***	***¥20,427***	
2. Capacity Building	**Unit**	**Course Cost**	**# Times**		**$**	**CNY**	
Construction Phase HSE Plan Development and Training	HSE Plan Development	$ 2,000	6	$	12,000	¥81,708	Counterpart Financing
	HSE Course Development	$ 2,000	1	$	2,000	¥13,618	
	HSE Course Delivery	$ 4,000	1	$	4,000	¥27,236	
Subtotal				***$***	***18,000***	***¥122,562***	
TOTAL Construction Phase					***$***	***CNY***	
				$	***21,000***	***¥142,989***	
Operation Phase (first 2 years)							
	Unit	**Unit Cost**	**# Times**		**$**	**CNY**	Counterpart
1. Ambient Monitoring	**Unit**	**Unit Cost**	**# Times**		**$**	**CNY**	
Noise	Seasonal Sampling	$ 200	8	$	1,600	¥10,894	Counterpart Financing
Wastewater	Seasonal Sampling	$ 150	8	$	1,200	¥8,171	
Subtotal				***$***	***2,800***	***¥19,065***	
2. Capacity Building	**Unit**	**Course Cost**	**# Times**		**$**	**CNY**	
Operation Phase HSE Plan Development and Training	HSE Plan Development	$ 2,000	5	$	10,000	¥68,090	Counterpart Financing
	HSE Course Development	$ 2,000	1	$	2,000	¥13,618	
	HSE Course Delivery	$ 4,000	1	$	4,000	¥27,236	
Subtotal				***$***	***16,000***	***¥108,944***	
TOTAL Operation Phase					***$***	***CNY***	
				$	***18,800***	***¥128,009***	
GRAND TOTAL Construction + Operation					***$***	***CNY***	
				$	***39,800***	***¥270,998***	

XI. APPENDIX II: QUESTIONNARE SAMPLE



调查问卷

姓 名	张艳	性 别	女	年 龄	35
民 族	汉	文化程度	大学	职 业	自由
单 位	济南高新区远顶网络			联系方式	15666016039

一、在回答下列问题时，请用√标出您的选择

1. 您认为你生活区域周围最主要的环境污染是（多选）：

A 地表水　B 环境空气　C 噪声　D 地下水
E 固体废弃物　F 其它，请注明_____

2. 在参加本次活动之前，您是否知道本项目？

A.知道　B.不知道

3. 如果您了解本项目，您是通过何种渠道了解本项目的信息？

A. 报纸　B. 网络　C. 标牌宣传　D. 民间渠道　E. 其它

4. 您的工作地点与本项目的距离？

A. 1km 以内　B. 1～3km　C. 3～5km　D. 5km 以外

5. 您的居住点与本项目的距离？

A. 1km 以内　B. 1～3km　C. 3～5km　D. 5km 以外

6. 通过介绍，您是否了解本项目的相关信息如项目建设内容，环境影响和环保措施等？

A.知道　B.不知道　C. 不太清楚

7. 通过介绍，您是否了解本项目对环境的影响

A.知道　B.不知道　C. 不太清楚

8. 经介绍后，您认为本项目在建设期间的主要环境影响是

A 地表水　B 地下水　C 噪声　D 环境空气，如扬尘
E 固体废弃物　F 交通问题　G 生态环境　H 其它

9. 您认为本项目在运营期间的主要环境影响是

A 地表水　B 地下水　C 噪声　D 环境空气，如粉尘/颗粒物
E 固体废物　F 生态环境　G 其它

10. 在了解项目建设期间要实施的环保措施后，您是否接受本项目建设期对环境的影响

10.1 环境空气（包括扬尘，颗粒物污染）

A. 接受　B. 基本接受　C. 接受　D. 不清楚

10.2 噪声

A. 接受　B. 基本接受　C. 接受　D. 不清楚

10.3 地表水

A. 接受　B. 基本接受　C. 接受　D. 不清楚

10.4 地下水

A. 接受　B. 基本接受　C. 接受　D. 不清楚

10.5 固体废弃物

A. 接受　B. 基本接受　C. 接受　D. 不清楚

调查问卷

姓 名	李娜	性 别	女	年 龄	36
民 族	汉	文化程度	高中	职 业	酒店
单 位	济南高新区[illegible]			联系方式	13256147678

一、在回答下列问题时，请用√标出您的选择

1. 您认为你生活区域周围最主要的环境污染是（多选）：

A 地表水　B 环境空气　C 噪声　D 地下水
E 固体废弃物　F 其它，请注明________

2. 在参加本次活动之前，您是否知道本项目？

A. 知道　B. 不知道

3. 如果您了解本项目，您是通过何种渠道了解本项目的信息？

A. 报纸　B. 网络　C. 标牌宣传　D. 民间渠道　E. 其它

4. 您的工作地点与本项目的距离？

A. 1km 以内　B. 1～3km　C. 3～5km　D. 5km 以外

5. 您的居住点与本项目的距离？

A. 1km 以内　B. 1～3km　C. 3～5km　D. 5km 以外

6. 通过介绍，您是否了解本项目的相关信息如项目建设内容，环境影响和环保措施等？

A. 知道　B. 不知道　C. 不太清楚

7. 通过介绍，您是否了解本项目对环境的影响

A. 知道　B. 不知道　C. 不太清楚

8. 经介绍后，您认为本项目在建设期间的主要环境影响是

A 地表水　B 地下水　C 噪声　D 环境空气，如扬尘
E 固体废弃物　F 交通问题　G 生态环境　H 其它

9. 您认为本项目在运营期间的主要环境影响是

A 地表水　B 地下水　C 噪声　D 环境空气，如粉尘/颗粒物
E 固体废物　F 生态环境　G 其它

10. 在了解项目建设期间要实施的环保措施后，您是否接受本项目建设期对环境的影响

10.1 环境空气（包括扬尘，颗粒物污染）

A. 接受　B. 基本接受　C. 接受　D. 不清楚

10.2 噪声

A. 接受　B. 基本接受　C. 接受　D. 不清楚

10.3 地表水

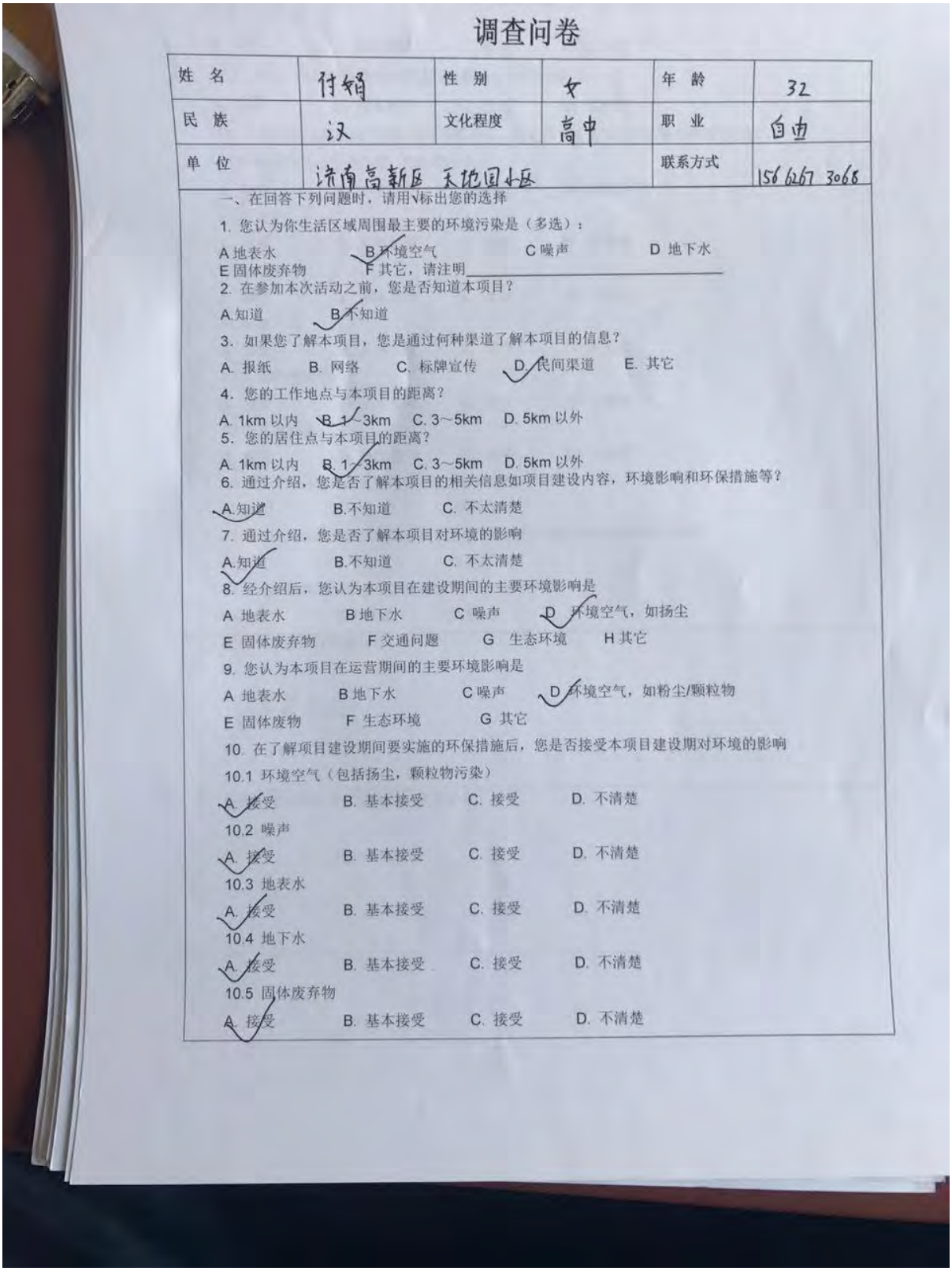
A. 接受　B. 基本接受　C. 接受　D. 不清楚

10.4 地下水

A. 接受　B. 基本接受　C. 接受　D. 不清楚

10.5 固体废弃物

A. 接受　B. 基本接受　C. 接受　D. 不清楚



调查问卷

姓 名	付娟	性 别	女	年 龄	32
民 族	汉	文化程度	高中	职 业	自由
单 位	济南高新区 天地国际			联系方式	158 6267 3068

一、在回答下列问题时，请用√标出您的选择

1. 您认为你生活区域周围最主要的环境污染是（多选）：

A 地表水　B 环境空气　C 噪声　D 地下水
E 固体废弃物　F 其它，请注明_____

2. 在参加本次活动之前，您是否知道本项目？

A.知道　B.不知道

3. 如果您了解本项目，您是通过何种渠道了解本项目的信息？

A. 报纸　B. 网络　C. 标牌宣传　D. 民间渠道　E. 其它

4. 您的工作地点与本项目的距离？

A. 1km 以内　B. 1～3km　C. 3～5km　D. 5km 以外

5. 您的居住点与本项目的距离？

A. 1km 以内　B. 1～3km　C. 3～5km　D. 5km 以外

6. 通过介绍，您是否了解本项目的相关信息如项目建设内容，环境影响和环保措施等？

A.知道　B.不知道　C. 不太清楚

7. 通过介绍，您是否了解本项目对环境的影响

A.知道　B.不知道　C. 不太清楚

8. 经介绍后，您认为本项目在建设期间的主要环境影响是

A 地表水　B 地下水　C 噪声　D 环境空气，如扬尘
E 固体废弃物　F 交通问题　G 生态环境　H 其它

9. 您认为本项目在运营期间的主要环境影响是

A 地表水　B 地下水　C 噪声　D 环境空气，如粉尘/颗粒物
E 固体废物　F 生态环境　G 其它

10. 在了解项目建设期间要实施的环保措施后，您是否接受本项目建设期对环境的影响

10.1 环境空气（包括扬尘，颗粒物污染）

A. 接受　B. 基本接受　C. 接受　D. 不清楚

10.2 噪声

A. 接受　B. 基本接受　C. 接受　D. 不清楚

10.3 地表水

A. 接受　B. 基本接受　C. 接受　D. 不清楚

10.4 地下水

A. 接受　B. 基本接受　C. 接受　D. 不清楚

10.5 固体废弃物

A. 接受　B. 基本接受　C. 接受　D. 不清楚

Initial Environmental Examination (Draft)

November 2017

People's Republic of China: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility (Deep-well Geothermal District Heating Subproject)

Prepared by China Energy Conservation and Environmental Protection Group for the Asian Development Bank

CURRENCY EQUIVALENTS

(as of 7 November 2017)

Currency unit	–	yuan (CNY)		
CNY1.00	=	$0.1514	or	€0.1299
$1.00	=	CNY6.6045	or	€0.8578
€1.00	=	CNY7.6995	or	$1.1658

ABBREVIATIONS

ADB	Asian Development Bank
AP	Affected Person
AQI	Air Quality Index
CSEMP	Construction Site Environmental Management Plan
EA	Executing Agency
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EPB	Environmental Protection Bureau
ESMS	Environment and Social Management System
FIL	Financial intermediation loan
FSR	Feasibility Study Report
GDP	Gross Domestic Product
GHG	Green House Gas
GIP	Good International Practice
GRM	Grievance Redress Mechanism
IA	Implementing Agency
IEE	Initial Environmental Examination
IT	Interim Target
MAC	Maximum Acceptable Concentration
MEP	Ministry of Environmental Protection
MSDS	Material Safety Data Sheet
PCR	Physical Cultural Resources
PPE	Personnel Protective Equipment
PPTA	Project Preparatory Technical Assistance
PRC	People's Republic of China
SPS	Safeguard Policy Statement, ADB
TA	Technical Assistance
TSP	Total Suspended Particulates

WB	World Bank
WHO	World Health Organization

WEIGHTS AND MEASURES

BOD_5	Biochemical Oxygen Demand, five days
$CaCO_3$	Calcium Carbonate
cm	Centimeter
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
dB(A)	A-weighted sound pressure level in decibels
DO	Dissolved Oxygen
kg	Kilogram
km	Kilometer
kWh	Kilowatt Hour
Leq	Equivalent Continuous Noise Level
m	Meter
m/s	Meters per Second
m^2	Square Meters
m^3	Cubic Meters
mg/l	Milligrams per Liter
mg/m^3	Milligrams per Cubic Meter
$\mu g/m^3$	Micrograms per Cubic Meter
NO_x	Nitrogen Oxides
^oC	Degrees Celsius
O_3	Ozone
pH	A measure of the acidity or alkalinity of a solution
PM	Particulate Matter
PM_{10}	Particulate Matter smaller than 10 micrometers
$PM_{2.5}$	Particulate Matter smaller than 2.5 micrometers
SO_2	Sulfur Dioxide
t/h	Tons per Hour
tce	Tons of coal equivalent

NOTES

(i) In this report, "$" refers to US dollars.

This initial environmental examination is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature. Your attention is directed to the “terms of use” section of the ADB website.

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EXECUTIVE SUMMARY

A. Introduction

1. This is the Initial Environmental Examination (IEE) report for the Deep-well Geothermal District Heating Subproject of the proposed People's Republic of China (PRC): Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility.[1] The subproject will develop a geothermal district heating infrastructure using deep-well geothermal energy technology, as an economically and environmentally advantageous alternative to the current practice of using coal-based space heating systems in Dezhou City of Shandong Province.

2. The subproject will develop a geothermal district heating system for a newly-built, reconstructed, and expanded residential area in Mi County, Lingcheng District, Dezhou City of Shandong Province. The subproject will be constructed in five phases: in each phase, eight geothermal wells will be drilled (four producing wells and four disposal wells) and two heat exchange stations will be built and provide district heating for an area of 160,000 square meters (m^2). The subproject will provide district heating for an area of 800,000 m^2.

B. Policy, Legal, and Administrative Framework for Environmental Impact Assessment

3. Environmental impact assessment (EIA) procedures have been established in the PRC for over 20 years. Domestic EIA studies are required to be undertaken by relevant PRC environmental laws and regulations. National and local legal and institutional frameworks for EIA review and approval ensure that proposed projects are environmentally sound, designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environment, health, social, or safety hazards.

4. Following Asian Development Bank's (ADB) Safeguard Policy Statement (SPS 2009), an Environmental and Social Management System (ESMS) for the financial intermediation loan (FIL) has been formulated to provide the screening, categorization, and review procedures for subproject selection. In implementing this FIL, subprojects should follow the screening and categorization procedures set out in the ESMS. The subproject has been classified as environment category B following SPS 2009 and ESMS, and an IEE is required.

C. Implementation Arrangements

5. Shandong Luhai Petroleum Technology Co. Ltd. (Luhai) will be the subborrower for the ADB FIL and responsible for day-to-day management during subproject preparation and implementation. China Energy Conservation and Environmental Protection Group (CECEP) will be the executing agency (EA) and the implementing agency (IA) and responsible for overall guidance during subproject preparation and implementation.

D. Description of the Environment

1. Location and Topography

6. The subproject is located in Mi County, Lingcheng District, Dezhou City of Shandong

[1] The greater BTH region comprises Beijing and Tianjin municipalities, the provinces of Hebei, Henan, Liaoning, Shandong, Shanxi, and Inner Mongolia Autonomous Region.

Province. Dezhou City is located in the northwest of the north shore of the Yellow River, bordering Hebei Province in north. It is located at east longitude 115°45'~117°36', northern latitude 36°24'~38°00'. It is near the Jinan City in south and Binzhou City in east with a total area of 10,356 square kilometers (km^2).

7. Dezhou city is in alluvial plain of Yellow River. Overall, it is located in flat terrain with altitude 20.34~21.01 meters (m) and the base of the Ordovician limestone. The area belongs to Quaternary stratigraphic with a thickness of up to 280 meters above the basic to the silt. The subproject site is in the east of Dezhou City, flat terrain, undulating small rivers, lakes, ponds, etc. in the area.

2. Meteorology and Climate

8. Dezhou city belongs to temperate continental monsoon climate with dry and windy weather in spring, hot and rainy weather in summer, clear and crisp weather in autumn days, and cold and few snow weather in winter. The annual average air pressure is 1,014 hectopascals (hPa); the annual average temperature is 12.9°C; the annual average precipitation in Dezhou from 1950–2011 was 547.5 millimeter (mm) and 67.7% occurring in the summer.

9. The maximum extreme high temperature is 43.4°C (23 July 1955) and the extreme minimum low temperature is -27°C (15 January 1958).

3. Water Resources

10. Annual average water resource of Dezhou City is 67,478,000 cubic meter (m^3). The per capita water resource is only 117 m^3. The distribution of water resources during the year is uneven, showing seasonal characteristics of a clear spring drought, summer floods, and drought again in late autumn.

4. Ecological and Sensitive Resources

11. The subproject site is located in a highly developed and modified agricultural and urban environment, surrounded by mixed agricultural, commercial, and residential land with little or no vegetation cover. There are no known rare or endangered flora or fauna, parks, nature reserves or areas with special national, regional or local ecological significance within or adjacent to the subproject site.

5. Socioeconomic Conditions

12. Dezhou is rich in natural resources. Coal reserves in Dezhou is 6 billion tons, petroleum reserves are 158 million tons, and natural gas reserves is 1 billion m^3.

13. In 2016, the city's gross domestic product (GDP) was CNY293.299 billion, of which the primary sector accounted for 10.1% or CNY29.62 billion; the secondary sector accounted for 47.8% or CNY140.20 billion; and the tertiary sector accounted for 42.1% or CNY123.48 billion.

6. Physical Cultural Resources

14. Dezhou has a rich history. However, the subproject activities are all within city limits in a highly developed and modified industrial and urban environments. There are no known physical cultural resources (PCR) in the subproject site.

E. Anticipated Impacts and Mitigation Measures

15. Anticipated positive and negative environmental impacts of the proposed subproject were assessed based on (i) the Feasibility Study Report (FSR) in 2014; (ii) a technical due diligence review of the FSR undertaken by ADB project preparatory technical assistance (PPTA) consultants; (iii) public consultations led by the subborrower and assisted by ADB PPTA consultants; and (iv) site visits, surveys and consultations undertaken by ADB PPTA consultants.

16. Pre-construction, construction, and operation phases were considered separately. The results of the assessment indicate that during the pre-construction phase environmental issues are very limited, and are mostly associated with ensuring appropriate incorporation of mitigation measures into the project design.

17. Potential negative environmental impacts during construction phase are short-term and localized, and are associated with soil erosion, construction noise, fugitive dust, disruption of traffic and community services, and risks to workers and community health and safety. These can be effectively mitigated through good construction, and health and safety practices.

18. Potential negative impacts during operation phase are associated with waste and wastewater, noise, and health and safety risks to workers and community. These can be effectively mitigated through good operation, and health and safety practices.

19. Potential positive operation phase impacts are significant and long-term, and are associated with emissions reductions compared to equivalent heat production from coal-fired boilers.

20. The subproject has a stable heating resource. It adopts mature drilling technology for geothermal wells, utilizes tail water recharging technology for the sustainable heat extraction without groundwater depletion (as it recharges water back to the underground reservoir after purification, to avoid reservoir water depletion and environmental pollution). The subproject has significant impact on energy savings and emission reduction. 9,843.3 tons of coal equivalent (tce) could be replaced, equivalent to a reduction of 25,789.45 tons of carbon dioxide (CO_2), 83.67 tons of sulfur dioxide (SO_2), 72.84 tons of nitrogen oxides (NO_x), and 2.79 tons of particulate matter (PM).

F. Analysis of Alternatives

21. The district heating area in Dezhou has increased rapidly from 13.8 million m^2 in 2010 to 28.88 million m^2 in 2015, with an annual growth rate of 15.0%. Thus, there is an urgent need to construct new heating infrastructure. However, current coal-based district heating systems are no longer an option in Dezhou due to worsening air quality. As clearly stated in the "*Dezhou Coal-fired Boiler Management Plan*", boiler with capacity lower than 10 tons per hour must use clean energy. If the subproject is not implemented, areas without district heating systems will be dependent on current heating methods such as polluting coal-based boilers, or expensive electric household boilers.

22. Implementation of the subproject will: (i) fulfill rapidly increasing heat demand; (ii) significantly reduce coal consumption; (iii) improve air quality; and (iv) reduce greenhouse gas (GHG) emissions. It will also provide valuable hands on experience and help to explore uses of geothermal heat.

G. Information Disclosure and Public Consultations-

23. The subborrower organized a public consultation meeting in May 2017 in which information was presented on the subproject scope, potential environmental impacts and proposed mitigation measures. Participants were asked to complete a questionnaire. A total of 20 questionnaires were distributed. Most of the respondents work and live within a 3-km radius of the subproject location; 75% of the respondents knew about the subproject either from other person, internet, newspapers or information signs, and 65% of respondents indicated that they were already familiar with the project benefits after the introduction of the subproject. The top three environment issues identified in their neighborhoods are air quality (55%), surface water (40%), and noise (35%). Groundwater quality and noise were identified as the top two issues during both the construction, and operation phase. However, most participants also indicated that potential air, waste water, solid waste, and noise impacts can be appropriately mitigated.

24. Overall support for the subproject is very strong; 90% of the respondents indicated that the subproject will improve local economic development, 85% indicated that the subproject will improve quality of life, and 90% of the respondents indicated that they support the proposed subproject.

H. Grievance Redress Mechanism

25. A subproject-level grievance redress mechanism (GRM) has been established to receive and facilitate resolution of complaints during the construction and operation phases. The GRM includes procedures for receiving grievances, recording/documenting key information, and evaluating and responding to the complainants in a reasonable timeframe. Any concerns raised through the GRM will be addressed quickly and transparently, and without retribution to the affected persons (AP).

I. Environmental Management Plan

26. A comprehensive Environmental Management Plan (EMP) has been developed to ensure: (i) implementation of identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of monitoring and reporting against the performance indicators; and (iii) compliance with the PRC's relevant environmental laws, standards and regulations and ADB's SPS 2009. The EMP includes an environment monitoring plan (EMoP) to monitor the environmental impacts of the subproject and assess the effectiveness of mitigation measures, and a capacity building and training program focused on health, safety and environment. Organizational responsibilities and budgets are clearly identified for implementation, monitoring and reporting. The EMP is presented in Appendix I.

J. Conclusion

27. Through the environmental assessment process, it is concluded that the subproject has: (i) selected appropriate technology for district heating and reducing the emissions of pollutants; (ii) identified potential negative environment impacts and established mitigation measures; (iii) received public support from the subproject beneficiaries and affected people; (iv) established subproject GRM procedures; and (v) prepared a comprehensive EMP including environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

28. Overall, any minimal adverse environmental impacts associated with the subproject can be prevented, reduced, or minimized through the appropriate application of mitigation measures. It is therefore recommended that: (i) the subproject is classified as environment category B; and (ii) the subproject will be supported by ADB, subject to the implementation of the commitments contained in the EMP and allocation of appropriate technical, financial and human resources by the subborrower to ensure these commitments are effectively and expediently implemented.

I. INTRODUCTION

A. The Subproject

1. The Deep-well Geothermal District Heating Subproject is located in Dezhou City of Shandong Province. The subproject will develop a geothermal district heating infrastructure using deep-well geothermal energy technology, as an economically and environmentally advantageous alternative to the current practice of using coal-based space heating systems.

2. Shandong Luhai Petroleum Technology Co., Ltd. (Luhai) is the subborrower which is responsible for daily operation and equipment maintenance of the subproject.

B. Introduction of Subborrower

3. Luhai is a public listed company, whose predecessor was Shandong Luhai Petroleum Equipment Co., Ltd that was founded in 2008 with registered capital of CNY10 million. On 16 July 2015, Luhai was successfully listed in the National Equities Exchange Quotations. The main business of Luhai include production and sale of drilling equipment and tools, research and development of measurement while drilling, exploration and development of geothermal energy, and technical services for horizontal (directional) wells. Luhai also provides services in geothermal heating system construction, engineering design of special process wells, such as geothermal wells, directional wells, horizontal wells, drilling operations and related technology services. Their products are widely used in oil and drilling industries, and are exported to countries such as Korea, Russia, and Iran. Luhai has acquired certifications from ISO9001, Health Safety and Environmental Management Systems and the American Petroleum Institute. Luhai has also obtained API7K, API5CT, API7-1, and API6A certifications.

4. In recent years, by virtue of its technical capabilities in oil drilling and equipment manufacturing, Luhai successfully entered the geothermal development market with deep-well water source heating as the main business, and began to provide heating service for rural areas that are unable to be covered by thermal power plants and district heating network in Shandong and other nearby provinces. Up to now, 76 geothermal wells of various types have already been completed in Hebei, Henan, and Shanxi provinces. The operation of the wells is in good condition and they've gained market recognition. As the construction of new rural areas expands, more and more new rural communities need central heating service. Under this circumstance, geothermal heating will enjoy a broad market prospect and a new industry with geothermal resource development and geothermal heating as the core will therefore take shape.

C. Report Purpose

5. Following ADB's SPS 2009, an Environmental and Social Management System (ESMS) for the Financial FIL has been formulated to provide the screening, categorization, and review procedures for subproject selection. In implementing this FIL, subprojects should follow the screening and categorization procedures set out in the ESMS. The subproject has been classified as environment category B following SPS 2009 and the ESMS, and an Initial Environmental Examination (IEE), including an Environmental Management Plan (EMP) is required.

D. Approach to Report Preparation

6. This report has been prepared based on the domestic FSR; a technical due diligence review of the FSR undertaken by ADB PPTA consultants; public consultations with key stakeholders and affected persons; and site visits, surveys and consultations undertaken by ADB PPTA environmental consultants.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

7. This IEE has been prepared in accordance with both the PRC national and local environmental legal and institutional framework and environmental assessment requirements, the ESMS, and applicable ADB policies, requirements, and procedures.

A. PRC Environmental Legal Framework

8. The environmental protection and management system in the PRC consists of a well-defined hierarchy of regulatory, administrative, and technical institutions. At the top level the People's Congress of the PRC has the authority to pass and revise national environmental laws; the Ministry of Environmental Protection (MEP) under the State Council promulgates national environmental regulations; and MEP either separately or jointly with the Administration of Quality Supervision, Inspection and Quarantine issues national environmental standards. Provincial and local governments can also issue provincial and local environmental regulations and guidelines in accordance with the national ones. In addition, national and local five-year environmental protection plans form an important part of the legal framework.

9. Key applicable PRC environmental laws are listed in **Table 1**. The implementation of environmental laws is supported by a series of associated regulations summarized in **Table 1**.

Table 1: Applicable PRC environmental laws

No.	Title of the Law	Year Issued/Updated
1	Environmental Protection Law	2015
2	National Environmental Impact Assessment Law	2003
3	Water Law	2002
4	Water Pollution Prevention and Control Law	2008
5	Air Pollution Prevention and Control Law	2000
6	Noise Pollution Prevention and Control Law	1999
7	Solid Waste Pollution Prevention and Control Law	2005
8	Water and Soil Conservation Law	2011
9	Land Administration Law	2004
10	Flood Control Law	1998
11	Forest Law	1998
12	Grassland Law	2013
13	Prevention and Control of Desertification	2002
14	Wild Fauna Protection Law	2004
15	Wild Flora Protection Law	1996
16	Agricultural Law	2003
17	Urban and Rural Planning Law	2008
18	Energy Conservation Law	2016

Source: ADB PPTA consultants.

10. In addition to environmental laws and regulations, there are occupational health and safety laws and regulations the subborrower must comply with, including the *PRC Safety Production Law* (2014), *State Administrative Regulations of Safety Production* (2003), and *PRC Prevention and Control of Occupational Diseases Law* (2011).

Table 2: National Administrative Regulations

No.	Regulation	Year Issued/Updated
1	Environmental Protection Management Regulations on Construction Project	2015
2	The PRC Basic Farmland Protection Ordinance	1998
3	The PRC Air Pollution Prevention and Control Law Implementation Rules	1997
4	The PRC Water Pollution Prevention and Control Law Implementation Rules	2000
5	The PRC Forestry Law Implementation Rules	2000
6	The PRC Water and Soil Conservation Law Implementation Rules	1993
7	The PRC Land Management Regulations Implementation Rules	1999
8	The PRC Wild Plant Protection Ordinance	1997
9	Notification of National Key Function Zoning Issued by the State Council	2010
10	The PRC River Management Ordinance	1988
11	The Decision on Several Environmental Protection Issues	1996
12	The National Ecological and Environmental Protection Platform	2000
13	The State Council Decision on Deepening Reform and Strict Land Management	2004

PRC = People's Republic of China.
Source: ADB PPTA consultants.

B. PRC Environmental Impact Assessment Framework

11. EIA procedures have been established in the PRC for over 20 years. Article 16 of the PRC *Law on Environmental Impact Assessment* (2003)[1] stipulates that an EIA document is required for any capital construction project producing significant environmental impacts. Projects are classified into three categories:

(i) **Category A** projects with significant adverse environmental impacts, for which a full EIA report is required;
(ii) **Category B** projects with adverse environmental impacts which are of a lesser degree and/or significance than those of Category A, for which a simplified tabular EIA report is required; and
(iii) **Category C** projects unlikely to have adverse environmental impacts, for which an EIA registration form is required.

12. A full EIA report for category A and a simplified tabular EIA report for category B are similar to ADB's EIA and IEE reports, respectively. The registration form of an EIA is similar to an ADB Category C project.

13. Applicable PRC environmental management and assessment guidelines are summarized in **Table 3**. In 2008 the MEP issued "Management Guideline on EIA Categories of Construction Projects" (revised 2015). MEP guidelines provide detailed EIA requirements for 23 sectors and 199 subsectors based on the project's size, type (e.g., water resources development, agriculture, energy, waste management, etc.), and site environmental sensitivity (e.g., protected nature reserves and cultural heritage sites).

14. MEP's "Guidelines on Jurisdictional Division of Review and Approval of EIAs for Construction Projects" (2009) defines which construction project EIAs require MEP review and

[1] *National Environmental Impact Assessment Law*, published on Oct 28 2002 and implemented in Sep 1, 2003.

approval, and which EIAs are delegated to the provincial Environmental Protection Department.

Table 3: Applicable PRC environmental management and assessment guidelines

No.	Guideline	Code and/or Year Issued/Updated
1	Guideline for Technical Review of EIA on Construction Projects	HJ 616-2011
2	Management Guideline on EIA Categories of Construction Projects	2008
3	Further Enhance the Management of EIA and Preventing Environmental Risks	2012
4	Guideline on Jurisdictional Division of Review and Approval of EIAs for Construction Projects	2009
5	Guideline on EIA Categories of Construction Projects	2015
6	Interim Guideline on Public Consultation for EIA	2006
7	Technical Guidelines for EIA – General Program	HJ 2.1-2011
8	Technical Guideline for EIA – Atmospheric Environment	HJ 2.2-2008
9	Technical Guideline for EIA – Surface Water	HJ/T 2.3-1993
10	Technical Guideline for EIA – Acoustic Environment	HJ 2.4-2009
11	Technical Guideline for EIA – Groundwater Environment	HJ 610-2011
12	Technical Guideline for EIA – Ecological Impact	HJ 19-2011
13	Technical Guidelines for Environmental Risk Assessment for Construction Projects	HJ/T 169-2004

EIA = environmental impact assessment.
Source: ADB PPTA consultants.

C. Domestic EIA Report

15. The subproject will provide heat to four new residential areas. Each new residential area will build one heat exchange station, one producing well, and one disposal well. The subproject is a supporting facility for the newly built residential areas. Per national regulation, EIA for each new residential area will be required, in which the environmental impacts of the subproject will be assessed and mitigation measures will be proposed. The EIA will be prepared by the developers and submitted to Dezhou Environmental Protection Bureau for approval. Therefore, no separate domestic EIA for the subproject will be prepared.

D. Relevant International Agreements

16. The PRC has signed a number of international agreements regarding environmental and biological protection. Those which have potential application to the subproject are listed in **Table 4.**

Table 4: Applicable international agreements

No.	Agreement	Year	Purpose
1	Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat	1975	Preventing the progressive encroachment on and loss of wetlands for now and the future
2	Convention Concerning the Protection of the World Cultural and Natural Heritage	1986	Conserving cultural and natural heritage sites.
3	Convention on Biological Diversity	1993	Conservation and sustainable use of biodiversity.
4	UN Framework Convention on Climate Change	1994	Stabilizing GHG concentrations in the atmosphere at a level that will prevent

No.	Agreement	Year	Purpose
			anthropogenic induced climate change.
5	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification	1996	Fighting against desertification and mitigating the effects of drought.
6	Kyoto Protocol	2002	Controlling emissions of anthropogenic GHGs in ways that reflect underlying national differences in GHG emissions, wealth, and capacity to make the reductions.
7	Stockholm Convention on Persistent Organic Pollutants	2004	Safeguarding human health and the environment from POPs, ascertaining sound management of stockpiles and wastes that contain POPs, and taking measures to reduce or eradicate releases from intentional production and use of POPs.
8	Paris climate agreement	2015	Dealing with greenhouse gas emissions mitigation, adaptation and finance starting in the year 2020.

GHG = greenhouse gas, POP = persistent organic pollutants.
Source: ADB PPTA consultants.

E. Applicable PRC Environmental Quality Standards

17. The environmental quality standard system that supports the implementation of the environmental protection laws and regulations in the PRC is classified into two categories by function: ambient environmental standards and pollutant emission/discharge standards. Standards applicable to the subproject are presented in **Table 5**, and key standards are further elaborated below.

1. Ambient Air Quality

18. Ambient air quality limits are intended to indicate safe exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Limits are given for one or more specific averaging periods, typically one-hour average, 24-hour average, and/or annual average. The PRC's recently updated *Ambient Air Quality Standards (*GB3095-2012) has two classes of limit values; Class 1 standards apply to special areas such as natural reserves and environmentally sensitive areas, and Class 2 standards apply to all other areas, including urban and industrial areas. The PRC standards for Class 2 areas are applicable for the subproject.[2]

[2] On 29 February 2012, the China State Council passed the roadmap for ambient air quality standards with the aim of improving the living environment and protecting human health. The Ambient Air Quality Standards (GB 3095-2012) prescribes the first-ever limits for $PM_{2.5}$. It also modified the previous area classifications by combining Class III (special industrial areas) with Class II (residential, mixed use areas).

Table 5: Applicable PRC environmental standards

No.	Standard	Code/Date
1	Ambient Air Quality Standards	GB 3095-2012
2	Groundwater Quality Standard	GB/T 14848-93
3	Surface Water Quality Standards	GB 3838-2002
4	Environmental Quality Standards for Noise	GB 3096-2008
5	Soil Quality Standard	GB15618-1995
6	Noise Standards for Construction Site Boundary	GB 12523-2011
7	Noise Standards for Industrial Enterprises at Site Boundary	GB 12348-2008
8	Standard for Flood Control	GB 50210-94

Source: ADB PPTA Consultant, 2017.

19. The World Health Organization (WHO) Air Quality Guidelines are recognized as international standards and are adopted by the *World Bank Group's Environment, Health and Safety Guidelines* (*EHS Guidelines)*. In addition to guideline values, interim targets (IT) are given for each pollutant by the WHO as incremental targets in a progressive reduction of air pollution. The WHO guidelines and corresponding PRC standards are presented in **Table 6**.

20. From a review of **Table 6** it can be observed that:

- For total suspended particulates (TSP), there are PRC standards but no corresponding WHO guidelines.
- For particulate matter with diameter less than 10 micrometers (PM_{10}) PRC Class 2 annual average and 24-hour average standards meet WHO IT-1 guidelines (there are no 1-hour average standards or guidelines for either PRC or WHO).
- For particulate matter with diameter less than 2.5 micrometers ($PM_{2.5}$) PRC Class 2 annual and 24-hour standards meet WHO IT-1 guidelines (there are no 1-hour standards or guidelines for either PRC or WHO).

Table 6: PRC ambient Air Quality Standards and WHO ambient air quality guidelines (mg/m^3)

Standard	TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	O_3	CO
WHO Ambient Air Quality Guidelines							
Annual mean	--	0.020	0.010	--	0.040	--	--
Annual mean IT-1	--	0.070	0.035	--	--	--	--
24-hr mean	--	0.050	0.025	0.020	--	--	--
24-hr mean IT-1	--	0.150	0.075	0.125	--	--	--
8-hr mean	--	--	--	--		0.100	--
8-hr mean IT-1	--	--	--	--		0.160	--
1-hr mean	--	--	--	--	0.200		0.030
1-hr mean IT-1	--	--	--	--	--		--
PRC Ambient Air Quality Standard (Class 2)							
Annual mean	0.200	0.070	0.035	0.060	0.040	--	--
24-hr mean	0.300	0.150	0.075	0.150	0.100	--	0.004
8-hr mean	--	--	--	--	--	0.160	--
1-hr mean	--	--	--	0.500	0.200	0.200	0.010

CO = carbon monoxide, mg/m^3 = milligram per cubic meter, NO_2 =nitrogen dioxide, O_3= ozone, PM_{10} = particulate matter smaller than 10 micrometers, $PM_{2.5}$ = particulate matter smaller than 2.5 micrometers, PRC = People's Republic of China, SO_2 = sulfur dioxide, TSP = total suspended particulates, WHO = World Health Organization.
Source: WHO Air Quality Guidelines (2006) in IFC *EHS Guidelines* (2007), and PRC GB 3095-2012.

- For sulfur dioxide (SO_2), WHO only has a 24-hour average guideline (0.125 mg/m^3), which is slightly lower than the PRC standard (0.150 mg/m^3). However, SO2 levels are low in the subproject area, and the subproject will only contribute extremely

low levels of SO_2, so the very minor difference is inconsequential.

- For nitrogen dioxide (NO_2), the PRC standard is equivalent to the WHO annual average guidelines, there is no WHO 24-hour average guideline; and the 1-hour average PRC standard is equivalent to the WHO guideline.

21. Overall the PRC standards show a high degree of equivalency to the WHO guidelines or IT-1 values, and are adopted for use in this IEE report.

2. Fugitive Particulate Matter Emission

22. Fugitive emission of PM such as dust from construction sites is regulated under PRC's *Air Pollutant Integrated Emission Standard* (GB 16297-1996), which sets 120 mg/m^3 as the maximum allowable emission concentration and $\leqslant$ 1.0 mg/m^3 as the concentration limit at the boundary of construction sites, with no specification on the particular matters particle diameter. There is no equivalent standard recommended in the *EHS Guidelines,* and the PRC standard is adopted for use in this IEE report.

3. Surface Water

23. PRC's *Surface Water Ambient Quality Standards* (GB3838-2002) defines five water quality categories for different environmental functions. For example, Category I is the best, such as water at sources of rivers and National Nature Reserves. Category V is the worst quality, suitable only for agricultural and scenic water uses. Based on information collection, Category V water quality standard (see **Table 7**) is applicable for the surface water in Dezhou which are Tuhai River, Majia River, Dehuixin River, Zhangweixin River, and South Canal. There are no applicable EHS guidelines or target for water quality in this context, and the PRC standard is adopted for use in this IEE report.

Table 7: Applicable surface standard

No.	Parameter	Category V Standard (mg/l, pH excluded)
1	pH	6–9
2	Dissolved Oxygen	2
3	COD_{Mn}	15
4	COD_{Cr}	40
5	BOD_5	10
6	NH_3-N	2.0
7	TP	0.4
8	TN	2.0
9	Copper	1.0
10	Zinc	2.0
11	Fluoride	1.5
12	Selenium	0.02
13	Arsenic	0.1
14	Total Mercury	0.001
15	Cadmium	0.01
16	Hexavalent Chromium	0.1
17	Lead	0.1
18	Cyanide	0.2
19	Volatile Phenol	0.1
20	Sulfide	1.0

No.	Parameter	Category V Standard (mg/l, pH excluded)
21	Petroleum	1.0
22	Anionic surfactant	0.3
23	Coliforms	40000

BOD5 = 5-day biochemical oxygen demand, CODcr = chemical oxygen demand, CODMn = permanganate index, mg/l = milligram per liter, NH_3-N= ammonia nitrogen; pH = potential of Hydrogen, TP = Total Phosphorus; TN = Total Nitrogen.
Source: Surface Water Ambient Quality Standards (GB3838-2002)

4. Groundwater

24. PRC's *Groundwater Water Ambient Quality Standards* (GB/T14848-93) also defines a number of water quality categories for different environmental functions. As groundwater is primarily used for irrigation, the Category III standard is applicable (**Table 8**). There is no equivalent standard recommended in the *EHS Guidelines,* and the PRC standard is adopted for use in this IEE report.

Table 8: Applicable groundwater standard

No	Parameter	Unit	Category III Standard
1	pH	-	6.5–8.5
2	COD_{Mn}	mg/l	3.0
3	Sulfate	mg/l	250
4	Chloride	mg/l	250
5	Volatile Phenols	mg/l	0.002
6	Total hardness ($CaCO_3$)	mg/l	450
7	Nitrate NO_{3-}	mg/l	20
8	Nitrite NO_{2-}	mg/l	0.02
9	NH_3-N	mg/l	0.2
10	Molybdenum	mg/l	0.1
11	Cyanide	mg/l	0.05
12	Cadmium	mg/l	0.01
13	Chromium VI	mg/l	0.05
14	Arsenic	mg/l	0.05
15	Zinc	mg/l	1.0
16	Fluoride	mg/l	1.0
17	Lead	mg/l	0.05
18	Iron	mg/l	0.3
19	Manganese	mg/l	0.1
20	Copper	mg/l	1.0
21	Selenium	mg/l	0.01
22	Total coliforms	/L	3.0

COD_{Mn} = permanganate index; demand; mg/l = milligram per liter, NO_{3-} = Nitrate; NO_{2-} = Nitrite; NH_3-N= ammonia nitrogen, pH = potential of Hydrogen.
Source: PRC Groundwater Water Ambient Quality Standards (GB/T14848-93)

5. Wastewater Discharge

6. **Table 9** presents relevant PRC wastewater discharge standards. The *EHS Guidelines* indicate that wastewater discharged to public or private wastewater treatment systems should: (i) meet the pretreatment and monitoring requirements of the sewer treatment system into which it discharges; (ii) not interfere, directly or indirectly, with the operation and maintenance of the

collection and treatment systems, or pose a risk to worker health and safety, or adversely impact characteristics of residuals from wastewater treatment operations; and (iii) be discharged into municipal or centralized wastewater treatment systems that have adequate capacity to meet local regulatory requirements for treatment of wastewater generated from the subproject.

7. The subproject will discharge wastewater to the municipal sewer systems for treatment at nearby municipal wastewater treatment plant. The wastewater discharges will be required to meet Class B maximum acceptable concentrations (MACs) in *Wastewater Quality Standards for Discharge to Municipal Sewers* (CJ 343-2010), and the waste water treatment plant's discharges are required to meet Class 1A of *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plants* (GB 18918-2002).

Table 9: PRC *Wastewater Quality Standards for Discharge to Municipal Sewers*

No	Pollutant	Maximum acceptable concentration (MAC) mg/L (except pH and chromacity)
		Class B
1	pH	6.5–9.5
2	SS	400
3	COD	500
4	Ammonia nitrogen	45
5	TDS	2000
6	Chromacity	70
7	BOD	350
8	Total phosphorus	8

BOD = biochemical oxygen demand, COD = chemical oxygen demand, pH = potential of Hydrogen, SS = suspended solid, TDS = total dissolved solid.
Source: PRC's Wastewater Quality Standards for Discharge to Municipal Sewers (CJ 343-2010).

6. Noise

25. **Table 10** presents relevant PRC *Urban Noise Standards* compared with relevant international guidelines from the WHO (as presented in the *EHS Guidelines*). Category I and II standards are applicable to the subproject area. The classes within the standards are not directly comparable, but the PRC Category I standards are equivalent to WHO Class I standards. Category II is utilized in this IEE report.

Table 10: PRC *Environmental Quality Standards for Noise* and relevant international guidelines

PRC Standards Leq dB(A)			International Standards One Hour Leq dB(A)		Comparison
Category	**Day** 06-22h	**Night** 22-06h	**Day** 07-22h	**Night** 22-07h	
0: Areas needing extreme quiet, such as special health zones	50	40	WHO Class I: residential, institutional, educational: 55 WHO Class II: industrial, commercial: 70	WHO Class I: Residential, institutional, educational: 45 WHO Class II: Industrial, Commercial: 70	Classes are not directly comparable, but PRC Class II standards exceed WHO Class II standards. PRC standards are utilized in this report.
I: Mainly residential; and cultural and educational institutions	55	45			
II: Mixed residential, commercial and industrial areas	60	50			
III: Industrial areas	65	55			
IV: Area on both sides of urban trunk roads	70	55			

dB(a) = A-weighted decibels, Leq = equivalent continuous noise level, PRC = People's Republic of China, WHO = World Health Organization.
Source: PRC standard GB3096-2008 and World Bank EHS guidelines

26. **Table 11** presents the relevant PRC and international standards (US EPA, there no such WHO or *EHS Guidelines* standards) for on-site construction noise. The PRC standards are more stringent than international guidelines, and are used in this IEE report.

Table 11: PRC *Noise Emission Standard for Construction Site Boundary* and relevant international guidelines

Day Leq dB(A)	Night Leq dB(A)	International Standards Leq dB(A)	Comparison
70	55	US EPA: 85 (day, 8-hour exposure)	PRC standards meet or are more stringent than international standards

dB(a) = A-weighted decibels, Leq = equivalent continuous noise level, PRC = People's Republic of China, US EPA = US Environmental Protection Agency.
Source: PRC standard GB12523-2011 and World Bank EHS guidelines

27. During operation noise at site boundaries should comply with Class II of the PRC *Industrial Enterprise Boundary Noise Emission Standards* (GB12348-2008) (**Table 12**).

Table 12: PRC Noise Emission Standards for Industrial Enterprise Boundary

Standard Type	Standard Value Leq dB(A)	
	Day	Night
Class 2	60	50

dB(a) = A-weighted decibels, Leq = equivalent continuous noise level, PRC = People's Republic of China.
Source: PRC standards GB12348-2008.

F. Applicable ADB Policies, Regulations and Requirements

28. The applicable ADB policies, regulations, requirements and procedures for EIA are the *Safeguard Policy Statement* (SPS 2009) and the *Environmental Safeguards–A Good Practice Sourcebook* (2012), which jointly provide the basis for this EIA. SPS 2009 promotes good international practice as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*. The policy is underpinned by the *ADB Operations Manual* for SPS 2009 (OM Section F1, 2013).

29. SPS 2009 establishes an environmental review process to ensure that projects undertaken as part of programs funded through ADB loans are environmentally sound, are designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environmental, health, social, or safety hazards.

30. At an early stage in the project cycle, typically the project identification stage, ADB screens and categorizes proposed projects based on the significance of potential project impacts and risks. A project's environment category is determined by the category of its most environmentally sensitive component, including direct, indirect, induced, and cumulative impacts. Project screening and categorization are undertaken to:

(i) reflect the significance of the project's potential environmental impacts;
(ii) identify the type and level of environmental assessment and institutional resources required for the safeguard measures proportionate to the nature, scale, magnitude and sensitivity of the proposed project's potential impacts; and,
(iii) determine consultation and disclosure requirements.

31. ADB assigns a proposed project to one of the following categories:

(i) **Category A.** Proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented; impacts may affect an area larger than the sites or facilities subject to physical works. A full-scale EIA including an EMP is required.
(ii) **Category B**. Proposed project's potential environmental impacts are less adverse and fewer in number than those of category A projects; impacts are site-specific, few if any of them are irreversible, and impacts can be readily addressed through mitigation measures. An IEE, including an EMP, is required.
(iii) **Category C**. Proposed project is likely to have minimal or no adverse environmental impacts. No EIA or IEE is required although environmental implications need to be reviewed.
(iv) **Category FI**. Proposed project involves the investment of ADB funds to, or through, a financial intermediary.

32. Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—CECEP's Regional Emission-Reduction and Pollution-Control Facility was categorized by ADB as FI. Following the screening and categorization procedures set out in the ESMS, the subproject has been classified as environment category B, and an IEE including an EMP is required.

33. SPS 2009 requires a number of additional considerations, including: (i) project risk and respective mitigation measures and project assurances; (ii) project-level grievance redress mechanism; (iii) definition of the project area of influence; (iv) physical cultural resources damage prevention analysis; (v) climate change mitigation and adaptation; (vi) occupational and community health and safety requirements (including emergency preparedness and response); (vii) economic displacement that is not part of land acquisition; (viii) biodiversity conservation and

natural resources management requirements; (ix) provision of sufficient justification if local standards are used; (x) assurance of adequate consultation and participation; and (xi) assurance that the EMP includes an implementation schedule and measurable performance indicators. These requirements, which may not be covered in the domestic EIA, have been considered, and all applicable environmental requirements in SPS 2009 are covered in this IEE.

34. During the design, construction, and operation phases of a project, ADB's SPS 2009 also requires the borrower to follow environmental standards consistent with good international practice (GIP), as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*.[3] The *EHS Guideline*s contain discharge effluent, air emissions, and other numerical guidelines and performance indicators as well as prevention and control approaches that are normally acceptable to ADB and are generally considered to be achievable at reasonable costs by existing technology. When host country regulations differ from these levels and measures, the borrower/subborrower is to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower/subborrower is required to provide justification for any proposed alternatives.

[3] *World Bank Group, Environmental, Health, and Safety Guidelines*, April 30, 2007, Washington, USA. http://www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

III. PROJECT DESCRIPTION

A. The Subproject

35. The subproject will develop a geothermal district heating system for a newly-built, reconstructed, and expanded residential area in Mi County, Lingcheng District, Dezhou City of Shandong Province. The subproject will be constructed in five phases: in each phase, eight geothermal wells will be drilled (four producing wells and four disposal wells) and two heat exchange stations will be built and provide district heating for an area of 160,000 m^2. The subproject will provide district heating for an area of 800,000 m^2.

B. Project Rational

36. Dezhou City is one of the cities with severe air pollution in the BTH region and its neighboring regions. In 2016, Dezhou ranked the last in Shandong Province for the comprehensive air quality index. It is urgent that Dezhou develops clean heating such as geothermal for heating to mitigate the severe air pollution issue.

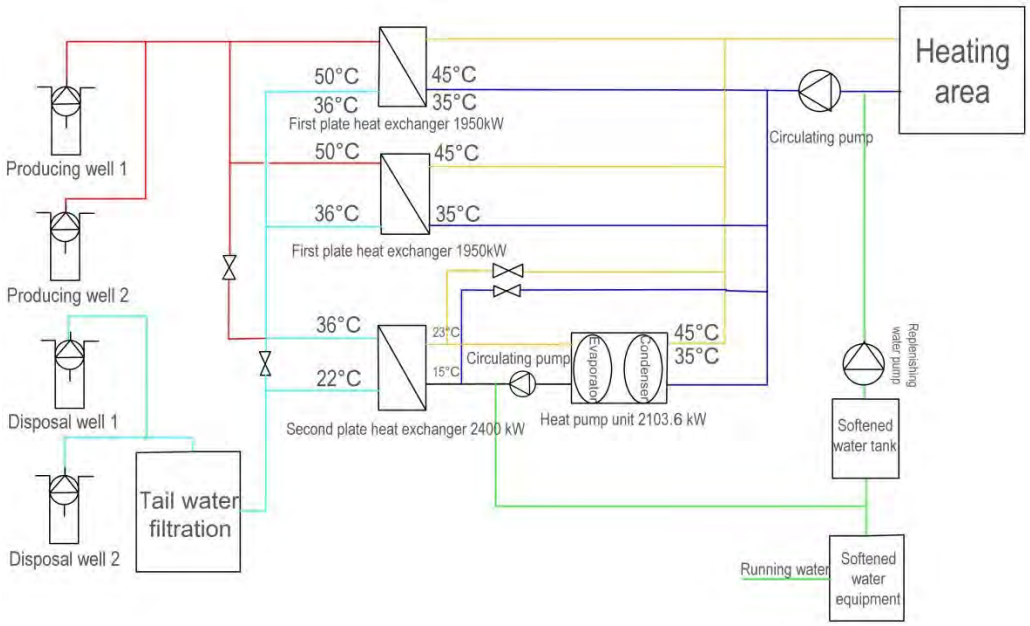
37. Dezhou is endowed with rich geothermal resource which is generally located in reservoirs at the depth of 1,100–1,450 meters with water temperature of 50°C–58°C. The heating yield of a single well is about 90 m^3/h–120 m^3/h. Its abundant geothermal energy can satisfy the heating demand for the entire Dezhou.

C. Key Subproject Features

38. Technical features of the subproject include: (i) in the aspect of geothermal well drilling, Luhai, along with its extensive experience working in oil fields, cooperates with universities such as China University of Petroleum and Yangtze University, developed a range of drilling technologies for geothermal well. The technologies are suitable for geothermal reservoirs of various geological conditions, and adopt different aquifer protection measures; (ii) in the aspect of well path control, the subproject employs qualified personnel and deploys orientators to ensure no deviation in well path control; (iii) in the aspect of well completion technologies, the subproject chooses suitable well drilling technology and well flushing methods based on geological features of various regions to ensure geothermal well's normal operation after well completion; (iv) in the aspect of underground water utilization, the subproject adopts water reinjection technology to recharge the water back to the underground reservoir on a continual basis, thereby ensuring simultaneous extraction and reinjection (the technical process is shown in Figure 6 below). After the geothermal water exchanges heat via the heat exchanger, the geothermal tail water will be purified through purifying equipment to remove impurities, to ensure the water is qualified for recharge; (v) to ensure the stability of heat source well and avoid water (heat) interflow, the subproject adjusts the distance between the disposal wells and water intake wells to the best position; (vi) the heat exchange stations are located near the heat load center. To resolve the corrosion and scaling issue, water softening equipment will be installed in the replenishing water pump of the secondary heating network. The subproject will use oil casing as the heating network, with rigid polyurethane foam as the thermal insulation material for prefabricated insulation, and external high density polyethylene pipe covering as the protective layer; and (vii) running water is processed to softened water via automatic water softening equipment and enters a softened water tank. The softened water diverges respectively into high-zone, mid-zone and low-zone circulating water system via 3 variable-frequency replenishing water pumps; the pressure for the variable-frequency replenishing water pump is identified in accordance to the backwater pressure signal

of the heating system, so that electricity use is minimized.

Figure 1: Water Recharge Flow Chart



°C = degree Celsius, Kw = kilowatt.

39. Various energy saving measures are taken by the subproject: (i) in respect of water pump type, a German-made Ritz submersible pump will be used. The pump is equipped with an alternating current variable frequency drive to enable stepless variable speed regulation of the asynchronous motor. Compared to a conventional submersible pump with the same lift and water volume, the selected pump could save 20% electricity; (ii) in respect of insulation measures of the heating network, the subproject uses a polyurethane insulation layer, on buried vertical-run high density polyethylene insulated tubes. This allows heating network transmission efficiency of up to 98%; (iii) the subproject uses smart equipment such as integrated temperature transmitters and electromagnetic flow meters to control parameters such as water temperature and operation frequency, for better energy efficiency; and (iv) in respect of water saving, geothermal water will be recharged back, after circulation in the heat exchanger. Rain water is also collected via a rainwater network into fire water pool, for road watering and greening purposes.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Location

40. The subproject is located in Mi County, Lingcheng District, Dezhou City of Shandong Province. Dezhou City is located in the northwest of the north shore of the Yellow River, bordering Hebei Province in north. It is located at east longitude 115°45'~117°36', northern latitude 36°24'~38°00'. It is near the Jinan City in south and Binzhou City in east with a total area of 10,356 km^2.

Figure 2: Subproject site location

Source: https://en.wikipedia.org/wiki/China

B. Shandong Province Overview

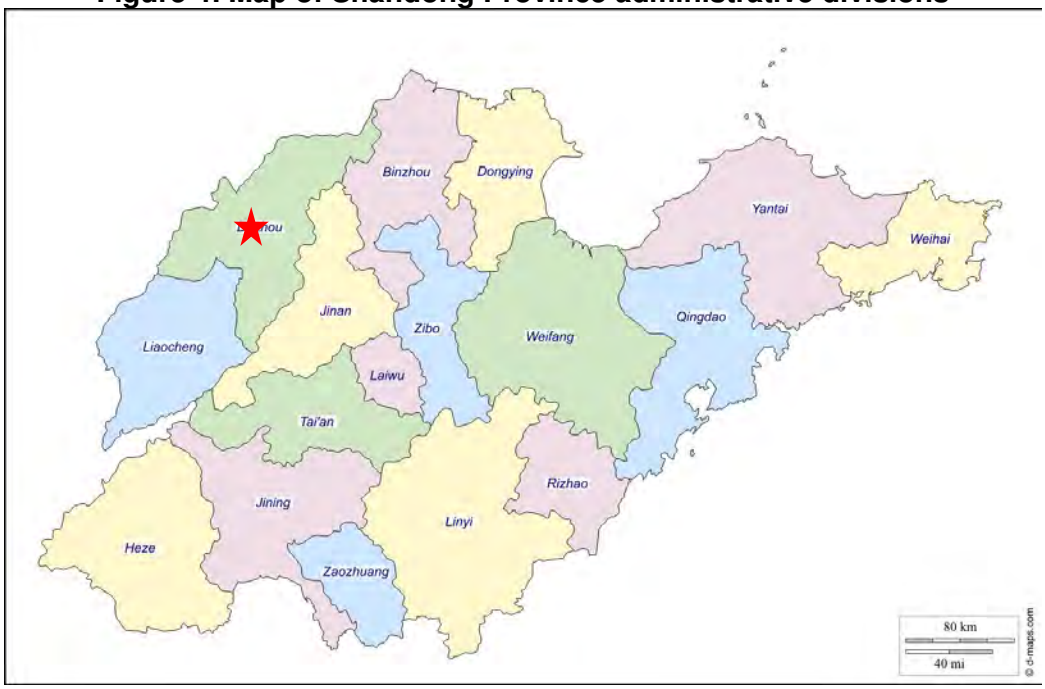
41. Shandong is a coastal province, and is part of the East China region (**Figure 3**). Neighboring provinces are Anhui, Hebei, Henan, and Jiangsu.

Figure 3: Shandong Province in China

Source: https://en.wikipedia.org/wiki/Shandong

42. Shandong is divided into 17 prefecture-level divisions including two sub-provincial cities. The 17 prefecture-level divisions of Shandong are subdivided into 137 county-level divisions (51 districts, 28 county-level cities, and 58 counties). Those are in turn divided into 1,941 township-level divisions (1,223 towns, 293 townships, two ethnic townships, and 423 subdistricts).

Figure 4: Map of Shandong Province administrative divisions



Source: http://d-maps.com

43. In 2016, the population of the province was 99.47 million. The land area is 157,100 km^2 and the coastline length is 3,100 km. The province has 17 municipalities and 140 counties (including county level cities and districts). Shandong has a temperate climate, with hot, rainy summers and dry, cold winters. Mean annual temperature is 10.5°C–13.5°C; the average temperature in July is 24°C–27°C, while the temperature in January is -4°C–-1°C. Mean annual precipitation is 550–950 mm, increasing from northwest to southeast. The province is divided into four topographical zones: (i) Northwestern Shandong Plain, formed by deposits of the Yellow River; (ii) Jiaolai Plain, between central-south Shandong and Jiaodong hilly regions, bounded by bays in the north and south and traversed by the Jiaolai, Weihe and Dagu rivers; (iii) Central-South Shandong hilly area, with elevations >1,000 m ASL; and (iv) Jiaodong Hilly Area, the main part of the Shandong Peninsula.

44. Shandong ranks first among the PRC provinces in the agriculture production of a variety of products, including cotton and wheat, as well as gold mining. Other important crops include tobacco, sorghum and maize, as well as peanuts, for which the province is especially well-known, providing nearly a quarter of the entire country's total. Shandong is also a significant producer of fruit. The province also has extensive deposits of natural gas, iron, diamonds, and bauxite deposits. In 2016, the total GDP of the province was CNY6.70082 trillion and per capita GDP was CNY67,706.

45. Shandong is one of the leading provinces driving the economic development in the PRC. However, it is facing increasing pressure to reduce its energy consumption and emission reduction in light of PRC's objective for achieving 40%–45% carbon intensity reduction by 2020 compared to 2005 levels. Shandong was included in the first three provinces to implement province-wide circular economy.

46. The Yellow River passes through Shandong's western areas, entering the sea along Shandong's northern coast; in its traversal of Shandong it flows on a levee, higher than the

surrounding land, and dividing western Shandong into the Hai He watershed in the north and the Huai River watershed in the south. The Grand Canal of China enters Shandong from the northwest and leaves on the southwest. Weishan Lake is the largest lake in the province. Shandong's coastline is 3,000 km long. Shandong Peninsula has a rocky coastline with cliffs, bays, and islands; the large Laizhou Bay, the southernmost of the three bays of Bohai Sea, is located to the north, between Dongying and Penglai; Jiaozhou Bay, which is much smaller, is to the south, next to Qingdao. The Miaodao Islands extend northwards from the northern coast of the peninsula.

47. The province has 30.58 billion m^3 of water resources and 307.4 m^3 per capita in 2016. The groundwater resources of Shandong is large, but is being exploited at an unsustainable rate. The demand for groundwater resources will continue to increase in the future with rising population and higher temperatures predicted in climate change scenarios.

C. Site Physical Resources

48. **Dezhou City.** Dezhou is a prefecture-level city in northwestern Shandong province. Dezhou City is located in the northwest of the north bank of the Yellow River. It is located at east longitude 115°45'~117°36', northern latitude 36°24'~ 38°00'. It borders the provincial capital of Jinan to the southeast, Liaocheng to the southwest, Binzhou to the northeast, and Hebei Province to the north with a total area of 10,356 km^2.

49. **Geology.** Dezhou area is mainly Quaternary stratigraphy, Neogene and Carboniferous-Permian coal-bearing strata, Middle Ordovician limestones, Archean metamorphic rocks and magmatic rocks. Since the Mesozoic, the main trend of crustal movement in this area is decreasing, by long-term accumulation, and the area is covered with deep Cenozoic strata.

50. **Topography**. Dezhou city is in alluvial plain of Yellow River. It is located in a flat terrain with altitude 20.34~21.01 m and the base of the Ordovician limestone. The area belongs to Quaternary stratigraphic with a thickness of up to 280 meters above the basic to the silt. The subproject site is in the east of Dezhou City, flat terrain, undulating small rivers, lakes, ponds, etc. (**Figure 5**).

Figure 5: Dezhou topography

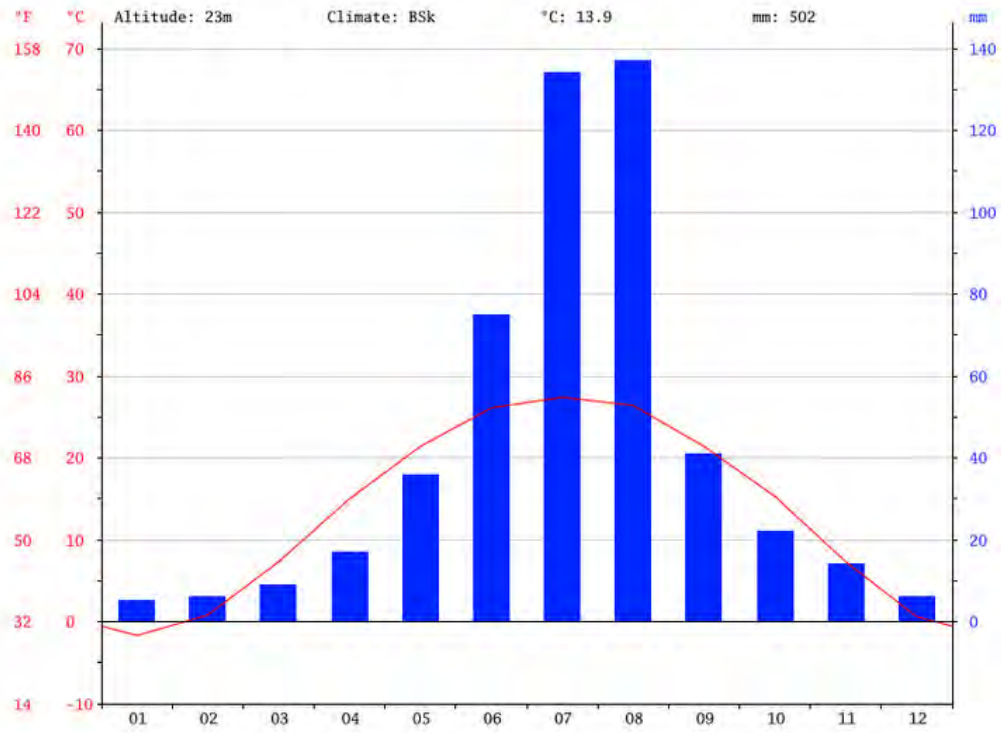
Source: Google map, 2017

51. **Hydrogeology.** Dezhou City belongs to the lower Yellow River alluvial plain with rich groundwater. Superficial layer of freshwater, superficial layer of saline water and deep freshwater are in interphase distribution. Shallow water area is mainly supplied by atmospheric precipitation and surface water infiltration, and deep freshwater relatively abundant in the past. Shallow water is the main source for urban mining industry and household water.

52. **Meteorology and Climate.** Dezhou City belongs to a temperate continental monsoon climate with dry and windy weather in spring, hot and rainy weather in summer, clear and crisp weather in autumn days, and cold and less snow weather in winter. The annual average air pressure is 1,014 hPa; the annual average temperature is 12.9°C; the annual average precipitation is 593 mm. The maximum extreme high temperature is 43.4°C (23 July 1955) and

the extreme minimum low temperature is -27°C (15 January 1958).

Figure 6: Average Climate Profile in Dezhou



Source: https://en.climate-data.org/location/2259/

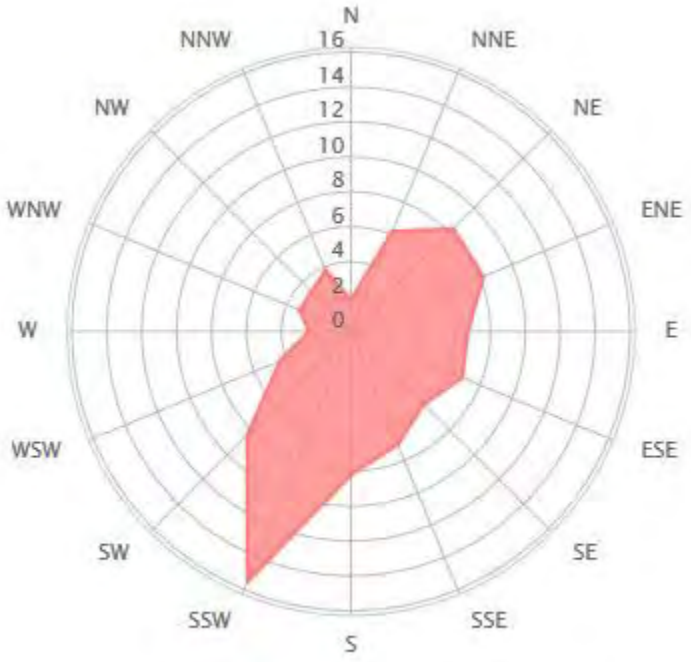
53. **Precipitation.** The annual average precipitation in Dezhou from 1950–2011 was 547.5 mm with 67.7% occurring in the summer.

54. **Sunshine and humidity.** Sunshine hours of Dezhou in 2016 were 2,592 hours, or 60% of the annual daytime hours. The annual average humidity is 64%

55. **Frost-free Days.** There is an average of 208 frost free days per year. The first frost typically occurs in the last 10 days of October, and the last frost day is typically in the last 10 days of March.

56. **Wind.** Dezhou city has a continental monsoon climate. The southwest monsoon occurs in summer, while the northeast monsoon occurs in winter. The annual calm days represents 8.66%. The dominant wind direction of the area is from southwest-south, accounting for 13% of the total windy days per year (based on data from 1950–2011) and the secondary wind direction is from south, accounting for 11% (**Figure 7**). The annual average wind speed is 2.9 m/s.

Figure 7: Dezhou Wind Rose



Source: https://www.windfinder.com/report/dezhou_lingxian

57. **Water Resources.** Annual average total water resource of Dezhou City is 67,478,000 m^3. The per capita water resource is only 117 m^3. The distribution of water resources during the year is uneven, showing seasonal characteristics of a clear spring drought and summer floods and drought again in late autumn.

58. **Shallow groundwater overdraft condition.** Shallow groundwater mining is mainly used for agricultural irrigation, while small amount is used for industrial and life. With the development of the national economy, industry, agriculture, and domestic water consumption is increasing in some areas. Surface water cannot meet the demand and the groundwater has become the main source of water. However, uncontrolled exploitation is easy to cause the water level to decline and deterioration of water quality and other environmental issues. Shallow groundwater overdraft amount refers to the amount that can lead to deterioration of water quality, vegetation degradation and other ecological imbalance of groundwater storage.

59. **Deep groundwater overdraft condition.** Buried deep pressure water system is that the depth below the 200 meters from the surface. The water pressure of untapped deep water was very big 60 years ago, which made Dezhou City become self-water distribution area. In recent years, due to the large amount of mining of the deep fresh water, the pressure of deep groundwater in the city has declined. Especially, in the Decheng district as the center of "Dezhou funnel", the depth of the funnel reached the deepest 113 m. According to information from Dezhou Water Resource Bureau[4], shallow groundwater overdraft area was 1,221 km^2 in 2015, and the bigger drop in deep groundwater was 1.1869 m.

[4] http://www.dzwater.gov.cn/n15489139/c26290751/content.html

D. Environmental Monitoring

1. Air Quality Monitoring

60. Air quality monitoring data from Dezhou EPB air quality monitoring station was collected over a 7-day period in mid-April 2017. Monitoring was undertaken for a minimum of 18 hours per day, allowing 24 hour averaging periods for SO_2, NO_2, $PM_{2.5}$, and PM_{10}. The results are presented in **Table 13**, which show that all parameters were in compliance with relevant ambient air quality standard, Class II of *Ambient Air Quality Standards (*GB3095-2012).

61. It is noted that site specific air quality monitoring will be undertaken during domestic EIA preparation for the newly built residential areas.

Table 13: Air quality monitoring results (ug/m^3)

Date	24-hr mean PM_{10}	24-hr mean $PM_{2.5}$	24-hr mean SO_2	24-hr mean NO_2
18 April 2017	126	29	28	37
19 April 2017	112	41	26	66
20 April 2017	121	42	21	35
21 April 2017	125	42	16	37
22 April 2017	131	43	18	31
23 April 2017	118	47	20	29
24 April 2017	124	46	20	31
Limit	150	75	**150**	80

NO_2 = nitrogen dioxide, $PM_{2.5}$ = particulate matter with diameter less than 2.5 micrometers, PM_{10} = particulate matter with diameter less than 10 micrometers, SO_2 = sulphur dioxide, ug/m^3 = microgram per cubic meter.
Source: www.aqistudy.cn/historydata/monthdata.php?city=%E5%BE%B7%E5%B7%9E

2. Surface Water

62. The surface water body near the subproject site is an Irrigation Canal (**Figure 8**), which is 50 m away from the subproject in the south and east direction. Irrigation Canal is a branch of Majia River.

Figure 8: Surface water near the subproject site

Source: Google map, 2017

63. Based on information from *Shandong Water Environmental Quality Bulletin in 2016*, surface water quality of all five rivers in Dezhou City can meet the Class V of *Environmental quality standards for surface water* (GB 3838-2002) and is 100% compliance with the standards in 2016. The irrigation Canal is part of Majia River, so it complies with the standards.[5]

64. Surface water quality monitoring will be undertaken during domestic EIA preparation for the newly built residential area.

3. Noise

65. Daytime and night-time noise monitoring was not undertaken at the subproject site. During the site visit in March 2017, PPTA consultants found that the main noise activities near the subproject site are agricultural activities and vehicles and there are no industrial facilities nearby.

[5] Source: http://www.sdein.gov.cn/dtxx/hbyw/201701/t20170116_303675.html

No excessive noise levels were experienced at the time of the site visit.

66. Ambient noise monitoring will be undertaken during domestic EIA preparation for the newly built residential area.

4. Groundwater

67. Luhai has already operated several similar projects in Dezhou City. According to the staff from Luhai, groundwater quality in Dezhou City can comply with relevant standards- Class III of *GB/T14848-93 Quality Standard for Ground Water*. During the site visit, groundwater quality report was provided to PPTA consultants for review.

68. Groundwater quality monitoring will be undertaken during domestic EIA preparation for the newly built residential area.

E. Ecological Resources

69. Based on site survey by PPTA consultant, there are no known ecological and/or sensitive resources near the subproject site.

70. The subproject area is located in mixed agricultural, commercial and residential areas. Virtually no original habitat remains. Habitats are rated as Ecological Impact Grade III (the lowest level) under the PRC's Technical Guideline on EIA Regarding Ecological Impact (HJ 19-2011).

1. Flora and Fauna at Subproject Site

71. The subproject site has little or no vegetation cover (**Figure 9**). There are no known rare or endangered flora or fauna, parks, nature reserves or areas with special national, regional or local ecological significance within or adjacent to the subproject site.

Figure 9: Subproject site conditions

(i) Residential areas near the subproject site

(ii) Road across the subproject site

2. Sensitive Receptors

72. The subproject is located within a newly built residential area which are sensitive receptors for air quality and noise impacts. **Table 14** and **Figure 10** present sensitive areas near the subproject site. The surface water body near the subproject site is presented in **Figure 8**.

Figure 10: Sensitive areas near the subproject site (air quality and noise)

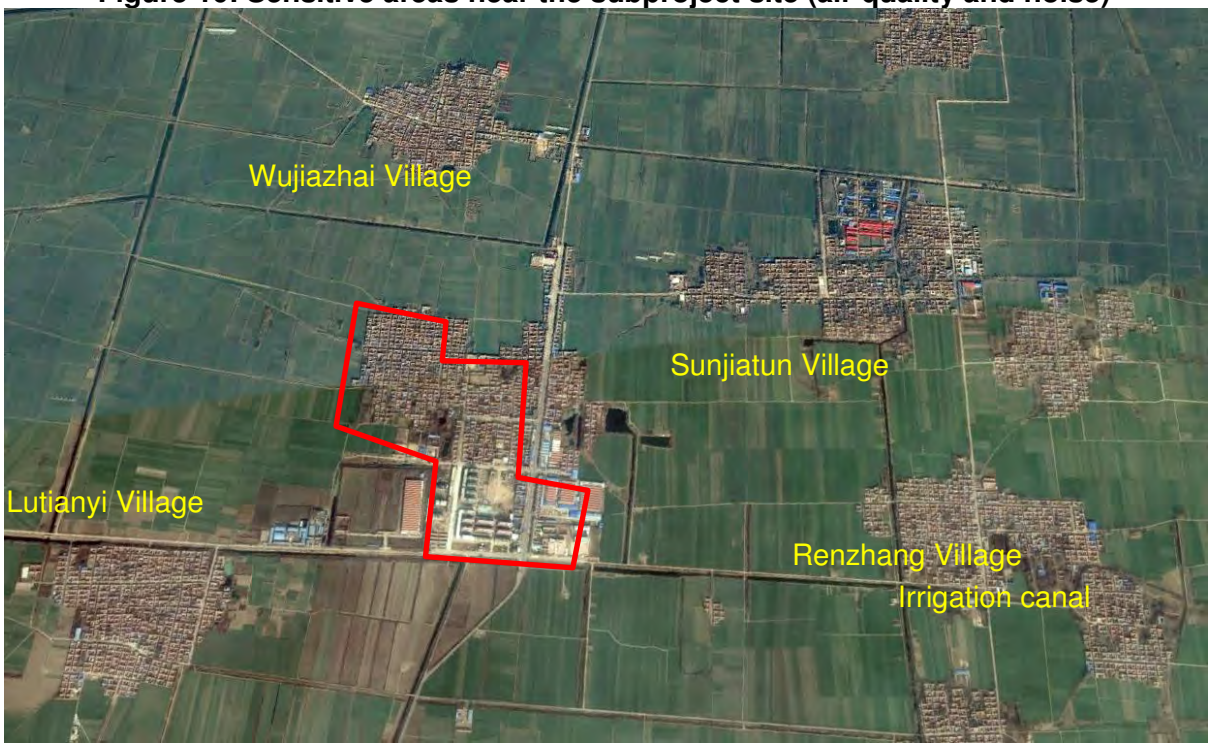


Table 14: Sensitive areas (air quality, noise and surface water)

Sensitivity	Area	Direction	Distance (m)	Function	Standard
Air quality	Renzhang Village	E	1,200	Residential Area	Category II
	Sunjiatun Village	NE	700	Residential Area	Category II
	Wujiazhai Village	N	720	Residential Area	Category II
	Lutianyi Village	SW	750	Residential Area	Category II
Noise	Renzhang Village	E	1,200	Residential Area	Category II
	Sunjiatun Village	NE	700	Residential Area	Category II
	Wujiazhai Village	N	720	Residential Area	Category II
	Lutianyi Village	SW	750	Residential Area	Category II
Surface water	Irrigation Canal	E, S	50	Agricultural irrigation	Category V

E = east, m = meter, NE = northeast, NW = northwest, SE = southeast, SW = southwest.

F. Socio-economic and Cultural Resources

1. Dezhou City

73. Dezhou is comprised of two districts, seven counties and two county-level cities (**Figure 11**) with a total area of 8,629 km^2. Total population by the end of 2016 was 5,514,700 (**Table 15**).

Figure 11: Map of Dezhou City administrative divisions

Source: https://en.wikipedia.org/wiki/Dezhou

Table 15: Data on Dezhou City administrative divisions

Subdivision	Land Area (km^2)	Population (2016)	Population Density (persons/km^2)
Decheng	539	445,300	826
Lingcheng	1,213	584,100	482
Yucheng	990	518,100	523
Leling	1,172	676,300	577
Qihe	1,411	619,900	439
Ningjin	833	467,300	561
Linyi	1,016	532,800	524
Pingyuan	1,047	458,600	438
Wucheng	751	385,400	513
Xiajin	882	520,100	590
Qingyun	502	306,800	611
Total	10,356	5,514,700	533

km^2 = square kilometer.
Source: Dezhou Statistical Bureau, 2016

74. There are 39 ethnicities including Hui, Mongolian and Manchu. However, the ethnic minorities only account for 1.5% of the total population while the rest is Han ethnicity. None of them will be affected by the subproject.

2. Economy

75. Dezhou is rich in natural resources. Coal reserves in Dezhou is 6 billion tons, petroleum reserves are 158 million tons, and natural gas reserves is 1 billion m^3.

76. In 2016, the city's GDP was CNY293.299 billion, of which the primary sector accounted for 10.1% or CNY 29.62 billion; the secondary sector accounted for 47.8% or CNY 140.20 billion; and the tertiary sector accounted for 42.1% or CNY123.48 billion.

3. Transportation

77. Dezhou lies on the main rail route from Beijing to Shanghai, which is known as Jinghu Railway. It is also one of the 23 stations on the exclusive Beijing-Shanghai High-Speed Railway. Dezhou has always been an important transport hub since ancient times, with its reputation of "Junction of Nine Arteries" and "Portal of the Capital" gradually established. In addition to two railways (the other is Shide Railway leading to Shijiazhuang), National Highway 104, 105 and some provincial roads cross the city as well. The Yellow River and the Grand Canal (China) both run through it.

4. Physical Cultural Resources

78. Dezhou has a rich history. However, there are no known physical cultural resources (PCRs) in the subproject site.[6]

[6] Physical cultural resources are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings and may be above or below ground or under water. Their cultural interest may be at the local, provincial, national, or international level. Within the Project area these could include:

(i) Funeral site: graves, cemeteries, shrines, stupas.
(ii) Religious buildings: Temples or Pagodas, complete or ruins.
(iii) Religious objects: Buddhist images or sculpture.
(iv) Sacred sites: sacred caves, forest, hills or cliffs.
(v) Historical sites or objects: artifacts, tools, relics, memorials.
(vi) Spirit sites: sites residents believe are occupied by a spirit (house, tree, stone, etc.).

V. ANTICIPATED IMPACTS AND MITIGATION MEASURES

2. Anticipated positive and negative environmental impacts of the proposed subproject were assessed based on the FSR; a technical due diligence review of the FSR undertaken by ADB PPTA specialists; public consultations led by the subborrower and assisted by ADB PPTA consultants; and site visits, surveys and consultations undertaken by ADB PPTA consultants.

3. Pre-construction, construction, and operation phases were considered separately. The results of the assessment indicate that during the pre-construction phase issues are very limited, and are mostly associated with ensuring appropriate incorporation of mitigation measures into the project design.

4. Potential negative construction phase environmental impacts are short-term and localized, and are associated with soil erosion, construction noise, fugitive dust, disruption of traffic and community services, and risks to worker and community health and safety. Potential negative operation phase impacts are associated with waste and wastewater, noise, and health and safety risks to workers and community.

79. Potential positive operation phase impacts are significant and long-term, and are associated with emissions reductions compared to equivalent heat production from coal-fired boilers.

A. Pre-Construction Phase Measures to be Implemented During Detailed Design

1. Siting and Land Acquisition

80. The subproject will not entail any permanent or temporary physical displacement or economic displacement. This is because:

(i) Land acquisition has been completed by the developers of the residential areas, and was found to be in compliance with the PRC and ADB requirements;
(ii) Drilling activities will be implemented in the residential areas where land acquisition was already completed by the developers.
(iii) Heating pipelines will be laid underground within the existing pipeline or road right of ways (RoWs).

81. Overall, the subproject will not result in any involuntary land acquisition, resettlement or physical displacement, and there will be no loss of personal property, structures, crops, trees or other assets. There are also no potential adverse impacts on disadvantaged or vulnerable groups, including the poor, women and children, and Indigenous Peoples.

2. Mitigation Measures and Monitoring during Detailed Design

82. Mitigation measures to be adopted during detailed design to minimize the impacts are as follows:

(i) **Detailed Design.** Environmental mitigation measures indicated in this IEE, EMP, and domestic EIA will be incorporated into the detailed design.
(ii) **Bidding Documents and Contracts.** Environmental mitigation measures indicated in this IEE, EMP, and domestic EIA will be included in contracts for civil works and equipment installations. All contractors will be required to strictly comply with the EMP.

(iii) **Environmental monitoring.** The environmental monitoring program (EMoP, see **Table 3** in **Appendix I**) will be incorporated into the design to ensure that environmental impacts are closely monitored and activities of the subproject construction and operating are closely supervised against the PRC environmental laws, regulations and standards, ADB SPS 2009, subproject EMP, and approved domestic EIA.

3. Grievance Redress Mechanism

83. In accordance with the GRM presented in Chapter VIII of the IEE, a staff member from the subborrower will be assigned overall responsibility for the GRM; GRM training will be provided for subborrower and GRM access points; and the GRM access point phone numbers, fax numbers, addresses and emails will be disclosed to the public.

4. Training and Capacity Building

84. An institutional strengthening and training program will be delivered by environmental consultants and experts (see **Table 4** in **Appendix I**). The training will focus on ADB's and PRC's environmental, health and safety laws, regulations and policies; implementation of the EMoP; the GRM; and international good EHS practices. Training will be provided to the subborrower, relevant staff and contractors and construction supervision company.

5. Permitting

85. All necessary construction permits will be obtained from the relevant authorities.

B. Anticipated Impacts and Mitigation Measures during Construction Phase

1. Erosion and Spoil

86. Construction activities such as drilling, land leveling, excavation, and filling activities may lead to surface erosion. The most vulnerable soil erosion areas in the construction site include excavation sites, leveling sites, spoil sites, temporary construction sites, and other areas where surface soil is disturbed. Soil erosion can also be more serious on slopes or near water bodies. Soil erosion can also occur after the completion of construction if site restoration is inadequate. Pipeline excavation and burial may also cause localized erosion and mudding of adjacent road. Finally, construction activities may generate surplus spoil.

87. These impacts can be mitigated through typical good construction practice, erosion controls and site maintenance:

(i) At the construction site, the potential for storm water runoff will be assessed and appropriate storm water drainage systems to minimize soil erosion will be implemented, including perimeter bunds and establishment of temporary detention and settling ponds to control topsoil runoff;
(ii) Land excavation and filling will be balanced to minimize the requirement for fill transportation;
(iii) During earthworks, the area of soil exposed to potential erosion will be minimized through good construction management;
(iv) Water-based drilling technology will be used, then drilling fluids generated during drilling activities is water-based, no oil related material will be released to soil or groundwater;

(v) Reuse of drilling water, where feasible;
(vi) Spoils will be reused on-site to the maximum extent feasible as fill. Temporary spoil storage sites will be identified, designed, and operated to minimize impacts. Spoil sites will be restored after the completion of storage activities. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site;
(vii) Spoils and aggregate piles will be covered with landscape material and/or regularly watered;
(viii) Waste construction material such as residual concrete, bricks, etc. will be used for backfill at the sites or nearby construction sites to the maximum extent feasible;
(ix) Construction and material handling activities will be limited or halted during periods of rains and high winds;
(x) Pipelines will be installed and backfilled in a sequenced section-by-section approach. Open excavation areas during trenching activities will be minimized, and appropriate construction compaction techniques utilized;
(xi) Any planned paving or vegetating of areas will be done as soon as practical after the materials are removed to protect and stabilize the soil; and
(xii) Once construction is completed, disturbed surfaces will be properly sloped and planted with native trees and grass.

2. Wastewater

88. Inappropriate treatment of domestic wastewater (from construction worker camps and/or workers) or construction wastewater (from drainage of drilling activities, excavation, washing aggregates, washing construction equipment and vehicles, pouring and curing concrete, and oil-containing wastewater from machinery repairs) may cause soil or groundwater resources contamination.

89. These impacts can be mitigated through typical good wastewater management practices:
(i) Adequate temporary sanitary facilities and ablutions will be provided for construction workers. Toilets will be equipped with septic tanks in accordance with PRC standards. Domestic wastewater will be treated in the septic tanks to meet relevant national standards and discharged based on requirements of relevant national standards;
(ii) Construction wastewater will be directed to temporary detention and settling ponds. Areas where construction equipment is being washed will be equipped with water collection basins and sediment traps. After settling, supernatant will be recycled and sediment will be periodically excavated, and either reused if possible as fill, disposed at official spoil disposal sites, or disposed at landfills;
(iii) Maintenance of construction equipment and vehicles will not be allowed on site to reduce wastewater generation;
(iv) Drilling equipment will be cleaned up before drilling to prevent groundwater pollution; and
(v) Reuse of drilling water, where feasible.

3. Air Pollution

90. Anticipated sources of air pollution from construction activities include: (i) dust generated from earth excavation, filling, loading, hauling and unloading; (ii) dust generated from disturbed and uncovered construction areas, especially on windy days; (iii) dust generated from construction material storage areas, especially on windy days; (iv) dust generated by the movement of vehicles and heavy machinery on unpaved access and haul roads; (v) dust

generated from aggregate preparation and concrete-mixing; and (vi) emissions from construction vehicles (gaseous CO and NO_2) and heavy diesel machinery and equipment. Similarly, dust and air pollution will also be generated during the installation of the heat supply pipelines from (i) excavation and piling of materials; (ii) raw material transport and unloading; (iii) cement mortar preparation; (iv) pipeline backfilling; and, (v) emissions from construction vehicles and heavy diesel machinery and equipment.

91. Without appropriate mitigations, construction phase activities may increase localized total suspended particulate (TSP)[7] levels, with worst case conditions occurring in clear weather without watering.

92. To reduce air quality impacts during the construction period, the following air quality management measure will be implemented:

(i) Subproject site under construction will be fully enclosed by fence prior to the commencement of construction. Fence height will be increased near sensitive locations (residential areas, schools, clinics and hospitals), if any;
(ii) Water will be sprayed on active construction sites including where fugitive dust is being generated on a daily basis, and more frequently during windy days;
(iii) All construction piles (spoil, aggregate other construction materials) with the potential to generate dust will be covered and/or regularly watered;
(iv) Construction activities will be halted during high wind events. Once construction is completed, disturbed surfaces will be properly sloped and planted with native trees and grass;
(v) Transport vehicles will be limited to low speeds in construction sites;
(vi) Loads will be covered during truck transportation to avoid spillage or fugitive dust generation. Fine materials will be transported in fully contained trucks;
(vii) Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds;
(viii) Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical; and
(xi) Staff from Luhai confirms that no H_2S or mercury will be generated during drilling activities.

4. Noise Impacts

93. During the construction phase, noise and vibration will be generated by on site construction activities using heavy equipment such as bulldozers, excavators, drilling equipment and by the transport of construction materials. Construction equipment is considered a point noise source, and the predictive model is as follows:

$$L_i = L_0 - 20\lg\frac{R_i}{R_0} - \Delta L$$

Where, L_i and L_0 are equipment noise sound levels at R_i and R_0, respectively, ΔL is additional decrement produced by barriers, vegetation and air.

94. For the impact of multiple construction machines on a location, sound level superposition

[7] Airborne particles or aerosols that are less than 100 micrometers are collectively referred to as TSP.

uses the following formula:

$$L = 10 \lg \Sigma 10^{0.1 \times L_i}$$

95. A significant increase in localized noise is expected during construction. Noise will be generated from construction activities including excavators, bulldozers, concrete-mixing plants, loaders, graders, rollers, drilling equipment and other heavy machinery and noise will be generated from goods and material transportation. Noise during pipeline construction will be generated by trench excavators, rollers and compaction machinery.

96. Though noise levels may be high, the impacts will be temporary and localized, and can be further mitigated.

97. In addition, noise generated from pipeline cleaning also has the potential to impact nearby residents.

98. To ensure construction activities meet PRC noise standards and to protect workers and adjacent residents, the following mitigation measures will be implemented:

(i) Construction activities, and particularly noisy ones, are to be limited to reasonable hours during the day and early evening. Construction activities will be strictly prohibited during the nighttime (22:00 h to 07:00 h). Exceptions will only be allowed in special cases, and only after getting approval of the surrounding residents, local EPB, and other relevant departments;
(ii) When undertaking construction planning, simultaneous high-noise activities will be avoided, and high noise activities will be scheduled during the day rather than evening hours. Similarly, construction site will be planned to avoid multiple high noise activities or equipment from operating at the same location;
(iii) Low-noise equipment will be selected as much as possible. Equipment and machinery will be equipped with mufflers and will be properly maintained to minimize noise;
(iv) Noise personnel protective equipment (PPE) will be provided to workers;
(v) Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and high traffic times;
(vi) Vehicles transporting construction materials or waste will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals;
(vii) Drilling site will be enclosed by fence to reduce noise, if necessary;
(viii) Special attention will be paid to protect sensitive sites near the subproject site; High noise construction activities will be positioned as far away from sensitive sites as possible. Temporary or permanent noise barriers will be installed to protect sensitive sites if necessary; and
(ix) Noise from cleaning of heating pipelines will be minimized by utilization of low noise valves, mufflers after the valves and sound insulation on the external walls of pipelines.

5. Solid Waste

99. Solid waste generated in the construction phase will include construction and domestic waste. Construction wastes include drilling fill, various building materials such as steel, timbers, rubble, and other types of waste. An estimated of 0.5 kg/day per worker of domestic waste will be generated from construction workers and 2.0 kg/m^2 construction waste will be generated from

construction activities. Inappropriate waste storage and disposal could affect soil, groundwater, surface water resources, and hence, public health and sanitation.

100. The following solid waste management measures will be implemented:

(i) Wastes will be reused or recycled to the extent possible. Waste construction material such as residual concrete, bricks will be used for backfill at the site.
(ii) Littering by workers will be prohibited;
(iii) Domestic waste containers will be provided at all work sites. Domestic waste will be collected on a regular basis by the local sanitation departments and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements;
(iv) Reuse of drilling fluid, where feasible;
(v) Construction waste dumpsters will be provided at all work sites. Construction waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements;
(vi) Excavated soil will be backfilled onsite to the extent possible. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site;
(vii) There should be no final waste disposal on site. Waste burning/incineration at or near the site is strictly prohibited; and
(viii) Contractors will be held responsible for proper removal and disposal of any significant residual materials, wastes, and contaminated soils that remain on the site after construction.

6. Hazardous and Polluting Materials

101. Inappropriate transportation, storage, use and spills of petroleum products and hazardous materials like waste resin can cause soil, surface and groundwater contamination. To prevent this, the following mitigation measures will be implemented:

(i) A hazardous material handling and disposal protocol that includes spill emergency response will be prepared and implemented by contractors;
(ii) Storage facilities for fuels, oil, chemicals and other hazardous materials will be within secured areas on impermeable surfaces provided with dikes, and at least 300 m from drainage structures and important water bodies. A standalone site within the storage facility will be designated for hazardous wastes;
(iii) Signs will be placed at chemicals and hazardous materials storage sites to provide information on type and name of chemicals and hazardous materials;
(iv) Suppliers of chemicals and hazardous materials must hold proper licenses and follow all relevant protocols and PRC regulations and requirements; and
(v) A Dezhou EPB certificated company (the certificated companies can be found in www.dzepb.gov.cn/n4146115/n4146356/n4147702/c18836179/content.html) will be hired to collect, transport, and dispose of hazardous materials in accordance with relevant PRC regulations and requirements.

7. Impacts to Flora and Fauna

102. Typical construction impacts on flora and fauna include removal of vegetation and disruption of the ecosystem during construction. If present, rare or endangered flora or fauna may also be impacted. However, the subproject construction site is located in urban environments, which have little or no vegetation cover other than recently established grasses and shrubs. Based on site visits, there is no known rare or endangered flora or fauna, parks, nature reserves

or areas with special ecological significance which will be impacted by the subproject. Impacts on flora or fauna are thus expected to be minimal and short-term. Nonetheless, to address potential impacts:

(i) A greening plan will be implemented. Site vegetation plans will be developed at the subproject site using appropriate native species; and
(ii) Any existing vegetated areas impacted by the subproject will be restored post-construction using appropriate native species.

8. Impacts on Community Disturbance and Safety

103. Project construction has the potential to cause significant community disturbance such as traffic congestion or delays, and public safety risks from construction activities, heavy vehicles, and machinery traffic. Construction may require relocation of municipal utilities such as power, water, and communication cables. There is also the potential for interruptions in municipal services and utilities resulting from damage to pipelines for water supply, drainage, and gas, as well as to underground power cables and communication cables. Mitigations will be implemented to address traffic and other community disturbance issues.

(i) Traffic control plans, agreed to by the local traffic control authority, will be developed and implemented in order to minimize community disturbance:
    a. Luhai will inform residents, institutions, business, and other affected parties the planned construction activities including schedule and duration of construction works, and expected traffic and other disruptions.
    b. Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and rush hours.
    c. Warning signs will be placed at construction sites in clear view of the public. All sites will be made secure, discouraging access by members of the public through appropriate fencing whenever appropriate.
    d. Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools, and hospitals.
    e. Roadside earthworks should be completed as quickly as possible, and all spoils, either backfilled or removed;
(ii) Public access to construction sites and other areas of danger will be restricted and temporary barriers will be installed;
(iii) Local authorities will be consulted to minimize disruption of public services such as telephone, water, gas, and power supply. Contactors will use good construction practices to avoid disruption of other services;
(iv) Contractors will take measures to minimize disruption of access to private properties and businesses where possible;
(v) Temporary access to affected private properties, businesses, and public service buildings will be provided including temporary crossings over pipeline trenches, and subsequently good quality permanent access will be provided; and
(vi) Pipelines construction should be planned to take place simultaneously with other construction activities to minimize the length of disruption.

9. Workers' Occupational Health and Safety

104. Construction may cause physical hazards to workers from noise and vibration, dust, handling heavy materials and equipment, falling objects, work on slippery surfaces, fire hazards,

chemical hazards such as toxic fumes and vapors, and others.

105. Contractors will implement adequate precautions to protect the health and safety of their workers:

(i) Each contractor will implement the relevant construction phase EHS plan;
(ii) Identify and minimize the causes of potential hazards to workers. Implement appropriate safety measures;
(iii) Provide training to workers on occupational health and safety, emergency response, especially with respect to using potentially dangerous equipment and storage, handling and disposal of hazardous waste;
(iv) Ensure that all equipment is maintained in a safe operating condition;
(v) Provide appropriate PPE to workers;
(vi) Implement work practices to limit workers' exposure to high noise or heat working environments in compliance with PRC noise standards for construction sites (GB 12523-2011);
(vii) Ensure regular safety meetings with staff; and
(viii) Ensure that material stockpiles or stacks, such as, pipes are stable and well secured to avoid collapse and possible injury to workers.

10. Physical Culture Resources

106. Based on site visits, there are no known cultural heritages or archaeological sites at or near the subproject site. However, construction activities have the potential to disturb unknown underground cultural relics. To address this issue, a construction phase chance find procedure will be established and activated if any chance finds of PCRs are encountered:

(i) construction activities will be immediately suspended if any PCRs are encountered;
(ii) destroying, damaging, defacing, or concealing PCRs will be strictly prohibited in accordance with PRC regulations;
(iii) the local Cultural Heritage Bureau will be promptly informed and consulted; and,
(iv) construction activities will resume only after thorough investigation and with the permission of the local Cultural Heritage Bureau.

C. Anticipated Impacts and Mitigation Measures during Operation Phase

107. The subproject may cause some adverse environmental impacts during operation including noise from subproject operation, use of water, production of wastewater and solid wastes, and safety hazards.

1. Water Consumption

108. The subproject will use municipal water as domestic water and production water. All the intake ground water is only used for heat exchange and will be 100% recharged. The PPTA consultant visited one heat exchange station of one similar project operated by Luhai and confirmed that all the intake groundwater is 100% recharged (**Figure 12**-intake flow is 49.04 m^3/h and recharge flow is 49.08 m^3/h).

Figure 12: Flows of intake and recharge groundwater

Source: PPTA consultant

2. Wastewater

109. Wastewater will be produced from canteens (if applicable) and toilet facilities. Production wastewater will include backwash wastewater, waste water generated during resin regeneration, and wastewater from secondary pipe network.

110. To address production and domestic wastewater:

(i) Wastewater from canteen will be treated by oil-separator, and discharged to municipal sewer combined with domestic wastewater;
(ii) Production wastewater will be discharged to municipal sewer through the pipelines; and
(iii) Groundwater discharge is prohibited.

3. Solid Waste

111. The subproject will generate domestic and production wastes. Production waste will include waste resin, and waste filter material. If not properly managed, these wastes can cause visual and environmental impacts. To mitigate this risk, the following measures will be implemented:

(i) Domestic waste bins will be provided and domestic waste will be routinely collected by the local sanitation department for recycling, if possible, or final disposal at an approved waste disposal site;
(ii) No permanent on-site solid waste disposal will be permitted at the subproject site;

(iii) No burning of wastes will be permitted at the subproject site; and
(iv) Waste resin and waste filter material will be collected, transported and treated by a certificated third company.

4. Noise

112. Noise sources during operation will mainly be from noise from pumps, fans etc. To mitigate noise impacts, the subproject will:

(i) Low-noise equipment will be used as far as possible, and noise reduction measures such as noise elimination, shock absorption, insulated enclosures and sound dampening materials on exterior walls will be implemented;
(ii) All equipments will be properly maintained to minimize noise;
(iii) Appropriate noise PPE will be provided to the workers who are likely to be exposed to high noise level environments; and
(iv) Layout for heat exchange stations will be reasonable planned to reduce noise.

5. Occupational Health and Safety

113. Plant operation poses risks to workers. Well blowouts and pipeline failures may present health and safety risks to workers.

114. To mitigate potential health and safety risks to workers, the following measures will be taken:

(i) Operation phase EHS plans will be developed and implemented and workers will be trained regularly on their implementation;
(ii) Regular maintenance of wellheads and geothermal fluid pipelines, including corrosion control and inspection; pressure monitoring; and use of blowout prevention equipment such as shutoff valves;
(iii) Design of emergency response for well blowout and pipeline rupture, including measures for containment of geothermal fluid spills;
(iv) PPE including goggles, gloves, safety shoes, will be provided to workers; and
(v) Provide training to workers on occupational health and safety, emergency response.

6. Emergency Response Plan

115. An emergency risk and response plan applicable to well blowouts and pipeline failure will be established in accordance with the “National Environmental Emergency Plan” (24 January 2006) and other relevant PRC laws, regulations and standards and will include measures in the World Bank EHS Guidelines with respect to occupational and community health and safety.

D. Anticipated Positive Operation Phase Impacts

116. The winter heating period in Dezhou lasts for 24 hours a day, 122 days per year, from November 15 every year to March 15 of the following year. Per the national standard for heating load calculation,[8] the 800,000 m^2 of heating area will need 379,469 GJ or 12947.3 tce per heating period. Compared to heating from coal-fired boiler, deep-well geothermal heating could save 13,119.9 tons of standard coal[9] (i.e. 76% of the 17,263.1 tce energy consumed by conventional

[8] 45 W/m^2.
[9] Supposed boiler efficiency is 75%.

large coal fired boiler). As a renewable energy technology, deep well geothermal energy consumes little electricity and there is no direct emission of greenhouse gas or other pollutants. The project will consume 13.15 GWh electricity per heating season (around 14.4kWh per square meter per heating period).

117. The subproject consists mainly of a plate heat exchanger, heat pump unit, and high-, mid- and low-zone circulating water pumps, replenishing water pump and softened water device. The devices with electricity consumption all use variable frequency drives, saving electricity consumption up to 24%.

Table 16: Emission reduction calculation

Energy Savings (tce)	13,119.9			
	CO_2	**SO_2**	**NO_x**	**PM**
Reference case emissions (ton)[10]	45,229.3	146.7	127.7	4.9
Project emissions (ton)[11]	9,991.4	6.2	5.7	1.2
Emission reduction(ton)	35,237.9	140.5	122.0	3.7

CO_2 = carbon dioxide, NO_x = nitrogen oxide, PM = particulate matter, SO_2 = sulfur dioxide.

118. The subproject has a stable heating source. It adopts mature drilling technology for geothermal wells, utilizes tail water recharging technology for the sustainable heat extraction without any water depletion (as it recharges water back to the underground reservoir after purification, to avoid reservoir water depletion and environmental pollution). The project has significant effect on energy saving and emission reduction in that 13,119.9 tce could be replaced, equivalent to 35,237.9 tons of CO_2, 140.5 tons of SO_2, 122.0 tons of NO_X, and 3.7 tons of PM emissions reduced.

[10] The emission factor is CO_2 2.62 t/tce; SO_2 8.5 kg/tce; NO_x 7.4 kg/tce and PM 0.283 kg/tce according to General Principles for Calculation of the Comprehensive Energy Consumption GB2589-81, Interim Measures on Promotion of Energy-saving and Low-carbon Technologies (File No. [2014]19), and Evaluation Indicator System and Illustration of New Energy Demonstration Cities in China by China National Energy Administration).

[11] The emission factor is CO_2 759.8 t/GWh; SO_2 0.47 t/GWh; NO_x 0.43 t/GWh and PM 0.09 kg/GWh.

VI. ANALYSIS OF ALTERNATIVES

119. An analysis of subproject alternatives was undertaken during the feasibility stage to determine the most financially and technically feasible way of achieving the project objectives while minimizing environmental and social impacts.

A. No Project Alternative

120. The district heating area in Dezhou has increased rapidly from 13.8 million m^2 in 2010 to 28.88 million m^2 in 2015, an annual growth rate of 15.0%. Thus, there is an urgent need to construct new heating infrastructure. However, current coal-based district heating systems are no longer an option in Dezhou due to worsening air quality. As clearly stated in the "Dezhou Coal-fired Boiler Management Plan," boilers with capacity lower than 10 tons per hour must use clean energy. If the subproject is not implemented, areas without district heating systems will be dependent on current heating methods such as polluting coal-based boilers, or expensive electric household boilers.

121. Implementation of the subproject will: (i) fulfill rapidly increasing heat demand; (ii) significantly reduce coal consumption; (iii) improve air quality; and (iv) reduce GHG emissions. It will also provide valuable hands on experience and help to explore uses of geothermal heat. For these reasons, the "no project" alternative is considered unacceptable.

B. Heat source

122. Dezhou City is one of the cities with severe air pollution in the BTH region. In 2016, Dezhou ranked the last in Shandong Province for the comprehensive air quality index. It is urgent that Dezhou develops clean heating such as geothermal for heating to mitigate the severe air pollution issue.

123. There are several clean heating sources options for district heating, including combined heat and power (CHP) plants, natural gas heat source plants (HSPs), industrial waste heat, geothermal energy, and heat pumps. Based on site visit and information collection, the subproject site is located at Yuji Village and there were no CHP plants, big industrial plants or natural gas gate station near the subproject site.

124. Dezhou is endowed with rich geothermal resource which is generally located in reservoirs at the depth of 1,100–1,450 meters with water temperature of 50°C–58°C. The heating yield of a single well is about 90 m^3/h–120 m^3/h. Its abundant geothermal energy can satisfy the heating demand for the entire Dezhou.

125. Based on the information above, geothermal heating is the most proven economically viable, energy efficient and environmentally friendly heat source option for the subproject location.

C. Geothermal utilization method

126. There are two technical options for geothermal heating. One is with heating from shallow ground source and heat pump; the other is direct heating with deep-well geothermal hot water:

(i) Shallow ground source heating involves extracting geothermal energy from ground water at around 16°C, via heat exchange tubes buried at a depth of 80–120 meters, then using a heat pump to increase the temperature to around 50°C. The

advantages of this technology are: (i) deep drilling technology is not needed, and there is minimal impact on groundwater resources; (ii) the coefficient of performance (COP) of shallow ground source heat pump is above 4, which is higher than those of air source heat pumps or electric boilers, etc. However, this technology also has disadvantages, including multiple shallow wells may be needed to draw enough heat energy. Generally, the proportion of areas for buried tube to heating area is 1:3. Hence, for this subproject's 800,000 m^2 heating area, 270,000 m^2 of buried tube area is needed, equalling to 17,800 buried tubes. The length of horizontal buried tube is more than 1.2 million meters while that of vertical buried tube is more than 900,000 meters. Secondly, a large amount of electricity will still be consumed by the heat pump during the heating period. The power consumption is 39 kWh for heating per square meter per heating period (assuming 15 hours per day, 120 days per year). Thirdly, heating and cooling imbalance will lead to the decay of geothermal energy after many years' operation.

(ii) The other option, deep-well geothermal energy, involves extracting underground water at 50°C–60°C from the depth of 1,000-2,000 meters, and exchanging heat via indirect counter current heat exchangers for heat supply. The water extracted from underground will then be filtered and recharged back. The whole system consists of geothermal well, pump room and pipe networks, among which the water pump is the only energy-consuming equipment. Compared to shallow ground source heat pump, deep-well geothermal energy has the tri-fold advantages of occupying less land, providing stable heating and low maintenance cost. For this subproject covering 800,000 m^2 heating area, only 20 producing wells and 20 disposal wells are needed for construction, and a heat pump is not necessary to boost the heat to higher temperature. However, the environmental risk of deep-well geothermal energy is the potential impact on underground water quality and groundwater depletion, so it is a must to ensure that the extracted water is filtered and recharged back.

(iii) Weighing between the two technologies, the subproject is to adopt deep-well geothermal energy technology for heating.

127. Deep-well geothermal energy is pollution-free and a renewable clean energy. The PRC is endowed with rich geothermal energy.[12] Many of the core technologies and the equipment involved in geothermal heating have already been developed and deployed, and were widely used in the new economic and technology development zones, green industrial parks, high-efficiency ecological agricultural demonstration projects in rural areas, in household heating (hydrothermal/geothermal heating areas in the PRC reach to 102 billion m^2 by the end of 2015), power generation, refrigeration, drying, and industries such as chemical, planting and breeding, real estate development, tourism, medical bathing treatment, healthy entertainment, etc. However, heating from deep-well geothermal is not widely deployed since it requires good understanding of drilling, geological condition, and special equipment. This subproject can be replicated for continuous heating and cooling using 100% renewable energy.

D. Overall Analysis of Alternatives

128. Based on the analysis of alternatives, the subproject has selected the most appropriate energy source, drilling method and geothermal utilization method.

[12] Per the research result published by Ministry of Land and Resources, hydrothermal geothermal resource amounts to 1.25 trillion tce and the annual exploitation quantity equals to 1.9 billion tce.

VII. INFORMATION DISCLOSURE AND PUBLIC CONSULTATION

A. PRC and ADB Requirements for Disclosure and Public Consultation

1. PRC Requirements

129. Relevant provisions in the PRC *Environmental Impact Assessment Law* (2003) and the *Regulations on the Administration of Construction Project Environmental Protection* (No. 253 Order of the State Council, 1998) require that an EIA for a construction project shall solicit opinions from affected residents, as well as other organizations and concerned stakeholders. However, the requirements for public consultation are different for various sectors and projects. For an environmental Category A project a full EIA report is required including two rounds of public consultations, while for a Category B project only a simplified tabular EIA is required without the need for public consultation.

130. The "Provisional Regulations on Public Participation in Environmental Impact Assessment" (2006) promulgated by State Environmental Protection Administration further improved the legislation of public participation in EIA in the PRC. It provides detailed requirements for the public participation process, including information disclosure standards, consultation methods, and public enquiry process. It is significant since it was the first document clearly regulating public participation in EIA in the PRC.[13]

131. In 2014, the Ministry of Environmental Protection (MEP) released "Guiding Ideas on Promoting Public Participation in Environmental Protection" (2014, No. 48) which defines public participation as "citizens, legal persons and other organizations' voluntary participation in environmental legislation, enforcement, judicature and law obedience, and the development, utilization, protection and transformation activities related to environment."

132. The public disclosure and consultation process undertaken during the preparation of the domestic EIA will be undertaken in compliance with the relevant PRC requirements, including the "Provisional Regulations on Public Participation in Environmental Impact Assessment" (2006) and the "Guiding Ideas on Promoting Public Participation in Environmental Protection" (2014, No. 48).

2. ADB Requirements

133. ADB's SPS 2009 has specific requirements for information disclosure and public consultation. Information disclosure involves delivering information about a proposed project to the general public and to affected communities and other stakeholders, beginning early in the project cycle and continuing throughout the life of the project. Information disclosure is intended to facilitate constructive engagement with affected communities and stakeholders over the life of the project.

134. SPS 2009 requires that borrowers take a proactive disclosure approach and provide relevant information from environmental assessment documentation directly to affected peoples and stakeholders. In addition, to make key documents widely available to the general public, SPS 2009 requires submission to ADB for posting on the ADB website as follows:

[13] Wang Ya Nan, 2012. *Public Participation in EIA, SEA and Environmental Planning in China.* Environmental Impact Assessment Research Centre.

(i) a draft full EIA (including the draft EMP) at least 120 days prior to ADB Board consideration for Category A projects, and/or environmental assessment and review frameworks before project appraisal, where applicable;
(ii) the final EIA/IEE;
(iii) a new or updated EIA/IEE and corrective action plan prepared during project implementation, if any; and
(iv) environmental monitoring reports.

135. SPS 2009 also requires that the borrower carry out consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Consultations should include presentations on environmental impacts, benefits and mitigation measures, the project GRM, and ADB's Accountability Mechanism. For category A projects, such consultations should include consultations both at an early stage of EIA field work and when the draft EIA report is available.

B. Project Information Disclosure

136. Dezhou EPB will post the domestic EIA report of newly built residential areas on its website. The information will include:

(i) project name and project information summary;
(ii) name and contact information of the proponent;
(iii) name and contact information of the institute responsible for preparing the EIA;
(iv) potential project environmental impacts and mitigation measures;
(v) key conclusions of the EIA report;
(vi) a link to download an abridged version of the EIA report; and
(vii) contact information and a request for questions, suggestions, and feedback from the public.

137. The subborrower will post the domestic EIA and this IEE report on its website, and CECEP will also post the domestic EIA and this IEE on its designated website for the FIL.

138. In addition, this IEE will be disclosed on the ADB’s website.

C. Public Consultation Meeting

139. A public consultation meeting was held by the subborrower on 27 April 2017 following ADB SPS’s requirements. A meeting information notice was posted in the residential areas for three days prior to the meeting. The notice provided basic information of the subproject and invited residents in the subproject areas to attend the meeting (**Figure 13**).

Figure 13: Public meeting notice in residential areas

140. During the meeting, information was presented about the subproject status, potential environmental impacts and proposed mitigation measures. Questions and subsequent discussions focused on focused issues on environmental issues of the project and benefits of the subproject.

141. Participants were also asked to complete a questionnaire (**Table 17**). A total of 20 questionnaires were distributed and 20 were retrieved, a recovery rate of 100%. A sample completed questionnaire is presented in **Appendix II**, while presents summary data on the questionnaire respondents, while

142. **Table 19** presents a summary of the questionnaire results.

143. Most of the respondents work and live within a 3-km radius of the subproject; 75% of respondents knew about subproject either from other person, internet, newspapers or information signs, and 65% of respondents indicated that they were already familiar with the subproject benefits after the introduction of the subproject. The top three environment issues respondents identified in their neighborhoods are air quality (55%), surface water (40%) and noise (35%). Groundwater quality and noise were identified as the top two issues during both the construction phase and the operation phase. However, most participants also indicated that potential air, waste water, solid waste and noise impacts can be appropriately mitigated.

144. The overall support for the subproject is very strong; 90% of the respondents indicated that the subproject will improve local economic development, 85% indicated that the subproject will improve quality of life, and 90% of respondents indicated that they support the proposed subproject.

Figure 14: Public consultation photographs

(i) Project environmental impact introduction

(ii) Completing questionnaires

Table 17: Project public consultation questionnaire

Name		**Sex**		**Age**
Nationality		**Education level**		**Occupation**
Company		**Title**		**Contact number**
1. What is the main environment pollution near your living areas in your opinion (multiple choice)? A. Surface water B. Ambient air C. Noise D. Ground water E. Solid waste F. Others				
2. Do you know this project? A. Yes B. No				
3. If you know this project, project information is obtained by which way? A. Internet B. Newspaper C. Information signs D. Other person E. Other				
4. Distance between your working place and project site A. <1 km B. 1-3 km C. 3-5 km D. > 5km				
5. Distance between your house and project site A. <1 km B. 1-3 km C. 3-5 km D. > 5km				
6. Do you understand this project like project information, project component, project benefit etc.,? A. Yes B. No C. Not clear				
7. Do you understand environment impacts of this project? A. Yes B. No C. Not clear				
8. What are the environmental issues of highest concern during construction period? A. Surface water B. Ambient air C. Noise D. Dust/PM E. Ground water F. Solid waste G. Traffic problems H. Ecological environment I. Others				
9. What is environmental issues of highest concern during operation period? A. Surface water B. Ambient air C. Noise D. Dust/PM E. Ground water F. Solid waste G. Ecological environment H. Others				
10 Based on construction phase mitigation measures proposed in EIA, do you accept the impacts to environment?				
10.1 Ambient air (PM, dust included) A. Accept B. Barely accept C. Do not accept D. Have no idea				
10.2 Noise A. Accept B. Barely accept C. Do not accept D. Have no idea				
10.3 Surface water A. Accept B. Barely accept C. Do not accept D. Have no idea				
10.4 Groundwater A. Accept B. Barely accept C. Do not accept D. Have no idea				
10.5 Solid waste A. Accept B. Barely accept C. Do not accept D. Have no idea				
10.6 Ecological environment A. Accept B. Barely accept C. Do not accept D. Have no idea				
10.7 Other (traffic problem and inconvenient by project construction) A. Accept B. Barely accept C. Do not accept D. Have no idea				
11 Based on operation phase mitigation measures proposed in EIA, do you accept the impacts to environment?				
11.1 Ambient air (PM, dust included) A. Accept B. Barely accept C. Do not accept D. Have no idea				
11.2 Noise A. Accept B. Barely accept C. Do not accept D. Have no idea				
11.3 Surface water A. Accept B. Barely accept C. Do not accept D. Have no idea				
11.4 Groundwater A. Accept B. Barely accept C. Do not accept D. Have no idea				
11.5 Solid waste A. Accept B. Barely accept C. Do not accept D. Have no idea				
11.6 Ecological environment A. Accept B. Barely accept C. Do not accept D. Have no idea				

12. Do you think construction of this project can improve local economic development or not? A. Yes B. No C. Not clear
13. Do you think whether construction of this project can improve your living quality (like better heat and cool supply service)? A. Yes B. No C. Not clear
14. After comprehensive analysis of project advantages and disadvantages, do you agree with the construction of this project? A. Yes B. No C. Not clear
Suggestions or requirements of the project:
Suggestions or requirements for environment protection of the project:
Project information *(a project summary was provided here), anticipated pollution control measures and environment benefits.*

Table 18: Summary data on questionnaire respondents

Parameter	Indicator	No.	%
Sex	Male	15	75%
	Female	5	25%
Age	Below 30	2	10%
	31-40	11	55%
	41-50	6	30%
	Above 50	1	5%
Nationality	Han people	20	100.0%
	Other	0	0
Education Level	Primary School or Below	0	0
	Junior school	1	5%
	High school, including technical secondary school	3	15%
	Bachelor degree or above, including junior college	16	80%
Occupation	Farmer	2	10%
	Employee	11	55%
	Civil servant	1	5%
	Self-employed entrepreneurs	6	30%

Table 19: Public consultation questionnaire results

Question	Item	No	% (shading denotes highest ranked)
1. What is the main environment pollution near your living areas in your opinion (multiple choice)	Surface water	8	40
	Ambient air	11	55
	Noise	7	35
	Ground water	3	15
	Solid waste	7	35
	Other	0	0
2. Do you know this project?	Yes	15	75
	No	5	25
3. If you know this project, project information is obtained by which way?	Internet	9	60
	Newspaper	1	6.7
	Information signs	3	20
	Other person	2	13.3
	Other	0	60
4. Distance between your working place and project site	<1 km	9	45
	1-3 km	6	30
	3-5 km	2	10
	> 5km	3	15
5. Distance between your house and project site	<1 km	8	40
	1-3 km	6	30
	3-5 km	3	15
	> 5km	3	15
6. Do you understand project information, project component, project benefit etc.,?	Yes	13	65
	No	2	10
	Not clear	5	25
7. Do you understand environment impacts of this project?	Yes	12	60
	No	3	15
	Not clear	5	25
8. What are environmental issues of highest concern during construction period?	Surface water	3	15
	Ambient air	2	10
	Noise	6	30
	Dust/PM	1	5
	Ground water	8	40
	Solid waste	0	0
	Traffic problems	0	0
	Ecological environment	0	0
	Other	0	0
9. What are environmental issues of highest concern during operation period?	Surface water	5	25
	Ambient air	1	5
	Noise	7	35
	Dust/PM	1	5
	Ground water	6	30
	Solid waste	0	0
	Ecological environment	0	0
	Other	0	0
10 Based on construction phase mitigation measures proposed in EIA, do you accept the impacts to environment?			

Question	Item	No	% (shading denotes highest ranked)
10.1 Ambient air (PM and dust is included)	Accept	16	80
	Barely accept	3	15
	Do not accept	1	5
	Have no idea	0	0
10.2 Noise	Accept	13	65
	Barely accept	3	15
	Do not accept	2	10
	Have no idea	2	10
10.3 Surface water	Accept	14	70
	Barely accept	4	20
	Do not accept	2	10
	Have no idea	0	0
10.4 Groundwater	Accept	15	75
	Barely accept	2	10
	Do not accept	0	0
	Have no idea	3	15
10.5 Solid waste	Accept	14	70
	Barely accept	2	10
	Do not accept	0	0
	Have no idea	4	20
10.6 Ecological environment	Accept	18	90
	Barely accept	2	10
	Do not accept	0	0
	Have no idea	0	0
10.6 Other (traffic problem and inconvenient by project construction)	Accept	17	85
	Barely accept	3	15
	Do not accept	0	0
	Have no idea	0	0
11 Based on operation phase mitigation measures proposed in EIA, do you accept the impacts to environment?			
11.1 Ambient air (PM and dust is included)	Accept	15	75
	Barely accept	4	20
	Do not accept	0	0
	Have no idea	1	5
11.2 Noise	Accept	16	80
	Barely accept	3	15
	Do not accept	1	5
	Have no idea	0	0
11.3 Surface water	Accept	15	75
	Barely accept	4	20
	Do not accept	1	5
	Have no idea	0	0
11.4 Groundwater	Accept	14	70
	Barely accept	3	15
	Do not accept	0	0
	Have no idea	3	15
11.5 Solid waste	Accept	17	85
	Barely accept	2	10

Question	Item	No	% (shading denotes highest ranked)
	Do not accept	1	5
	Have no idea	0	0
11.6 Ecological environment	Accept	19	95
	Barely accept	0	5
	Do not accept	0	0
	Have no idea	0	0
12. Do you think whether construction of this project can improve local economic development or not?	Yes	18	90
	No	1	5
	Not clear	1	
13. Do you think whether construction of this project can improve your living quality (like better heat and cool supply service) or not?	Yes	17	85
	No	3	15
	Not clear	0	0
14. After comprehensive analysis about advantages and disadvantages of this project, do you agree with the construction of this project?	Yes	18	90
	No	0	0
	Not clear	2	10

EIA = environmental impact assessment, PM = particulate matter.

145. The results in **Table 19** show that there is a very high degree of understanding of, and support for the subproject from residents and farmers living and working near the subproject site. There are some concerns that the subproject may potentially have negative impacts on the surface water, noise and air, but there is also a very high confidence in the mitigation measures that are to be adopted by the project. Overall there was strong (90%) support for the project construction.

A. Future Consultation Activities

146. The subborrower will continue to conduct regular community liaison activities during the construction and operations phases, including the implementation of the grievance redress mechanism (GRM, see Chapter VIII). Ongoing consultation will ensure that public concerns are understood and dealt with in a timely manner.

VIII. GRIEVANCE REDRESS MECHANISM

A. Introduction

147. A project grievance can be defined as an actual or perceived project related problem that gives ground for complaint by an affected person (AP). As a general policy, a Project Management Office (PMO) will be established by the subborrower and will work proactively toward preventing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. In addition, as the subproject has strong public support and will not involve any involuntary land or property acquisition or resettlement, significant grievance is unlikely to happen. Nonetheless, during construction and operation it is possible that unanticipated impacts may occur if the mitigation measures are not properly implemented, or unforeseen issues arise. To address complaints if or when they arise, a subproject GRM will be established in accordance with ADB requirements and GRM requirements as specified in the ESMS for CECEP. A GRM is a systematic process for receiving, recording, evaluating and addressing AP's project-related grievances transparently and in a reasonable timeframe.

B. ADB's GRM Requirements

148. ADB's SPS 2009 requires a project to establish a GRM to receive and facilitate resolution of AP's concerns and complaints about the project's environmental performance during construction and operation phases of the project. The GRM should be scaled to the risks and adverse impacts of the project; should address affected people's concerns and complaints promptly, using an understandable and transparent process; should be readily accessible to all sections of the community at no cost and without retribution; and, should not impede access to the PRC's judicial or administrative remedies.

C. Current GRM Practices in the PRC

149. At the national level, a framework to address grievance has been established. State Council Decree No. 431 "Regulations on Letters and Visits" (January 2005) codifies a complaint mechanism at all levels of government, and safeguards the complainants from any retaliation. MEP's "Decree No. 34 Environmental Letters and Visits System" provides specific guidelines to establish a system and address environmental complaints. When APs are negatively affected by project activities, they may complain to the contractors and the project company by themselves or through their community organizations, or complain directly to local EPBs. If the issue is not resolved they may take legal action, though that is typically considered as a last option.

D. Subproject Level GRM

150. The objective of the subproject GRM is to prevent and address community concerns, reduce risks, and assist the subproject to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the sub-project level GRM has been designed to (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the subproject; (ii) demonstrate concern about community members and their environmental well-being; and (iii) prevent and mitigate any adverse environmental impacts on communities caused by the subproject implementation and operations. The GRM will be accessible to all members of the community.

151. The overall approach of the GRM is to deal with grievances at a local level first in an efficient manner, and escalate to higher level of authority if the grievance cannot be resolved. The designated person from the PMO will be responsible for the implementation of the GRM. The PMO will be the key contact point for residents, businesses, government departments and other stakeholders who may require information about the subproject or who have an issue they would like to discuss.

152. The GRM will be implemented through five steps, advancing to the next level only if the grievance was unable to be redressed at the previous level.

(i) **Step 1**: If a concern arises, the AP should try to resolve the issue of concern either directly with the contractor or with the contactor via GRM access points (community leaders, neighborhood organizations, PMO, local EPB) during the construction phase, and/or the operator during the operation phase. If the concern is resolved successfully, no further follow-up action is required. Nonetheless, the contractor (during construction) and/or the operator (during operation) shall record any complaint and actions taken to resolve the issues and report the results to the PMO. If no solution is found within 10 working days or if the AP is not satisfied with the suggested solution under Step 1, proceed to Step 2. The AP may also skip step 1 and directly file the complaint with PMO.

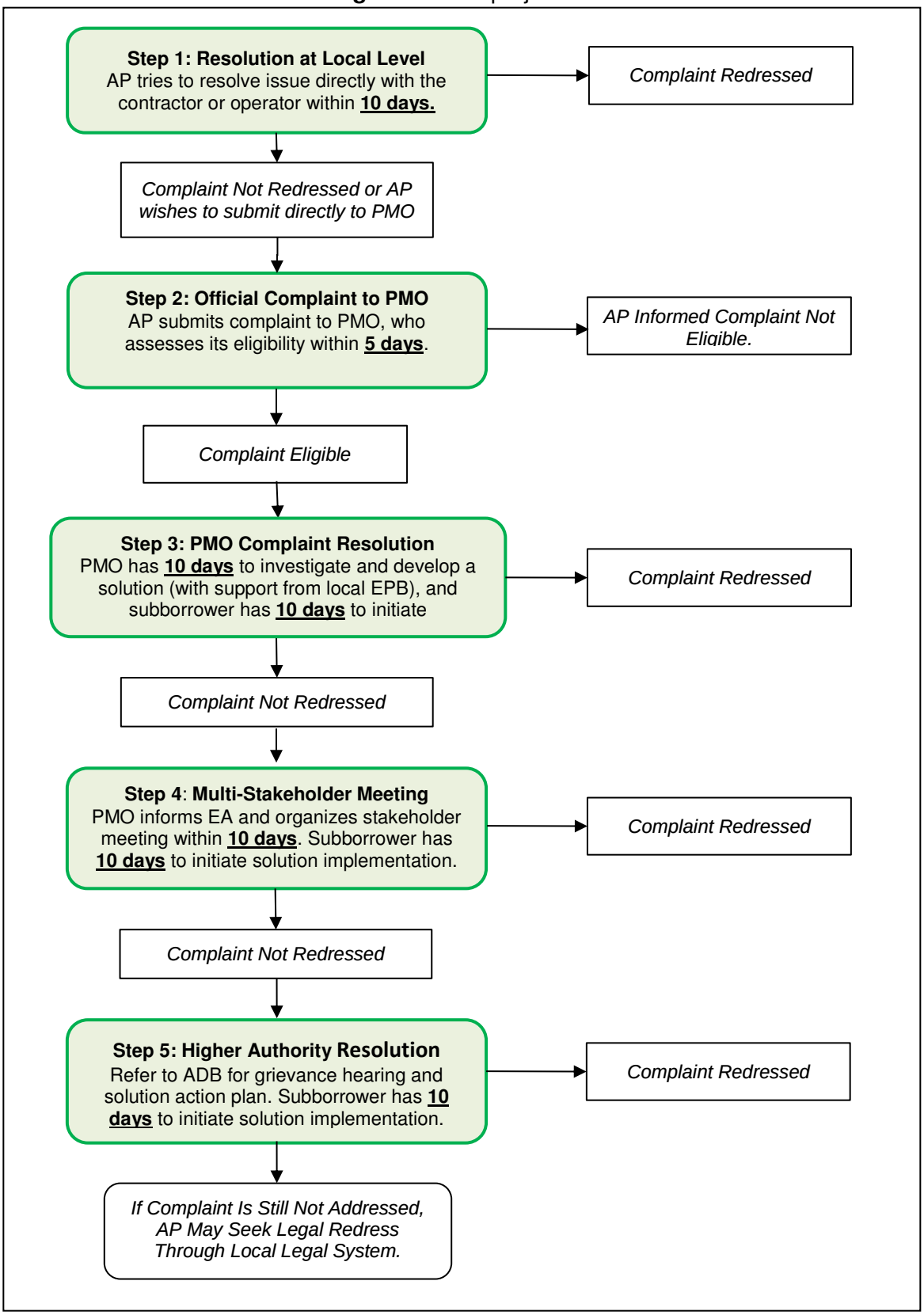
(ii) **Step 2:** The AP will submit the grievance to the PMO, who will record the grievance, assess its eligibility and report back to the AP within 5 working days. If the grievance is eligible, proceed to step 3.

(iii) **Step 3:** The PMO will investigate the complaint, and consult with the subborrower, local EPB, and other stakeholders as appropriate to identify a solution. The PMO will give a clear reply to the AP within 10 working days with the suggested solution, and the subborrower will ensure that implementation of the agreed-upon redress solution begins within 10 working days. If no solution is found or if the complainant is not satisfied with the suggested solution under Step 3, proceed to Step 4.

(iv) **Step 4:** The PMO will inform the EA the grievance, and will organize a multi-stakeholder meeting within 10 days, where all relevant stakeholders, including the complainant, the EA, subborrower, and local EPB can discuss the issue. The multi-stakeholder meeting will aim to find a solution acceptable to all, and identify responsibilities and an action plan. The subborrower will ensure that the implementation of agreed-upon redress solution begins within 10 working days of the completion of the multi-stakeholder meeting.

(v) **Step 5:** If the complainant is still not satisfied with the suggested solution under Step 4, the grievance will be directed to ADB. ADB will direct the EA to organize a hearing process and shall determine a solution acceptable to all. Based on the hearing results, an action plan shall be developed and the subborrower will ensure that the implementation of the agreed-upon redress solution begins within 10 working days of the completion of the hearing.

Figure 15: Subproject GRM



AP = affected person, EPB = environmental protection bureau, PMO = project management office.

IX. CONCLUSIONS

153. The subproject will bring significant positive environmental benefits. The utilization of geothermal as clean heat source will reduce the emissions of greenhouse gases and other air pollutants in Dezhou City. When compared to the equivalent production of energy through traditional coal-fired sources, once operational the subproject will: (i) result in annual energy savings equivalent to 9,843.3 tons of standard coal, thereby providing a global public good by avoiding the annual emissions of 25,789.45 tons of CO_2; (ii) improve local air quality through the estimated annual reduction of emissions of SO_2 by 83.67 tons, NO_x by 72.84 tons, and PM by 2.79 tons.

154. Through the environmental assessment process, it is concluded that the subproject has: (i) selected appropriate technology for district heating and reducing the emission of pollutants; (ii) identified potential negative environment impacts and established mitigation measures; (iii) received public support from the project beneficiaries and affected people; (iv) established subproject GRM procedures; and (v) prepared a comprehensive EMP including environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

155. Based on the analysis conducted, it is concluded that overall the subproject will result in significant positive socioeconomic and environmental benefits, and will not result in significant adverse environmental impacts that are irreversible, diverse, or unprecedented. Overall, any minimal adverse environmental impacts associated with the subproject can be prevented, reduced, or minimized through the appropriate application of mitigation measures. It is therefore recommended that:

(i) the subproject is classified as environment category B;
(ii) the subproject will be supported by ADB, subject to the implementation of the commitments contained in the EMP and allocation of appropriate technical, financial and human resources by the subborrower to ensure these commitments are effectively and expediently implemented.

Appendices

Appendix I: Environmental Management Plan

Appendix II: Questionnaire sample

APPENDIX I: ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

1. The objectives of the EMP are to ensure (i) implementation of identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of monitoring and reporting; and (iii) compliance with the PRC's relevant environmental laws, standards and regulations and ADB's SPS 2009. Organizational responsibilities and budgets are clearly identified for execution, monitoring and reporting.

2. The EMP is to be implemented in all phases of the subproject cycle including– design, pre-construction, construction, and operation. In the detailed design stage the EMP will be used by the design institute for incorporating mitigation measures into the detailed designs The EMP will be updated at the end of the detailed design, as needed.

3. The EMP will be included as a separate annex in all bidding and contract documents. The contractors will be informed of their obligations to implement the EMP, and to provide for EMP implementation costs in their bids for subproject works. The EMP is presented in **Table 1**.

Table 1 Environmental Management Plan

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
Pre-construction phase						
Transportation and mobilization of construction materials and equipment	Dust generation during vehicle movement	(i) Construction material (sand/soil) should be covered while being transported. (ii) Water to be sprinkled as needed. (ii) Emissions from vehicles and equipment should comply with national standards.	Air quality	PRC ambient air quality standards	Subborrower	Subproject design
	Noise generation	(i) Movement of vehicles should be restricted during day time. (ii) Noise levels from vehicles and equipment to comply with noise standards.	Noise levels	PRC noise standards	Subborrower	Subproject design
Encroachment to environmentally sensitive areas	Loss of precious ecosystems/ species	Avoid encroachment by careful site selection.	Loss of floral and faunal habitats	PRC regulations	Subborrower	Detail design
Involuntary resettlement or land acquisition	Loss of lands and structures	Compensation paid for temporary/permanent loss of productive land and structures per PRC regulations	Public complaints	PRC regulations	Subborrower	Prior to construction
Construction phase						
Site Clearance	Loss of flora and fauna	– A greening plan will be implemented. Site vegetation plans will be developed at project site using appropriate native species. – Any existing vegetated areas impacted by the subproject will be restored after construction using appropriate native species.	Subproject construction site	NA	Contractor, subborrower, CECEP	Whole construction stage
Removal of vegetation and drilling	Soil erosion, surface water runoff	– Potential for storm water runoff will be assessed and appropriate storm water drainage systems to minimize soil erosion will be implemented, including perimeter bunds and establishment of temporary detention and settling ponds to control topsoil runoff. – Land excavation and filling will be balanced to minimize the requirement for fill transportation. – During earthworks, the area of soil exposed to potential erosion will be minimized through good construction management. – Water-based drilling technology will be used, thus no oil	Subproject construction site	PRC Control Standards for Soil and Water Loss on Development and Construction Projects (GB50434-2008)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		related material will be released to soil or groundwater. – Reuse of drilling water, where feasible. – Spoils will be reused on-site to the maximum extent feasible as fill. Temporary spoil storage sites will be identified, designed, and operated to minimize impacts. Spoil sites will be restored after the completion of storage activities. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site. – Spoils and aggregate piles will be covered with landscape material and/or regularly watered. – Waste construction materials such as residual concrete, bricks, etc., will be used for backfill at the sites or nearby construction sites to the maximum extent feasible. – Construction and material handling activities will be limited or halted during periods of rains and high winds. – Pipelines will be installed and backfilled in a sequenced section-by-section approach. Open excavation areas during trenching activities will be minimized, and appropriate construction compaction techniques utilized. – Any planned paving or vegetating of areas will be done as soon as practical after the materials are removed to protect and stabilize the soil. – Once construction is completed, disturbed surfaces will be properly sloped and planted with native trees and grass.				
Subproject construction, such as drilling, etc.	Surface and groundwater contamination from construction and domestic wastewater	– Adequate temporary sanitary facilities and ablutions will be provided for construction workers. Toilets will be equipped with septic tanks following PRC standards. Domestic wastewater will be treated in the septic tanks following relevant national standards. – Construction wastewater will be directed to temporary detention and settling ponds. Areas where construction equipment is being washed will be equipped with water collection basins and sediment traps. After settling, supernatant will be recycled and sediment will be periodically excavated, and either reused if possible as fill, disposed at official spoil disposal sites, or disposed at landfills. – Maintenance of construction equipment and vehicles will not be allowed on site to reduce wastewater generation. – Drilling equipment will be cleaned up before drilling to prevent groundwater pollution.	Subproject construction site	PRC's Surface Water Ambient Quality Standards (GB3838-2002)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		– Reuse of drilling water, where feasible.				
Transportation of construction materials, evacuation and drilling	Increase in dust, equipment and vehicle emissions	– Subproject site under construction will be fenced. Fence height will be increased near sensitive locations (residential areas, schools, clinics and hospitals), if any. – Water will be sprayed on active construction sites including where fugitive dust is being generated on a daily basis, and more frequently during windy days. – All construction piles (spoil, aggregate other construction materials) with the potential to generate dust will be covered and/or regularly watered. – Construction activities will be halted during high wind events. Once construction is completed, disturbed surfaces will be properly sloped and planted with native trees and grass. – Transport vehicles will be limited to low speeds in construction sites. – Loads will be covered during truck transportation to avoid spillage or fugitive dust generation. Fine materials will be transported in fully contained trucks. – Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds. – Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical.	Subproject construction site	PRC's Air Pollutant Integrated Emission Standards (GB 16297-1996)	Contractor, subborrower, CECEP	Whole construction stage
Drilling, evacuation, and vehicle movement	Increase in noise levels	– Construction activities, and particularly noisy ones, are to be limited to reasonable hours during the day and early evening. Construction activities will be strictly prohibited during the nighttime (22:00 h to 07:00 h). Exceptions will only be allowed in special cases, and only after getting approval of the surrounding residents, local EPB and other relevant departments. – Simultaneous high-noise activities will be avoided, and high-noise activities will be scheduled during the day rather than evening hours. Construction site will avoid multiple high noise activities or equipment from operating at the same location. – Low-noise equipment will be selected. Equipment and machinery will be equipped with mufflers and will be properly maintained to minimize noise. – Noise PPE will be provided to workers. – Transportation routes and delivery schedules will be planned	Subproject construction site	PRC's Noise Standards for Construction Site Boundary (GB 12523-2011)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		to avoid densely populated and sensitive areas and rush hours. – Vehicles transporting construction materials or waste will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals. – Drilling site will be enclosed by fence to reduce noise, if necessary. – High noise construction activities will be positioned as far away from sensitive sites as possible. Temporary or permanent noise barriers will be installed to protect sensitive sites if necessary. – Noise from cleaning of heating pipelines will be minimized by utilization of low noise valves, mufflers after the valves and sound insulation on the external walls of pipelines.				
Subproject construction	Solid waste generation	– Wastes will be reused or recycled to the extent possible. Waste construction material such as residual concrete, bricks will be used for backfill at the site. – Littering by workers will be prohibited. – Domestic waste containers will be provided at all work sites. Domestic waste will be collected on a regular basis by the local sanitation departments and transported for recycling, reuse, or disposal at a licensed landfill. – Reuse of drilling water, where feasible. – Construction waste dumpsters will be provided at all work sites. Construction waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at a licensed landfill. – Excavated soil will be backfilled to the extent possible. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site. – There should be no final waste disposal on site. Waste burning/incineration at or near the site is strictly prohibited. – Contractors will be held responsible for proper removal and disposal of any residual materials, wastes, and contaminated soils that remain on the site after construction.	Subproject construction site	PRC's Standards for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB 18599-2011)	Contractor, subborrower, CECEP	Whole construction stage
Subproject Construction	Hazardous and Polluting Materials	– A hazardous material handling and disposal protocol that includes spill emergency response will be prepared and implemented by contractors. – Storage facilities for fuels, oil, chemicals, and other hazardous	Subproject construction site	PRC's General Specifications of Engineering and Technology for	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		materials will be within secured areas on impermeable surfaces provided with dikes with a storage capacity of at least 110% of the capacity of the hazardous materials stored, and at least 300 m from drainage structures and important water bodies. A standalone site within the storage facility will be designated for hazardous wastes. – Signs will be placed at chemicals and hazardous materials storage sites to provide information on type and name of chemicals and hazardous materials. – Suppliers of chemicals and hazardous materials must hold proper licenses and follow all relevant protocols and PRC regulations and requirements. – A Dezhou EPB certificated company will be hired to collect, transport, and dispose of hazardous materials.		Hazardous Waste Disposal (HJ 2042 -2014)		
Vehicle movement and other construction activities	Community Disturbance and Safety	– Traffic control plans, agreed to by the local traffic control authority, will be developed and implemented to minimize community disturbance. – Luhai will inform residents, institutions, business and other affected parties the planned construction activities including schedule and duration of construction works, and expected traffic and other disruptions. – Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and rush hours. – Warning signs will be placed at construction sites in clear view of the public. All sites will be made secure, discouraging access by members of the public through appropriate fencing whenever appropriate. – Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals. – Roadside earthworks should be completed as quickly as possible, and all spoil either backfilled or removed. – Public access to construction sites and other areas of danger will be restricted. – Local authorities will be consulted to minimize disruption of public services such as telephone, water, gas and power supply. Contactors will use good construction practices to avoid disruption of other services.	Subproject construction site	NA	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		– Contractors will take measures to minimize disruption of access to private properties and businesses. – Temporary access to affected private properties, businesses and public service buildings will be provided including temporary crossings over pipeline trenches, and subsequently good quality permanent access will be provided. – Pipelines construction should be planned to take place simultaneously with other construction activities to minimize the length of disruption.				
Subproject construction	Risk to workers	– Each contractor will implement construction phase EHS plan. – Identify and minimize the causes of potential hazards to workers. Implement appropriate safety measures. – Provide training to workers on occupational health and safety, emergency response, especially with respect to using potentially dangerous equipment and storage, handling and disposal of hazardous waste. – Ensure that all equipment is maintained in a safe operating condition. – Provide appropriate PPE to workers. – Implement work practices to limit workers' exposure to high noise or heat working environments. – Ensure regular safety meetings with staff. – Ensure that material stockpiles or stacks, such as, pipes are stable and well secured to avoid collapse and possible injury to workers.	Subproject construction site	PRC Noise Standards for Construction Sites (GB 12523-2011)	Contractor, subborrower, CECEP	Whole construction stage
Evacuation, earthworks, and drilling	Damage to PCRs	– Construction activities will be immediately suspended if any PCRs are encountered. – Destroying, damaging, defacing, or concealing PCRs will be strictly prohibited in accordance with PRC regulations. – Local Cultural Heritage Bureau will be promptly informed and consulted. – Construction activities will resume only after thorough investigation and with the permission from the local Cultural Heritage Bureau.	Subproject construction site	NA	Contractor, subborrower, CECEP	Whole construction stage
Operation phase						
Subproject operation	Discharge of Production and Domestic	– Wastewater from canteen will be treated by oil-separator, and discharged to municipal sewer combined with domestic wastewater.	Subproject operation site	PRC's Integrated Sewage Discharge	Subborrower, CECEP	Whole operation stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
	Wastewater	– Production wastewater will be discharged to municipal sewer through the pipelines. – Groundwater discharge is prohibited.		Standard (GB8978-1996)		
Subproject operation	Solid Waste generation	– Domestic waste bins will be provided and domestic waste will be routinely collected by the local sanitation department for recycling, if possible, or final disposal at an approved waste disposal site. – No permanent on-site solid waste disposal will be permitted at the subproject site. – No burning of wastes will be permitted at the subproject site. – Waste resin and waste filter material will be collected, transported and treated by a certificated third company.	Subproject operation site	PRC's Standards for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB 18599-2011)	Subborrower, CECEP	Whole operation stage
Equipment operation	Increase in noise level	– Low-noise equipment will be used and noise reduction measures such as noise elimination, shock absorption, insulated enclosures and sound dampening materials on exterior walls will be implemented. – All equipment will be properly maintained to minimize noise. – Appropriate noise PPE will be provided to the workers who are likely to be exposed to high noise level environments. – Layout for heat exchange stations will be reasonable planned to reduce noise.	Subproject operation site	PRC's Industrial Enterprise Boundary Noise Emission Standard (GB12348-2008)	Subborrower, CECEP	Whole operation stage
Subproject operation	Risks to workers and community	– Operation phase EHS plans will be developed and implemented and workers will be trained regularly. – Regular maintenance of wellheads and geothermal fluid pipelines, including corrosion control and inspection; pressure monitoring; and use of blowout prevention equipment such as shutoff valves; – Design of emergency response for well blowout and pipeline rupture, including measures for containment of geothermal fluid spills; – PPE including goggles, gloves, safety shoes, will be provided to workers. – Provide training to workers on occupational health and safety, emergency response. – Production and disposal well will be fenced with warning signs. Access to heat exchange stations will be strictly limited to staff.	Subproject operation site	NA	Subborrower, CECEP	Whole operation stage

CECEP = China Energy Conservation and Environmental Protection Group, EPB = environmental protection bureau, Luhai = Shandong Luhai Petroleum Technology Co., Ltd., NA = not applicable, PRC = People's Republic of China.

B. Implementation Arrangements

4. CECEP will be the executing agency (EA) and the implementing agency (IA). CECEP Huayu Fund Management Co. Ltd. (CECEP Huayu) will manage the Loan. The EA will establish a Project Management Office (PMO) including an Environment Officer and a Social Officer.

5. The EA will retain an environmental expert if needed to provide support to the PMO in mitigation implementation, environmental monitoring, reporting, and addressing any environment related issues that arise including grievances. The environmental expert will also support contractors in developing Contractor Environmental Management Plans (CEMP) and associated subplans prior to construction and operation.

6. The PMO Environment Officer will be responsible for regular internal inspections of mitigation measures at the construction site, in accordance with the Environmental Monitoring Plan (EMoP). A third party environmental monitoring entity will be engaged by the subborrower and will undertake construction and operation phase ambient environmental monitoring as per the EMoP.

7. The contractor will be responsible for implementing relevant mitigation measures during construction. Following the award of each construction contract, the contractor will prepare the CEMP and associated subplans which detail the means by which the Contractor will comply with the EMP. The Contractor will identify a lead focal point for environmental issues (e.g. Chief Site Engineer), will implement the CEMP, and will take all reasonable measures to minimize the impact of construction activities on the environment. The Contractor will also submit monthly environmental records to the PMO on EMP implementation, including the EMoP. They are also required to report any spills, accidents, and grievances received, and any actions taken. The PMO Environmental Officer will prepare and submit semi-annual and annual environmental monitoring reports to CECEP.

8. CECEP will visit the subproject site regularly to ensure that the EMP and EMoP are properly implemented. CECEP will review the semi-annual and annual environmental monitoring reports submitted by the PMO Environmental Officer and consolidate them with the reports from other subborrowers. CECEP will submit the consolidated semi-annual and annual environmental monitoring reports to ADB as specified in the ESMS.

9. ADB will conduct due diligence of environment issues during the subproject review missions. ADB will review the semi-annual and annual environmental monitoring reports submitted by CECEP and will disclose them on its website. If the PMO fails to meet safeguards requirements described in the EMP, CECEP/ADB will seek corrective measures and advise the PMO on items in need of follow-up actions.

10. The subproject implementation organization and the roles and responsibilities of the participating agencies are presented in **Table 2**.

Table 2: Project implementation and management organizations

Organization	Role and Responsibility
CECEP	- Will serve as the EA/IA and project contact point for ADB. - Responsible for coordinating project implementation activities among government agencies such as finance bureau, development and reform commission, environmental protection bureau, water resources bureau, agriculture and forestry bureau, livestock and land resource bureau. - Coordinating the activities of and meeting the requirements of the ADB visiting missions.

Organization	Role and Responsibility
CECEP Huayu	On behalf of the executing agency, a PMO will be including a safeguard unit with suitably qualified and experienced full time staff. PMO will be responsible for all project organization and implementation activities, including the following: - Formulating the subproject management and operating procedures, implementation plans, and budgets. - Ensuring project's compliance with loan and project agreements and with the safeguards requirements as specified in the ESMS. - Managing the activities of the design institutes, procurement agents, and consultants in accordance with government and ADB regulations. - Communicating and coordinating with concerned offices and with external contacts. - Taking part in capacity development and training. - Overseeing the implementation of different project outputs. - Monitoring the subproject's physical and financial progress and compliance with project's reporting requirements, ensuring project progress reports are prepared and submitted to ADB on time. - Addressing complaints received from APs. - Organizing project acceptance verification. - Coordinating the activities of and meeting the requirements of ADB review missions. - Supervising the implementation of EMP and EMoP. - Conducting regular site visits and safeguard review missions in accordance with the requirements set forth in the ESMS. - Preparing and submitting consolidated semi-annual and annual environmental monitoring reports as required by the ESMS to ADB. - Requiring subborrowers to prepare corrective action plans in the event of noncompliance with EMP or EMoP.
Subborrower	Main responsibilities include: - Contracting and administering contractors and suppliers. - Supervising construction and monitoring quality control. - Ensuring compliance with EMP, EMoP, and engaging external environmental safeguard consultant if needed. - Monitoring project's physical and financial progress and preparing regular progress reports to the PMO. - Testing and commissioning of completed project facilities. - Identifying and implementing O&M arrangements. - Coordinating with and assisting the PMO in developing project management procedures and detailed implementation plan, and monitoring achievement thereof. - Arranging the commissioning of the constructed facilities. - Preparing progress reports for submission to the executing agency and/or PMO. - Preparing semi-annual and annual environmental monitoring reports and submitting to PMO.
Environmental Monitoring Company	A qualified independent environmental monitoring company will be recruited to implement the ambient monitoring portion of the EMoP.
ADB	Responsible for the following: - Providing the EA/IA and PMO with guidance to ensure smooth project implementation and achieve the desired development impacts and their sustainability. - Conducting regular review missions. - Monitoring the implementation of EMP and EMoP. - Monitoring status of compliance with loan and project covenants, including safeguards. - Reviewing environmental monitoring reports and disclosing them on ADB website. - Regularly updating the subproject information documents for public disclosure at ADB web site, including the safeguards documents. - Requiring CECEP Huayu to develop corrective action plan for any non-compliance issues.

ADB = Asian Development Bank, AP = affected person, CECEP = China Energy Conservation and Environmental Protection Group, CECEP Huayu = CECEP Huayu Fund Management Co. Ltd., EA = executing agency, EMP = Environmental Management Plan, EMoP = environmental monitoring plan, ESMS = environmental and social management system, IA = implementing agency, O&M = operation and maintenance, PMO = project management office.

C. Potential Impacts and Mitigation Measures

11. The potential impacts of the project during pre-construction, construction and operation have been identified and mitigation measures developed (see Chapter V of the IEE and **Table 1** of Appendix).

D. Environment Monitoring Plan

12. An EMoP to monitor the environmental impacts of the subproject and assess the effectiveness of mitigation measures is presented in **Table 3.** The EMoP includes both compliance inspection undertaken by the PMO Environment Officer, and ambient air, noise, and wastewater monitoring undertaken by a third party environmental monitoring entity. Ambient monitoring will be conducted in compliance with relevant PRC regulations, methods and technical specifications.

13. The data and results of environmental compliance inspection and monitoring activities will be used to assess: (i) the extent and severity of actual environmental impacts against the predicted impacts and baseline data collected before the subproject implementation; (ii) performance or effectiveness of environmental mitigation measures or compliance with pertinent environmental rules and regulations; (iii) trends in impacts; (iv) overall effectiveness of EMP implementation; and (v) the need for additional mitigation measures and corrective actions if non-compliance is observed.

E. Institutional Strengthening and Capacity Building

14. The institutional strengthening and capacity building focuses on the safeguards requirements of relevant PRC laws and regulations and the ADB' SPS 2009. The training will focus on the ADB SPS 2009; PRC safeguard requirements; development and implementation of EHS plans during construction and operation; implementation of the EMP, the EMoP, and the GRM; and worker and community health and safety issues and measures (**Table 3**)**.**

Table 3: Environmental Monitoring Plan (EMoP)

Subject	Parameter	Location	Frequency	Implemented by	Supervised by
A. Construction Phase					
Erosion, Borrow and Spoil	Compliance inspection of implementation of erosion and stormwater control measures	Construction sites, spoil disposal sites	Monthly during construction stage; and once after completion of spoil disposal	Contractor and subborrower	PMO and CECEP
Air Pollution	Ambient dust monitoring (TSP, PM_{10}, $PM_{2.5}$)	Construction site	Quarterly during construction stage	third party environmental monitoring entity	PMO and CECEP
	Compliance inspection of implementation of air pollution control measures	Construction site	Monthly during construction stage	Contractor and subborrower	PMO and CECEP
Wastewater	Compliance inspection of implementation of wastewater management measures	Construction site	Monthly during construction stage	Contractor and subborrower	PMO and CECEP
Noise	Ambient noise monitoring (day and night Leq dB(A))	Construction site	Quarterly during construction stage	third party environmental monitoring entity	PMO and CECEP
Solid Waste	Compliance inspection of implementation of solid waste management measures	Waste collection and disposal sites.	Monthly during construction season	Contractor and subborrower	PMO and CECEP
Hazardous and Polluting Materials	Compliance inspections of implementation of hazardous materials management measures	Storage facilities for fuels, oil, chemicals and other hazardous materials. Vehicle and equipment maintenance areas.	Monthly during construction stage	Contractor and subborrower	PMO and CECEP
Flora and Fauna	Compliance inspection of land clearing to ensure mitigation measures are being implemented	Construction site	Monthly during construction stage	Contractor and subborrower	PMO and CECEP

Subject	Parameter	Location	Frequency	Implemented by	Supervised by
Socioeconomic Impacts	Compliance inspection of implementation of traffic control measures	Construction site roads. Transportation routes.	Monthly during construction stage	Contractor and subborrower	PMO and CECEP
	Compliance inspection of implementation of Occupational and Community Health and Safety measures and an Emergency Response Plan	Construction site	Monthly during construction stage	Contractor	PMO and CECEP
B. Operation Phase					
Wastewater	Compliance insertion during operation phase of waste water management measures implementation	Project site	Semi-annual	Subborrower	PMO and CECEP
Solid Waste	Compliance insertion during operation phase of solid waste management measures implementation	Project site	Semi-annual	Subborrower	PMO and CECEP
Hazardous and Polluting Materials	Compliance inspection during operation phase of hazardous materials management	Project site	Semi-annual	Subborrower	PMO and CECEP
Health and Safety and Emergency Response	Compliance inspection during operation phase of occupational and community health and safety management measures and an Emergency Response Plan implementation	Project site	Semi-annual	Subborrower	CECEP

Table 4: Institutional strengthening and training program

Training Topic	Trainers	Attendees	Contents	Times	Days	# Persons	Budget (USD)
Construction Phase Environment, Health and Safety Training	Qualified environment expert	Contractors, PMO, subborrower	**ADB and PRC laws, regulations and policies** – ADB's safeguard policy statement – Project applicable PRC environmental, health and safety laws, policies, standards and regulations – International environmental, health and safety management practice in civil irrigation and drainage construction **GRM** – GRM structure, responsibilities, and timeframe – Types of grievances and eligibility assessment **Implementation of Construction Phase EMP** – Impacts and mitigation measures – Monitoring and reporting requirements – Non-compliance and corrective actions	3 (once prior to start of construction, and then once during years 2 to 3)	2	30	**Training Development** Fixed costs: $2,000 per course delivery x 3 = $ 6,000
Operation Phase Environment, Health and Safety Plan Training	Qualified environment expert	PMO, subborrower	**ADB and PRC laws, regulations and policies** – ADB's safeguard policy statement – Project applicable PRC environmental, health and safety laws, policies, standards and regulations – International environmental, health and safety management practice in civil irrigation and drainage operation **GRM** – GRM structure, responsibilities, and timeframe – Types of grievances and eligibility assessment **Implementation of Operation Phase EMP** – Impacts and mitigation measures – Monitoring and reporting requirements – Non-compliance and corrective actions	3 (once prior to start of operation, and then once during years 2 and 3)	2	30	**Training Development** Fixed costs: $2,000 per course delivery x 3 = $6,000
			Total	**6**		**60**	**$12,000**

ADB = Asian Development Bank, EMP = environmental management plan, GRM = grievance redress mechanism, PMO = project management office, PRC = People's Republic of China.

F. Reporting Requirements

15. The subborrower will submit semi-annual environmental monitoring reports during construction phase and annual reports operation phase to the CECEP on the implementation and compliance with loan covenants and EMP, including information on all spills, accidents, grievance received, and appropriate actions taken.

16. CECEP will review these reports and consolidate them with the environmental monitoring reports from other subborrowers and submit to ADB.

17. The environmental reporting requirements are summarized in the **Table 5**.

Table 5: Reporting Requirements

Report	Prepared by	Submitted to	Frequency
A. Construction Phase			
Environmental monitoring reports	Subborrower	CECEP reviews and submits to ADB	Semi-annually
B. Operation Phase			
Environmental monitoring report	Subborrower	EA reviews and submits to ADB	Annually

ADB = Asian Development Bank, CECEP = China Energy Conservation and Environmental Protection Group, EA = executing agency.

G. Performance Indicators

18. Performance indicators (**Table 6**) have been developed to assess the implementation of the EMP. These indicators will be used to evaluate the effectiveness of environmental management.

Table 6: Performance Indicators

No.	Description	Indicators
1	Staffing	(i) PMO established with appropriately qualified staff including Environment Officer. (ii) Appropriately qualified environmental expert recruited if needed. (iii) Third party environmental monitoring entity engaged.
2	Budgeting	(i) Environment mitigation cost during construction and operation is sufficiently and timely allocated. (ii) Environment monitoring cost is sufficiently and timely allocated. (iii) Budget for capacity building is sufficiently and timely allocated.
3	Monitoring	(i) Compliance monitoring is conducted by Subborrower as per EMoP. (ii) Construction and operation phase ambient and effluent monitoring is conducted by third party environmental monitoring entity.
4	Supervision	(i) CECEP to review the implementation of EMP; (ii) ADB reviews consolidated environmental monitoring reports.

No.	Description	Indicators
5	Reporting	(i) Semi-annual environmental monitoring reports during construction phase and annual reports during operation phase prepared by the subborrower are submitted to CECEP.
6	Capacity Building	(i) Training on ADB safeguard policy, EMP implementation, and GRM is provided during subproject implementation.
7	Grievance Redress Mechanism	(i) GRM contact persons are designated at the subborrower and the PMO, and GRM contact information disclosed to the public before construction. (ii) All complains are recorded and processed within the set time framework in the GRM of this IEE.
8	Compliance with PRC standards	(i) Project complies with the PRC's environmental laws and regulations and meets all required standards.

ADB = Asian Development Bank, CECEP = China Energy Conservation and Environmental Protection Group, EMP = environmental management plan, EMoP = environmental monitoring plan, IEE = initial environmental examination, PMO = project management office.

H. Estimated Budget for EMP Implementation

19. The estimated budget for EMP implementation of the subproject is presented in **Table 7**. Costs are presented for mitigation implementation, ambient monitoring, capacity building, and GRM implementation. The costs do not include salaries of PMO staff.

I. Mechanisms for Feedback and Adjustment

20. The effectiveness of mitigation measures and monitoring plans will be evaluated through a feedback reporting system. If, during compliance inspections and monitoring, substantial deviation from the EMP is observed, PMO will consult with the CECEP and propose appropriate corrective action plan.

21. Any major EMP adjustments will be subject to ADB review and approval and ADB may pursue additional environmental assessment and, if necessary, further public consultation. The revised EMP with ADB confirmation is subject to reposting on the ADB's website as the ADB public communications policy requires. The revised EMP will be passed on to the subborrower for implementation.

Table 7: Estimated Budget for Implementing EMP

Construction Phase							
1. Ambient Monitoring	**Unit**	**Unit Cost**	**# Times**	**Cost USD**		**Cost RMB**	**Source of Funds**
Air - TSP	Quarterly	$ 300	12	$ 3,600		¥24,512	Counterpart Financing
Noise	Quarterly	$ 200	12	$ 2,400		¥16,342	
Subtotal				***$ 6,000***		***¥40,854***	
2. Capacity Building	**Unit**	**Course Cost**	**# Times**	**Cost USD**		**Cost RMB**	
Construction Phase HSE Plan Development and Training	HSE Plan Development	$ 2,000	4	$ 8,000		¥54,472	Counterpart Financing
	HSE Course Development	$ 2,000	1	$ 2,000		¥13,618	
	HSE Course Delivery	$ 4,000	1	$ 4,000		¥27,236	
Subtotal				***$ 14,000***		***¥95,326***	
TOTAL Construction Phase				***Cost USD***		***Cost RMB***	
				$ 20,000		***¥136,180***	
Operation Phase (first 2 years)							
	Unit	**Unit Cost**	**# Times**	**Cost USD**		**Cost RMB**	Counterpart
1. Ambient Monitoring	**Unit**	**Unit Cost**	**# Times**	**Cost USD**		**Cost RMB**	
Noise	Seasonal Sampling	$ 200	4	$ 800		¥5,447	Counterpart Financing
Wastewater	Seasonal Sampling	$ 150	4	$ 600		¥4,085	
Subtotal				***$ 1,400***		***¥9,533***	
2. Capacity Building	**Unit**	**Course Cost**	**# Times**	**Cost USD**		**Cost RMB**	
Operation Phase HSE Plan Development and Training	HSE Plan Development	$ 2,000	4	$ 8,000		¥54,472	Counterpart Financing
	HSE Course Development	$ 2,000	1	$ 2,000		¥13,618	
	HSE Course Delivery	$ 4,000	1	$ 4,000		¥27,236	
Subtotal				***$ 14,000***		***¥95,326***	
TOTAL Operation Phase				***Cost USD***		***Cost RMB***	
				$ 15,400		***¥104,859***	
GRAND TOTAL Construction + Operation				***Cost USD***		***Cost RMB***	
				$ 35,400		***¥241,039***	

APPENDIX II: QUESTIONNARE SAMPLE

姓 名	刘文	性 别	女	年 龄	28
民 族	汉	文化程度	大专	职 业	个体
单 位				联系方式	

一、在回答下列问题时，请用√标出您的选择

1. 您认为你生活区域周围最主要的环境污染是（多选）：

A 地表水　　B 环境空气　　C 噪声　　D 地下水

E 固体废弃物　　F 其它，请注明 E

2. 在参加本次活动之前，您是否知道本项目？

A.知道　　B.不知道

3. 如果您了解本项目，您是通过何种渠道了解本项目的信息？

A. 报纸　　B. 网络　　C. 标牌宣传　　D. 民间渠道　　E. 其它

4. 您的工作地点与本项目的距离？

A. 1km 以内　　B. 1～3km　　C. 3～5km　　D. 5km 以外

5. 您的居住点与本项目的距离？

A. 1km 以内　　B. 1～3km　　C. 3～5km　　D. 5km 以外

6. 通过介绍，您是否了解本项目的相关信息如项目建设内容，环境影响和环保措施等？

A.知道　　B.不知道　　C. 不太清楚

7. 通过介绍，您是否了解本项目对环境的影响

A.知道　　B.不知道　　C. 不太清楚

8. 经介绍后，您认为本项目在建设期间的主要环境影响是

A 地表水　　B 地下水　　C 噪声　　D 环境空气，如扬尘

E 固体废弃物　　F 交通问题　　G 生态环境　　H 其它

9. 您认为本项目在运营期间的主要环境影响是

A 地表水　　B 地下水　　C 噪声　　D 环境空气，如粉尘/颗粒物

E 固体废物　　F 生态环境　　G 其它

10. 在了解项目建设期间要实施的环保措施后，您是否接受本项目建设期对环境的影响

10.1 环境空气（包括扬尘，颗粒物污染）

A. 接受　　B. 基本接受　　C. 接受　　D. 不清楚

10.2 噪声

A. 接受　　B. 基本接受　　C. 接受　　D. 不清楚

10.3 地表水

A. 接受　　B. 基本接受　　C. 接受　　D. 不清楚

10.4 地下水

A. 接受　　B. 基本接受　　C. 接受　　D. 不清楚

10.5 固体废弃物

A. 接受　　B. 基本接受　　C. 接受　　D. 不清楚

10.6 生态环境

A. 接受　　B. 基本接受　　C. 接受　　D. 不清楚

10.7 其它（项目建设带来的交通问题和出行的不便利）

A. 接受　　B. 基本接受　　C. 接受　　D. 不清楚

11. 了解项目运营期间要实施的环保措施后，您是否接受本项目运营期对环境的影响

11.1 环境空气（包括粉尘，颗粒物污染）

A. 接受　　B. 基本接受　　C. 接受　　D. 不清楚

11.2 噪声

A. 接受　　B. 基本接受　　C. 接受　　D. 不清楚

11.3 地表水

A. 接受　　B. 基本接受　　C. 接受　　D. 不清楚

11.4 地下水

A. 接受　　B. 基本接受　　C. 接受　　D. 不清楚

11.5 固体废弃物

A. 接受　　B. 基本接受　　C. 接受　　D. 不清楚

11.6 生态环境

A. 接受　　B. 基本接受　　C. 接受　　D. 不清楚

12. 您认为本项目的建设能否促进当地的经济发展？

A.会　　B.不会　　C.说不清

13. 您认为本项目的建设能否改善您的生活质量（如更好的供热供冷服务）

A.会　　B.不会　　C.说不清

14. 综合利弊后，您是否赞成本项目的开工建设？

A.赞成　　B.不赞成　　C.说不清

二、您对本项目有何要求和建议？

建议改善取暖方式，节能、减排，保护环境。

三、您对本项目的环境保护有何要求和建议？

建议减少噪声，不要对居民生活有影响

四、这部分可以放入项目信息，环境影响和环保措施（可删除）。

Initial Environmental Examination (Draft)

November 2017

People's Republic of China: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility (Super ESCO Subproject)

Prepared by China Energy Conservation and Environmental Protection Group for the Asian Development Bank

CURRENCY EQUIVALENTS

(as of 7 November 2017)

Currency unit	–	yuan (CNY)		
CNY1.00	=	$0.1514	or	€0.1299
$1.00	=	CNY6.6045	or	€0.8578
€1.00	=	CNY7.6995	or	$1.1658

ABBREVIATIONS

ADB	Asian Development Bank
AP	Affected Person
AQI	Air Quality Index
CECEP	China Energy Conservation and Environmental Protection Group
CNG	Compressed Natural Gas
EA	Executing Agency
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMC	Energy Management Contracting
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EPB	Environmental Protection Bureau
ESCO	Energy Service Company
ESMS	Environment and Social Management System
FSR	Feasibility Study Report
GDP	Gross Domestic Product
GHG	Green House Gas
GIP	Good International Practice
GRM	Grievance Redress Mechanism
IA	Implementing Agency
IEE	Initial Environmental Examination
IT	Interim Target
MAC	Maximum Acceptable Concentration
MEP	Ministry of Environmental Protection
MSDS	Material Safety Data Sheet
PCR	Physical Cultural Resources
PPE	Personnel Protective Equipment
PPTA	Project Preparatory Technical Assistance
PRC	People’s Republic of China

SPS	Safeguard Policy Statement, ADB
TA	Technical Assistance
TSP	Total Suspended Particulates
WB	World Bank
WHO	World Health Organization
WWTP	Waste water treatment plant

WEIGHTS AND MEASURES

BOD_5	Biochemical Oxygen Demand, five days
$CaCO_3$	Calcium Carbonate
cm	Centimeter
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
dB(A)	A-weighted sound pressure level in decibels
DO	Dissolved Oxygen
kg	Kilogram
km	Kilometer
kWh	Kilowatt Hour
Leq	Equivalent Continuous Noise Level
m	Meter
m/s	Meters per Second
m^2	Square Meters
m^3	Cubic Meters
mg/l	Milligrams per Liter
mg/m^3	Milligrams per Cubic Meter
$\mu g/m^3$	Micrograms per Cubic Meter
NO_x	Nitrogen Oxides
^oC	Degrees Celsius
O_3	Ozone
Pa	Pascal
pH	A measure of the acidity or alkalinity of a solution
PM	Particulate Matter
PM_{10}	Particulate Matter smaller than 10 micrometers
$PM_{2.5}$	Particulate Matter smaller than 2.5 micrometers
SO_2	Sulfur Dioxide
t/h	Tons per Hour

NOTES

(i) In this report, "$" refers to US dollars.

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EXECUTIVE SUMMARY

A. Introduction

1. This is the Initial Environmental Examination (IEE) report for Super ESCO Subproject of proposed People's Republic of China (PRC): Air Quality Improvement in the Greater Beijing–Tianjin–Hebei (BTH) Region—Regional Emission-Reduction and Pollution-Control Facility.

2. The subproject includes a series of energy service company (ESCO) subprojects in An Steel Company which are: (i) waste heat recovery from flue gas of heating furnace at Chaoyang Steel Plant; (ii) industrial waste heat recovery for residential district heating in Anshan; (iii) reconstruction of 100-ton mechanical vacuum degassing in Anshan; (iv) energy-saving reconstruction on high-pressure quenching water pump at Bayuquan Heavy Plate Mill; (v) draft fan frequency adjustment at Bayuquan Pelletizing Plant; (vi) water pump energy-saving reconstruction at Anshan Steel Plant; (vii) energy-saving reconstruction on circulating water pump and engine of blasting furnace at Anshan Steel Plant.

B. Policy, Legal and Administrative Framework for Environmental Impact Assessment

3. Environmental impact assessment (EIA) procedures have been established in the PRC for over 20 years. Domestic EIA studies are required to be undertaken by relevant PRC environmental laws and regulations. National and local legal and institutional frameworks for EIA review and approval ensure that proposed projects are environmentally sound, designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environment, health, social, or safety hazards.

4. Following ADB's Safeguard Policy Statement (SPS 2009), an Environmental and Social Management System (ESMS) for the Financial Intermediaries (FI) Loan has been established to provide the screening, categorization, and review procedures for subproject selection. In implementing this FI Loan, subprojects are required to follow the screening and categorization procedures set out in the ESMS. The Super ESCO subproject has been classified as environment category B following SPS 2009 and the ESMS, and an IEE including an Environmental Management Plan (EMP) is required.

C. Implementation Arrangements

5. Ansteel Energy Service Co., Ltd. (Ansteel ESCO) will be the subborrower and responsible for day-to-day management during subproject preparation and implementation. China Energy Conservation and Environmental Protection Group (CECEP) will be the executing agency (EA) and the implementing agency (IA) and responsible for overall guidance during subproject preparation and implementation.

D. Description of the Environment

1. Location and Topography

6. The subproject is located in Anshan City, Chaoyang City, and Bayuquan District of Yingkou City in Liaoning Province. Anshan is located in central area of Liaoning Province. Sited on the edge of the Liao River plains, Anshan has wide flat lands in the west and central regions that develop into hilly and mountainous terrain on the eastern fringes. The area is rich in mineral

resources including iron ore, coal, magnesite, talcum and jade. The plains of western Anshan are good for agriculture. The large flat fields make it ideal for modern agriculture. In total, Anshan contains 24,480 hectares of arable land accounting for 26.4% of the total land area.

2. Meteorology and Climate

7. Anshan has a monsoon-influenced humid continental climate (Köppen *Dwa*) characterized by hot and humid summers due to the monsoon, and rather long, cold, and very dry winters due to the Siberian anticyclone. The four seasons are distinctive. Nearly half of the annual rainfall occurs in July and August. The monthly 24-hour average temperatures range from −8.6 °C in January to 25.0 °C in July, while the annual mean temperature is 9.60 °C. Sunshine is generous and amounts to 2,543 hours annually, while the relative humidity averages 58%, ranging from 47% in March and April to 75% in July and August. Extreme temperatures have ranged from −26.9 °C up to 36.5 °C. The annual average precipitation in Anshan from 1971-2011 was 712 mm, of which 61.0 % occurs in the June to August period. The lowest recorded annual precipitation was 384.8 mm in 1989 and the highest was 1,042 mm in 1986.

8. Chaoyang has a rather dry, monsoon-influenced humid continental climate (Köppen Dwa), with cold but very dry winters, and hot, humid summers; spring and autumn are relatively brief. The monthly 24-hour average temperature ranges from −9.7 °C in January to 24.8 °C (76.6 °F) in July, for an annual average of 9.04 °C. A majority of the annual rainfall occurs in July and August alone. Due to the aridity, diurnal temperature variation is large, especially during spring and autumn, and averages 13.3 °C annually. With monthly percent possible sunshine ranging from 50% in July to 71% in January, the city averages 2,748 hours of bright sunshine annually.

9. Yingkou has a four-season humid continental climate (Köppen Dwa) with strong monsoonal influences. Though the climate is somewhat tempered by the city's location on the Bohai Gulf, winters are long, windy, cold but dry, and summers are hot and humid. The monthly 24-hour average temperature ranges from −8.5 °C in January to 25.0 °C in July, while the annual mean is 9.48 °C. Precipitation is somewhat enhanced by the coastal location, with a majority of the annual rainfall occurring in July and August alone. With monthly percent possible sunshine ranging from 51% in July to 68% in three months, the city receives 2,774 hours of bright sunshine annually.

3. Water Resources

10. There are 35 rivers in Anshan. The six big rivers in Anshan are Liao River mainstream, Hun River, Taizi River, Raoyang River, Daliao River and Dayang River. The total length of rivers in Anshan is 1,421.6 km. In 2016, Anshan city has 3.4 billion m^3 of water resources with per capita of 983 m^3.

11. There are 69 rivers in Chaoyang with a water area of 19,777 km^2. The four major rivers in Chaoyang are Daling River, Xiaoling River, Qinglong River and Laoha River. The total length of rivers in Chaoyang is 2,560 km. In 2016, Chaoyang city has 1.359 billion m3 of water resources and 398 m^3 per capita. In 2016, gross storage capacity of Chaoyang was 4.99 billion m^3. In 2016, total water supply in Chaoyang was 4.606 billion m^3, in which 13.3% was from surface water, 85.7% was from ground water and 1.0% was from wastewater recycle.

12. There are 113 rivers in Yingkou with a water area of 414 km^2. The ten major rivers in Yingkou are Daliao River, Daqing River, Huzhuang River, Xiongyuei River, Fudu River, Dahan River, Sha River, Laodong River, Minxing River and Biliu River. The total length of rivers in

Yingkou is 1,801.4 km. In 2016, Yingkou city has 1.05 billion m3 of water resources and 453 m^3 per capita.

(i) Ecological and Sensitive Resources

13. The subproject site is located in existing Anshan Steel Plant, Ansteel Bayuquan Steel Plant and Ansteel Chaoyang Steel Plan which are highly developed and modified industrial areas. Surrounding land use is industrial land with little or no vegetation cover. There are no known rare or endangered flora or fauna, parks, nature reserves or areas with special national, regional or local ecological significance within or adjacent to the subproject site

5. Socioeconomic Conditions

14. The northeast China is a major industrial zone and Anshan is one of the key industrial areas in the northeast region. The city is renowned as "China's capital of iron and steel". Prior to the development of the iron and steel industries, Anshan was a relatively small city of little importance. As the steel mills expanded, so did the city. Spin off industries developed around the steel plant making the area a centre of heavy industry.

15. In 2015, Anshan's GDP was CNY 234.9 billion, of which the primary sector accounted for 5.8% or CNY 13.6 billion; the secondary sector accounted for 47.5% or CNY 111.6 billion; and the tertiary sector accounted for 46.7% or CNY 109.70 billion.

16. Agriculture forms the backbone of Chaoyang's economy. In addition to wheat, corn, beans, and potatoes, Chaoyang is also an important region for the growing of cotton and fruit. The city has also begun to venture into the production of shaji (sea-buckthorn berries), which have become popular in China because of their dual use as food and as medicine. Chaoyang is home to the largest man-made thicket of shaji. Chaoyang has more than 1,600 industrial enterprises, manufacturing a wide range of products including steel, machinery, textiles, diesel engines, automobiles, and paper.

17. In 2016, the Chaoyang's GDP was CNY 70.89 billion, of which the primary sector accounted for 26.0% or CNY 1.84 billion; the secondary sector accounted for 22.6% or CNY 1.60 billion; and the tertiary sector accounted for 51.4% or CNY 36.44 billion.

18. In the process of the 50 years development in China, Yingkou has became an industrial city with completed industrial sectors, including textile, machinery, electronics, petrol-chemistry, medicine, construction material and home appliances. In the city, there are more than 3,000 enterprises in 40 industrial sectors with 1700 kinds of products. The production capacities of textile, dyeing and nylon yarn in Yingkou rank the first in Liaoning Province. The salt chemical industry in Yingkou has a long history. The paper making and cigarette sectors in Yingkou have important positions in China. And the alarming equipments, mini-motors, medium plate rolling, cement, fluid equipments in Yingkou city are well known in Liaoning Province.

19. In 2015, Yingkou's GDP was CNY 151.4 billion, of which the primary sector accounted for 7.3% or CNY 11.1 billion; the secondary sector accounted for 48.1% or CNY 72.8 billion; and the tertiary sector accounted for 44.6% or CNY 67.5 billion.

6. Physical Cultural Resources

20. The area of Anshan has been inhabited since prehistoric times. The area remained of little significance, a small city in Liaoning province, overshadowed by neighboring Liaoyang city, until the city became "China's capital of iron and steel" in the mid-20th century. The subproject activities are all in highly developed and modified industrial areas. There are no known physical cultural resources (PCRs) in the subproject site.

21. Chaoyang has a long and rich history. The discovery of the over five-thousand-year-old Niuheliang Hongshan Cultural Ruins in the region has drawn attention to Chaoyang as one of the birthplaces of ancient Chinese culture Chaoyang, has become the focus of great interest in the world of palaeontology. During the 1990s, many new, unique and fascinating fossils were discovered in this region. The ESCO project activities are all in highly developed and modified industrial areas. There are no known PCRs in the ESCO project site.

22. Yingkou has a very long history, which can be traced back to 280,000 years ago. Yingkou was historically known as Newchwang in postal romanization; it was one of the Treaty Ports opened under the Treaties of Tianjin of 1858. Yingkou has become an industrial city with completed industrial sectors, including textile, machinery, electronics, petrol-chemistry, medicine, construction material and home appliances. The ESCO project activities are all in highly developed and modified industrial areas. There are no known PCRs in the ESCO project site.

E. Anticipated Impacts and Mitigation Measures

23. Anticipated positive and negative environmental impacts of the proposed subproject were assessed based on (i) the Feasibility Study Report (FSR) (2017); (ii) a technical due diligence review of the FSR undertaken by ADB project preparation technical assistance (PPTA) consultants; and (iii) site visits, surveys and consultations undertaken by ADB PPTA consultants.

24. Environmental impacts during pre-construction, construction and operation phases were considered separately. The results of the assessment indicate that environmental issues are very limited during pre-construction phase, and are mostly associated with ensuring appropriate incorporation of mitigation measures into the subproject design.

25. Potential negative environmental impacts during construction phase are short-term and localized, and are associated with soil erosion, construction noise, fugitive dust, disruption of traffic and community services, and risks to worker health and safety and community. These can be effectively mitigated through good construction and health and safety practices.

26. Potential negative impacts during operation phase are associated with solid waste, wastewater, noise, and health and safety risks to workers and community. These can be effectively mitigated through good operation and health and safety practices.

27. Potential positive operation phase impacts are significant and long-term, and are associated with energy saving and emission reduction. The subproject will in total replace 35,887.6 tons of coal equivalent (tce), equaling to 100,135.1 tons of carbon dioxide (CO_2), 8,668.6 tons of sulphur dioxide (SO_2), 272.2 tons of nitrogen oxide (NO_X), and 1,464.6 tons of particulate matter (PM).

F. Analysis of Alternatives

28. There are gaps between Ansteel Group and international and domestic advanced level on energy consumption. Engagement of ESCO companies is an appropriate method. As a subsidiary of Ansteel Group, Ansteel ESCO is very familiar with the production process and technology used in iron and steel industry. In addition, with its years of energy management contracting (EMC) experience in several other steel companies, Ansteel ESCO is capable of being the super ESCO of iron and steel industry.

29. Implementation of the subproject will: (i) significantly reduce energy consumption; (ii) improve air quality; (iii) reduce GHG emissions; and (iv) effective utilization of waste heat. For these reasons, the "no project" alternative is considered unacceptable.

30. Based on the analysis of alternatives, the subproject has selected the appropriate ESCO company and subproject components. The establishment of a Super ESCO like Ansteel ESCO will enable companies in iron and steel industry to be renovated and improved using various technologies that are accumulated by Ansteel ESCO. Supporting such kind of Super ESCO will make significant contributions to energy conservation and emission reduction in iron and steel sector. It will also help transformation and upgrade of steel industry in the PRC. The model of Ansteel ESCO is exemplary to other steel companies or companies of high energy consumption.

G. Information Disclosure and Public Consultations

31. The domestic EIAs are being prepared by certificated environmental firms. ADB PPTA consultant communicated with the firm on undertaking public consultation based on both ADB and PRC's requirements.

32. Because the domestic EIA preparation just started, no public consultation meeting was held. According to the plan, a public consultation meeting will be held after the domestic EIA is finished.

H. Grievance Redress Mechanism

33. A subproject-level grievance redress mechanism (GRM) has been established to receive and facilitate resolution of complaints about the subproject during the construction and operation phases. The GRM includes procedures for receiving grievances, recording/ documenting key information, and evaluating and responding to the complainants in a reasonable timeframe. Any concerns raised through the GRM will be addressed quickly and transparently, and without retribution to the affected persons (APs).

I. Environmental Management Plan

34. A comprehensive environmental management plan (EMP) has been developed to ensure: (i) implementation of identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of environmental monitoring plan (EMoP) against the performance indicators; and (iii) compliance with relevant PRC environmental laws, standards and regulations and the ADB's SPS 2009. The EMP includes an EMoP to monitor the environmental impacts of the subproject and assess the effectiveness of mitigation measures, and a capacity building and training program focusing on health, safety and environment. Organizational responsibilities and budgets are clearly identified for implementation, monitoring and reporting. The EMP is presented in Appendix I.

J. Conclusion

35. Through the environmental assessment process, it is concluded that the subproject has: (i) selected appropriate ESCO company and ESCO projects to reduce energy consumption and emission; (ii) identified potential negative environment impacts and appropriately established mitigation measures; (iii) established effective subproject GRM procedures; and (iv) prepared a comprehensive EMP including environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

36. Overall, any adverse environmental impacts associated with the subproject can be prevented, reduced, or minimized through the appropriate application of mitigation measures. It is therefore recommended that: (i) the subproject is classified as environment category B; (ii) the subborrower will undertake public consultation based on requirements of ADB's SPS 2009 and PRC policies; and (iii) the subproject will be supported by ADB, subject to the implementation of the commitments contained in the EMP and allocation of appropriate technical, financial and human resources by the subborrower to ensure these commitments are effectively and expediently implemented.

I. INTRODUCTION

A. The Subproject

1. Super ESCO subproject is located in Anshan City, Chaoyang City and Bayuquan district of Yingkou City of Liaoning province. The subproject includes seven ESCO projects, which are: (i) waste heat recovery from flue gas of heating furnace at Chaoyang Steel Plant; (ii) industrial waste heat recovery for residential district heating in Anshan; (iii) reconstruction of 100-ton mechanical vacuum degassing in Anshan; (iv) energy-Saving reconstruction on high-pressure quenching water pump at Bayuquan Heavy Plate Mill; (v) draft fan frequency adjustment at Bayuquan Pelletizing Plant; (vi) water pump energy-saving reconstruction at Anshan Steel Plant; and (vii) energy-saving reconstruction on circulating water pump and engine of blasting furnace at Anshan Steel Plant. No. 1 ESCO project is located at Ansteel Chaoyang Steel Plant, No. 4 and 5 ESCO projects are located at Ansteel Bayuquan Steel Plant and the other ESCO projects are located at Anshan Steel Plant (**Figure 1**).

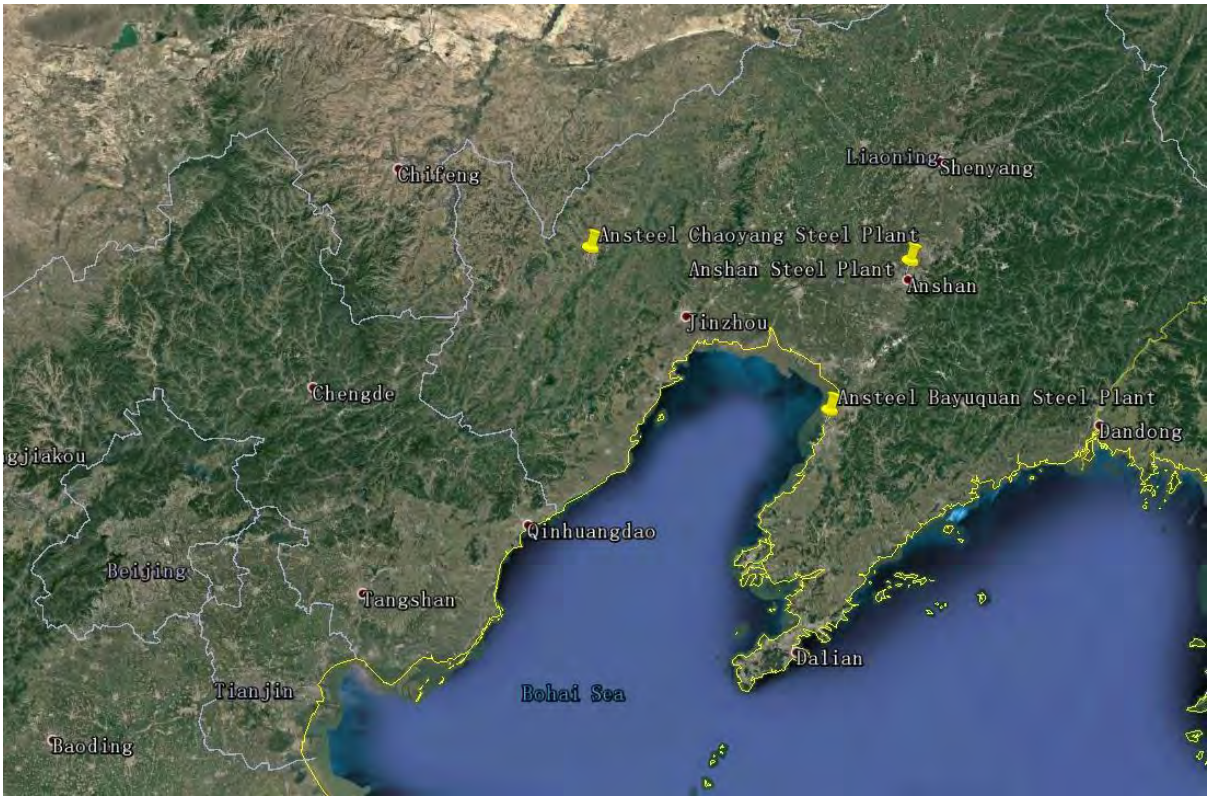


Figure 1: Project location

2. Ansteel ESCO is the subborrower which is responsible for daily operation and equipment maintenance of the subproject.

B. Introduction of Subborrower

3. Ansteel ESCO was founded in December 2010, with a registered capital of CNY 20

million which was increased to CNY 100 million later. Ansteel ESCO has been actively promoting energy saving projects and their implementation based on energy performance contracts. In March 2011, it obtained the approval from the National Development and Reform Commission (NDRC) and Ministry of Finance (MOF) and became one of the only two ESCO companies recognized by MOF and NDRC in iron and steel industry in the PRC. In recent years, by conducting energy efficiency diagnosis, promoting EMC and sharing energy savings mode, Ansteel ESCO not only helps reduce energy consumption, pollution emissions and production cost and gain profit for clients, but also strengthens its own capacity.

4. Ansteel ESCO is a subsidiary of Ansteel Group. Ansteel Group, headquartered in Anshan City, was reorganized from Anshan Steel and Iron Group Corporation and Panzhihua Iron & Steel Group Corporation in May 2010, being a State-owned Enterprises (SOE) under State-owned Assets Supervision and Administration Commission of the State Council of the PRC. After the reorganization, Ansteel Group has formed cross-regional, multi-bases and international operation layout and become a steel enterprise with the greatest resource advantages in the PRC.

C. Report Purpose

5. Following ADB's SPS 2009, an ESMS for the FI Loan has been established to provide the screening, categorization, environmental and social assessment and review procedures for subproject selection. In implementing this FI Loan, subprojects are required to follow the screening and categorization procedures set out in the ESMS. The super ESCO subproject has been classified as environment category B following SPS 2009 and the ESMS, and an IEE, including an EMP is required.

D. Approach to Report Preparation

6. This report has been prepared based on a domestic FSR; a technical due diligence review of the FSR undertaken by ADB PPTA consultants; public consultations with Anshan ESCO and site visits, surveys and consultations undertaken by ADB PPTA environmental consultants.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

7. This IEE has been prepared in accordance with both the PRC's national and local environmental legal and institutional framework and environmental assessment requirements, and applicable ADB policies, requirements and procedures.

A. PRC Environmental Legal Framework

8. The environmental protection and management system in the PRC consists of a well-defined hierarchy of regulatory, administrative and technical institutions. At the top level the People's Congress has the authority to pass and revise national environmental laws; the Ministry of Environmental Protection (MEP) under the State Council promulgates national environmental regulations; and MEP either separately or jointly with the Administration of Quality Supervision, Inspection and Quarantine issues national environmental standards. Provincial and local governments can also issue provincial and local environmental regulations and guidelines in accordance with the national ones. In addition, national and local five-year environmental protection plans form an important part of the legal framework.

9. Key applicable PRC environmental laws are listed in **Table 1**. The implementation of environmental laws is supported by a series of associated regulations summarized in **Table 2**.

Table 1: Applicable PRC environmental laws

No.	Title of the Law	Year Issued/Updated
1	Environmental Protection Law	2015
2	Environmental Impact Assessment Law	2016
3	Water Law	2016
4	Water Pollution Prevention and Control Law	2008
5	Air Pollution Prevention and Control Law	2015
6	Noise Pollution Prevention and Control Law	1999
7	Solid Waste Pollution Prevention and Control Law	2016
8	Water and Soil Conservation Law	2011
9	Land Administration Law	2004
10	Flood Control Law	1998
11	Forest Law	1998
12	Grassland Law	2013
13	Prevention and Control of Desertification	2002
14	Wild Fauna Protection Law	2004
15	Wild Flora Protection Law	1996
16	Agricultural Law	2003
17	Urban and Rural Planning Law	2008
18	Energy Conservation Law	2016

Source: ADB PPTA consultants.

10. In addition to environmental laws and regulations, there are occupational health and safety laws and regulations the subproject must comply with, including the *PRC Safety Production Law* (2014), *State Administrative Regulations of Safety Production* (2003), and *PRC Prevention and Control of Occupational Diseases Law* (2011).

Table 2: National Administrative Regulations.

No.	Regulation	Year Issued/Updated
1	Environmental Protection Management Regulations on Construction Project	2015
2	The PRC Basic Farmland Protection Ordinance	1998
3	The PRC Air Pollution Prevention and Control Law Implementation Rules	1997
4	The PRC Water Pollution Prevention and Control Law Implementation Rules	2000
5	The PRC Forestry Law Implementation Rules	2000
6	The PRC Water and Soil Conservation Law Implementation Rules	1993
7	The PRC Land Management Regulations Implementation Rules	1999
8	The PRC Wild Plant Protection Ordinance	1997
9	Notification of National Key Function Zoning Issued by the State Council	2010
10	The PRC River Management Ordinance	1988
11	The Decision on Several Environmental Protection Issues	1996
12	The National Ecological and Environmental Protection Platform	2000
13	The State Council Decision on Deepening Reform and Strict Land Management	2004

Source: ADB PPTA consultants.

B. PRC Environmental Impact Assessment Framework

11. Environmental impact assessment (EIA) procedures have been established in the PRC for over 20 years. Article 16 of the PRC *Law on Environmental Impact Assessment* (2016)[1] stipulates that an EIA document is required for any capital construction project with significant environmental impacts. Projects are classified into three categories for environment impact:

Category A: projects with significant adverse environmental impacts, for which a full EIA report is required;

Category B: projects with adverse environmental impacts which are of a lesser degree and/or significance than those of Category A, for which a simplified tabular EIA report is required; and

Category C: projects unlikely to have adverse environmental impacts, for which an EIA registration form is required.

12. A full EIA report for category A project and a simplified tabular EIA report for category B project are similar to ADB's EIA and IEE reports, respectively. The registration form of an EIA is similar to an ADB Category C project.

13. Applicable PRC environmental management and assessment guidelines are summarized in **Table 3**. In 2008 the MEP issued "Management Guideline on EIA Categories of Construction Projects" (revised 2015). The MEP guidelines provide detailed EIA requirements for 23 sectors and 199 subsectors based on the project's size, type (e.g., water resources development, agriculture, energy, waste management, etc.), and site environmental sensitivity (e.g., protected nature reserves and cultural heritage sites).

14. The MEP's "Guidelines on Jurisdictional Division of Review and Approval of EIAs for Construction Projects" (2009) defines which construction project EIAs require MEP's review and approval, and which EIAs are delegated to the provincial Environmental Protection Bureau

1 *Environmental Impact Assessment Law*, published on 28 October 2002 and became effective on 1 September 2003. The EIA law was amended in 2016.

(EPB)s.

Table 3: Applicable PRC environmental management and assessment guidelines

No.	Guideline	Code and/or Year Issued/Updated
1	Guideline for Technical Review of EIA on Construction Projects	HJ 616-2011
2	Management Guideline on EIA Categories of Construction Projects	2008
3	Further Enhance the Management of EIA and Preventing Environmental Risks	2012
4	Guideline on Jurisdictional Division of Review and Approval of EIAs for Construction Projects	2009
5	Guideline on EIA Categories of Construction Projects	2015
6	Interim Guideline on Public Consultation for EIA	2006
7	Technical Guidelines for EIA – General Program	HJ 2.1-2011
8	Technical Guideline for EIA – Atmospheric Environment	HJ 2.2-2008
9	Technical Guideline for EIA – Surface Water	HJ/T 2.3-1993
10	Technical Guideline for EIA – Acoustic Environment	HJ 2.4-2009
11	Technical Guideline for EIA – Groundwater Environment	HJ 610-2016
12	Technical Guideline for EIA – Ecological Impact	HJ 19-2011
13	Technical Guidelines for Environmental Risk Assessment for Construction Projects	HJ/T 169-2004

Source: ADB PPTA consultants.

C. Domestic EIA Report

15. The ESCO projects in Anshan and Chaoyang were categorized classified as environment category B under the PRC EIA Law and Anshan EPB requirements. A tabular-type Domestic EIA Report will be prepared by the subborrower and submitted to the Anshan EPB for review and approval. The EIA report will be revised based on the EPB's comments, after which the Anshan EPB will approve the report. The ESCO project in Yingkou will not be required to prepare EIA report under the PRC EIA Law and Yingkou EPB requirements.

D. Due Diligence Reviews of Existing and Associated Facilities

37. The No. 1 ESCO project will be located within the premises of the existing Ansteel Chaoyang Steel Plant and will source waste heat from exhaust gas of two heating furnaces. As per the ADB SPS 2009, the Ansteel Chaoyang Steel Plant is an existing facility for No. 1 ESCO project, and an environmental audit of the existing facility is required. In addition, the two heating furnaces are associated facilities, and due diligence environmental review is required and is included in the environmental audit of Ansteel Chaoyang Steel Plant.

38. The No. 2, No. 3, No. 6 and No. 7 ESCO projects will be located within the premises of the existing Anshan Steel Plant and No. 2 ESCO project will source waste heat from waste heat of cooling water from the Heavy Plate Mill and Wire Rod Plant of Anshan Steel Plant. As per the ADB SPS 2009, the Anshan Steel Plant is an existing facility for No. 2, No. 3, No. 6 and No. 7 ESCO projects, and an environmental audit of the existing facility is required. In addition, the Heavy Plate Mill and Wire Rod Plant are associated facilities of No. 2 ESCO project, and due diligence environmental review is required and is included in the environmental audit of Anshan Steel Plant.

39. The No. 4 and No. 5 ESCO projects will be located within the premises of the existing Ansteel Bayuquan Steel Plant. As per the ADB SPS 2009, the Ansteel Bayuquan Steel Plant is

an existing facility for No. 4 and No. 5 ESCO projects, and an environmental audit of the existing facility is required.

16. Due diligence reviews of the project existing and associated facilities are presented in Appendix II.

E. Relevant International Agreements

17. The PRC has signed a number of international agreements regarding environmental and biological protection. Those which have potential application to the project are listed in **Table 4**.

Table 4: Applicable international agreements

No.	Agreement	Year	Purpose
1	Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat	1975	Preventing the progressive encroachment on and loss of wetlands for now and the future
2	Convention Concerning the Protection of the World Cultural and Natural Heritage	1986	Conserving cultural and natural heritage sites.
3	Convention on Biological Diversity	1993	Conservation and sustainable use of biodiversity.
4	UN Framework Convention on Climate Change	1994	Stabilizing greenhouse gas (GHG) concentrations in the atmosphere at a level that will prevent anthropogenic induced climate change.
5	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification	1996	Fighting against desertification and mitigating the effects of drought.
6	Kyoto Protocol	2002	Controlling emissions of anthropogenic GHGs in ways that reflect underlying national differences in GHG emissions, wealth, and capacity to make the reductions.
7	Stockholm Convention on Persistent Organic Pollutants	2004	Safeguarding human health and the environment from persistent organic pollutants (POPs), ascertaining sound management of stockpiles and wastes that contain POPs, and taking measures to reduce or eradicate releases from intentional production and use of POPs.
8	Paris climate agreement	2015	Dealing with greenhouse gas emissions mitigation, adaptation and finance starting in the year 2020.

Source: ADB PPTA consultants.

F. Applicable PRC Environmental Quality Standards

18. The environmental quality standard system that supports the implementation of the environmental protection laws and regulations in the PRC is classified into two categories by

function: ambient environmental standards and pollutant emission/discharge standards. Standards applicable to the subproject are presented in **Table 5**, and key standards are further elaborated below.

1. Ambient Air Quality

19. Ambient air quality standards are intended to indicate safe exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Limits are given for one or more specific averaging periods, typically one-hour average, 24-hour average, and/or annual average. The PRC's recently updated *Ambient Air Quality Standards (*GB3095-2012) has two classes of limit values; Class 1 standards apply to special areas such as natural reserves and environmentally sensitive areas, and Class 2 standards apply to all other areas, including urban and industrial areas. The PRC standards for Class 2 areas are applicable for the subproject.[2]

Table 5: Applicable PRC environmental standards

No.	Standard	Code/Date
1	Ambient Air Quality Standards	GB 3095-2012
2	Groundwater Quality Standards	GB/T 14848-93
3	Surface Water Quality Standards	GB 3838-2002
4	Environmental Quality Standards for Noise	GB 3096-2008
5	Soil Quality Standards	GB15618-1995
6	Noise Standards for Construction Site Boundary	GB 12523-2011
7	Noise Standards for Industrial Enterprises at Site Boundary	GB 12348-2008
8	Standard for Flood Control	GB 50210-94
9	Emission standards of air pollutants for boiler	GB 13271-2014
10	Emission standards for odor pollutants	GB 14554-93

Source: ADB PPTA Consultants.

20. The World Health Organization (WHO) Air Quality Guidelines are recognized as international standards and are adopted by the World Bank Group's Environment, Health and Safety Guidelines (*EHS Guidelines)*. In addition to guideline values, interim targets (IT) are given for each pollutant by the WHO as incremental targets in a progressive reduction of air pollution. The WHO guidelines and corresponding PRC standards are presented in **Table 6**.

21. From a review of **Table 6** it can be observed that:

- For total suspended particles (TSP), PRC has standards but WHO guidelines do not have.
- For PM_{10}, PRC Class 2 annual average and 24-hour average standards meet WHO IT-1 guidelines (there are no 1-hour average standards or guidelines for either PRC or WHO).
- For $PM_{2.5}$ PRC Class 2 annual and 24-hour standards meet WHO IT-1 guidelines (there are no 1-hour standards or guidelines for either PRC or WHO).

2 On 29 February 2012, the China State Council passed the roadmap for ambient air quality standards with the aim of improving the living environment and protecting human health. The Ambient Air Quality Standards (GB 3095-2012) prescribes the first-ever limits for $PM_{2.5}$. It also modified the previous area classifications by combining Class III (special industrial areas) with Class II (residential, mixed use areas).

Table 6: PRC ambient Air Quality Standard and WHO ambient air quality guidelines, mg/m^3

Standard	TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	O_3	CO
WHO Ambient Air Quality Guidelines							
Annual mean	--	0.020	0.010	--	0.040	--	--
Annual mean IT-1	--	0.070	0.035	--	--	--	--
24-hr mean	--	0.050	0.025	0.020	--	--	--
24-hr mean IT-1	--	0.150	0.075	0.125	--	--	--
8-hr mean	--	--	--	--		0.100	--
8-hr mean IT-1	--	--	--	--		0.160	--
1-hr mean	--	--	--	--	0.200		0.030
1-hr mean IT-1	--	--	--	--	--		--
PRC Ambient Air Quality Standard (Class 2)							
Annual mean	0.200	0.070	0.035	0.060	0.040	--	--
24-hr mean	0.300	0.150	0.075	0.150	0.100	--	0.004
8-hr mean	--	--	--	--	--	0.160	--
1-hr mean	--	--	--	0.500	0.200	0.200	0.010

Source: WHO Air Quality Guidelines (2006) in IFC *EHS Guidelines* (2007), and PRC GB 3095-2012.

- For SO_2 WHO only has a 24-hour average guideline (0.125 mg/m^3), which is slightly lower than the PRC standard (0.150 mg/m^3). However, SO_2 levels are low in the subproject area, and the subproject will only contribute extremely low levels of SO_2, so the very minor difference is inconsequential.
- For NO_2 the PRC standard is equivalent to the WHO annual average guidelines, there is no WHO 24-hour average guideline; and the 1-hour average PRC standard is equivalent to the WHO guideline.

22. Overall the PRC standards show a high degree of equivalency to the WHO guidelines or IT-1 values, and they are adopted for use in this IEE report.

2. Exhaust Gas Emission

23. For the seven ESCO projects, no exhaust gas will be generated during project operation, thus exhaust gas emission standard is not applicable.

3. Fugitive Particulate Matter Emission

24. Fugitive emission of PM such as dust from construction sites is regulated under PRC's *Air Pollutant Integrated Emission Standards* (GB 16297-1996), which sets 120 mg/m^3 as the maximum allowable emission concentration and $\leqslant$1.0 mg/m^3 as the concentration limit at the boundary of construction sites, with no specification on the particular matter's particle diameter. There is no equivalent standard recommended in the *EHS Guidelines,* and the PRC standards are adopted for use in this IEE report.

4. Surface Water

25. PRC's *Environmental Quality Standard for Surface Water* (GB3838-2002) defines five water quality categories for different environmental functions. For example, Category I is the best, such as water at sources of rivers and National Nature Reserves. Category V is the worst quality, suitable only for agricultural and scenic water uses. Based on site visit, the surface water near the ESCO projects in Anshan is Yunliang River, which is used for industrial water and the Category IV water quality standard is applicable (see **Table 7**). For the ESCO project in Chaoyang, there was no surface water near the site. There is no applicable *EHS Guidelines* or

target for water quality in this context, and the PRC standard is adopted in this IEE report.

Table 7: Applicable surface water standards

No.	Parameter	Category IV Standard (mg/l, pH excluded)
1	pH	6-9
2	Dissolved Oxygen	3
3	COD_{Mn}	10
4	COD_{Cr}	30
5	BOD_5	6
6	NH_3-N	1.5
7	TP	0.3
8	TN	1.5
9	Copper	1.0
10	Zinc	2.0
11	Fluoride	1.5
12	Selenium	0.02
13	Arsenic	0.1
14	Total Mercury	0.001
15	Cadmium	0.005
16	Hexavalent Chromium	0.05
17	Lead	0.05
18	Cyanide	0.2
19	Volatile Phenol	0.01
20	Sulfide	0.5
21	Petroleum	1.0
22	Anionic surfactant	0.3
23	Coliforms	20000

Source: Class IV, GB3838-2002, Environmental Quality Standard for Surface Water.
Note: COD_{Mn} = permanganate index; CODcr = chemical oxygen demand; BOD_5 = 5-day biochemical oxygen demand; NH_3-N= ammonia nitrogen; TP = Total Phosphorus; TN = Total Nitrogen.

26. PRC's *Sea Water Quality Standard* (GB 3097-1997) also defines a number of water quality categories for different environmental functions). Based on site visit, the surface water near the ESCO projects in Yingkou is Bohai Sea, which is used for industrial water and the Category IV sea water quality standard is applicable (see **Table 8**). There is no equivalent standard recommended in the *EHS Guidelines,* and the PRC standard is adopted in this IEE report.

Table 8: Applicable sea water standards

No.	Parameter	Category IV Standard (mg/l, pH excluded)
1	pH	6.8—8.8
2	Dissolved Oxygen	4
3	Suspended solids	100
4	COD_{Cr}	4
5	BOD_5	4
6	Inorganic nitrogen	0.4
7	Non-ionic ammonia	0.02
8	Mercury	0.0002
9	Cadmium	0.01
10	Lead	0.01
11	Hexavalent Chromium	0.02
12	Total Chromium	0.2
13	Arsenic	0.05
14	Copper	0.05
15	Zinc	0.1
16	Selenium	0.02
17	Nickel	0.02
18	Cyanide	0.1
19	Sulfide	0.1
20	Volatile Phenol	0.01
21	Petroleum	0.3
22	Anionic surfactant	0.1
23	Fecal coliform	20000
24	Coliforms	10000

Source: Class IV, GB 3097-1997, Sea Water Quality Standard.
Note: CODcr = chemical oxygen demand; BOD5 = 5-day biochemical oxygen demand.

5. Groundwater

27. PRC's *Groundwater Water Ambient Quality Standard* (GB/T14848-93) also defines a number of water quality categories for different environmental functions. As groundwater near all the ESCO projects is primarily used for irrigation, Category III standard is applicable (**Table 9**). There is no equivalent standard recommended in the *EHS Guidelines,* and the PRC standard is adopted in this IEE report.

Table 9: Applicable groundwater standard

No	Parameter	Unit	Category III Standard
1	pH	-	6.5-8.5
2	COD_{Mn}	mg/l	3.0
3	Sulfate	mg/l	250
4	Chloride	mg/l	250
5	Volatile Phenols	mg/l	0.002
6	Total hardness ($CaCO_3$)	mg/l	450
7	Nitrate NO_{3-}	mg/l	20
8	Nitrite NO_{2-}	mg/l	0.02
9	NH_3-N	mg/l	0.2
10	Molybdenum	mg/l	0.1
1	Cyanide	mg/l	0.05
12	Cadmium	mg/l	0.01
13	Chromium VI	mg/l	0.05
14	Arsenic	mg/l	0.05
15	Zinc	mg/l	1.0

No	Parameter	Unit	Category III Standard
16	Fluoride	mg/l	1.0
17	Lead	mg/l	0.05
18	Iron	mg/l	0.3
19	Manganese	mg/l	0.1
20	Copper	mg/l	1.0
21	Selenium	mg/l	0.01
22	Total coliforms	/L	3.0

Source: Class III, GB/T14848-93 Quality Standard for Ground Water.
Note: COD_{Mn} = permanganate index; CODcr = chemical oxygen demand; BOD_5 = 5-day biochemical oxygen demand; NO_3- = Nitrate; NO_2- = Nitrite; NH_3-N= ammonia nitrogen; TP = Total Phosphorus; TN = total nitrogen.

6. Wastewater Discharge

28. **Table 10** presents the relevant PRC wastewater discharge standards. The *EHS Guidelines* indicate that wastewater discharged to public or private wastewater treatment systems should: meet the pretreatment and monitoring requirements of the sewer treatment system into which it discharges; not interfere, directly or indirectly, with the operation and maintenance of the collection and treatment systems, or pose a risk to worker health and safety, or adversely impact characteristics of residuals from wastewater treatment operations; and be discharged into municipal or centralized wastewater treatment systems that have adequate capacity to meet local regulatory requirements for treatment of wastewater generated from the subproject.

29. During construction phase, the subproject will discharge construction and domestic wastewater to the existing waste water treatment plants (WWTPs) at the three steel plants. The wastewater discharged will be required to meet Class B maximum acceptable concentrations (MACs) in Wastewater *Quality Standards for Discharge to Municipal Sewers* (CJ 343-2010), and the WWTPs discharges are required to meet Discharge standard of water pollutants for iron and steel industry (GB 13456—2012). The WWTPs discharges are recycled in Anshan Steel Plant and Ansteel Chaoyang Steel Plant.

30. During operation phase, only No. 1 and 2 ESCO projects will generate wastewater. Based on the waste water quality, the waste water will be treated in existing WWTPs and recycled. The wastewater discharged will also be required to meet *Discharge standard of water pollutants for iron and steel industry* (GB 13456—2012),

Table 10: PRC *Wastewater Quality Standards for Discharge to Municipal Sewers*

No.	Pollutant	Maximum acceptable concentration (MAC) mg/L (except pH and chromacity)
		Class B
1	pH	6.5-9.5
2	Suspended Solid	400
3	COD	500
4	Ammonia nitrogen	45
5	Total dissolved solid	2000
6	Chromacity	70
7	BOD_5	350
8	Total phosphorus	8

Source: PRC's Wastewater Quality Standards for Discharge to Municipal Sewers (CJ 343-2010).
Note: COD = chemical oxygen demand; BOD5 = 5-day biochemical oxygen demand.

7. Noise

31. **Table 11** presents the relevant PRC *Urban Noise Standards* compared with relevant international guidelines from the WHO (as presented in the *EHS Guidelines*). Category I and II standards are applicable to the subproject area. The classes within the standards are not directly comparable, but the PRC Category I standards are equivalent to WHO Class I standards. Category III is utilized in this IEE report.

Table 11: PRC *Environmental Quality Standards for Noise* and relevant international guidelines

PRC Standards Leq dB(A)			**International Standards One Hour Leq dB(A)**		**Comparison**
Category	**Day** 06-22h	**Night** 22-06h	**Day** 07-22h	**Night** 22-07h	
0: Areas needing extreme quiet, such as special health zones	50	40	WHO Class I: residential, institutional, educational: 55 WHO Class II: industrial, commercial: 70	WHO Class I: Residential, institutional, educational: 45 WHO Class II: Industrial, Commercial: 70	Classes are not directly comparable, but PRC Class II standards exceed WHO Class II standards. PRC standards are utilized in this report.
I: Mainly residential; and cultural and educational institutions	55	45			
II: Mixed residential, commercial and industrial areas	60	50			
III: Industrial areas	65	55			
IV: Area on both sides of urban trunk roads	70	55			

Source: GB3096-2008 and ADB PPTA consultant.

32. **Table 12** presents the relevant PRC and international standards (US EPA, there are no WHO or *EHS Guidelines* standards) for on-site construction noise. The PRC standards are more stringent than international guidelines, and are utilized in this IEE report.

Table 12: PRC *Noise Emission Standard for Construction Site Boundary* and relevant international guidelines

Day Leq dB(A)	**Night Leq dB(A)**	**International Standards Leq dB(A)**	**Comparison**
70	55	US EPA: 85 (day, 8hour exposure)	PRC standards meet or are more stringent than international standards

Source: GB12523-2011 and ADB PPTA consultant.

33. During operation noise at site boundaries should comply with Class II of the PRC *Industrial Enterprise Boundary Noise Emission Standard* (GB12348-2008) (**Table 13**).

Table 13: PRC *Emission standard for industrial enterprises noise at boundary*

Standard Type	Standard Value Leq dB(A)	
	Day	Night
Class 2	60	50

Source: GB12348-2008

G. Applicable ADB Policies and Requirements

34. The major applicable ADB policies, requirements and procedures for EIA/IEE are the SPS 2009 and the *Environmental Safeguards – A Good Practice Sourcebook* (2012), which jointly provides the basis for this IEE. SPS 2009 promotes good international practice as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*. The policy is underpinned by the ADB Operations Manual for the SPS (OM Section F1, 2013).

35. SPS 2009 establishes an environmental review process to ensure that projects undertaken as part of programs funded through ADB loans are environmentally sound, are designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environment, health, social, or safety hazards.

36. At an early stage in the project cycle, typically the project identification stage, ADB screens and categorizes proposed projects based on the significance of potential project impacts and risks. A project's environment category is determined by the category of its most environmentally sensitive component, including direct, indirect, induced, and cumulative impacts. Project screening and categorization are undertaken to:

(i) reflect the significance of the project's potential environmental impacts;
(ii) identify the type and level of environmental assessment and institutional resources required for the safeguard measures proportionate to the nature, scale, magnitude and sensitivity of the proposed project's potential impacts; and
(iii) determine consultation and disclosure requirements.

37. ADB assigns a proposed project to one of the following categories:

i) **Category A.** Proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented; impacts may affect an area larger than the sites or facilities subject to physical works. A full-scale EIA including an EMP is required.
ii) **Category B**. Proposed project's potential environmental impacts are less adverse and fewer in number than those of category A projects; impacts are site-specific, few if any of them are irreversible, and impacts can be readily addressed through mitigation measures. An IEE, including an EMP, is required.
iii) **Category C**. Proposed project is likely to have minimal or no adverse environmental impacts. No EIA or IEE is required although environmental implications need to be reviewed.
iv) **Category FI**. Proposed project involves the investment of ADB funds to, or through, a financial intermediary.

38. Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—Regional Emission-Reduction and Pollution-Control Facility was categorized by ADB as FI. Following the screening and categorization procedures set out in the ESMS, the subproject has been classified as environment category B and thus an IEE is required.

39. SPS 2009 requires a number of additional considerations, including: (i) project risk and respective mitigation measures and project assurances; (ii) project-level grievance redress mechanism; (iii) definition of the project area of influence; (iv) physical cultural resources damage prevention analysis; (v) climate change mitigation and adaptation; (vi) occupational and community health and safety requirements (including emergency preparedness and response); (vii) economic displacement that is not part of land acquisition; (viii) biodiversity conservation and natural resources management requirements; (ix) provision of sufficient justification if local standards are used; (x) assurance of adequate consultation and participation; and (xi) assurance that the EMP includes an implementation schedule and measurable performance indicators. These requirements, which may not be covered in the domestic EIA, have been considered, and all applicable environmental requirements in the SPS 2009 are covered in this IEE.

40. During the design, construction, and operation phases of a project, SPS 2009 also requires the borrower to follow environmental standards consistent with good international practice (GIP), as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*.[3] The *EHS Guideline*s contain discharge effluent, air emissions, and other numerical guidelines and performance indicators as well as prevention and control approaches that are normally acceptable to ADB and are generally considered to be achievable at reasonable costs by existing technology. When host country regulations differ from these levels and measures, the borrower/subborrower is to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the borrower/subborrower is required to provide justification for any proposed alternatives.

3 *World Bank Group, Environmental, Health, and Safety Guidelines*, April 30, 2007, Washington, USA. http://www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

III. PROJECT DESCRIPTION

A. The Subproject

41. The super ESCO subproject is located in Anshan City, Chaoyang City and Yingkou City of Liaoning Province. The subproject includes seven ESCO projects, which are: (i) waste heat recovery from flue gas of heating furnace at Chaoyang Steel Plant; (ii) industrial waste heat recovery for residential district heating in Anshan; (iii) reconstruction of 100-ton mechanical vacuum degassing in Anshan; (iv) energy-saving reconstruction on high-pressure quenching water pump at Bayuquan Heavy Plate Mill; (v) draft fan frequency adjustment at Bayuquan Pelletizing Plant; (vi) water pump energy-saving reconstruction at Anshan Steel Plant; (vii) energy-saving reconstruction on circulating water pump and engine of blasting furnace at Anshan Steel Plant.

42. An ESCO is a company that operates based on EMC, whose primary purpose is to gain profit through improvement of energy efficiency. The main businesses of ESCOs include providing clients with project fund, technology and operation and maintenance service, sharing energy-saving benefits in agreed proportion with clients within the contract period, and transferring energy-saving benefit and proprietary right to clients as the contract period ends. ESCO gains profit by sharing the energy-saving benefit made from the project implementation with the clients, while it undertakes most of the project risk, addressing the main barriers of energy-saving projects. However, since the borrowing amount of an individual energy-saving project is relatively small, while the cost is high and processes are complicated, it is difficult for a single project to get financing, which negatively impacts the energy-saving market and related companies. For this reason, Super ESCO, which tends to facilitate large-scale implementation of energy-efficiency projects, comes into play. Super ESCO will package small projects and apply for a loan. Super ESCOs operate in industrial companies or a certain sector with extensive industrial knowledge, profound technical expertise and the capability for sustainable development in businesses.

B. Key Subproject Features

43. Ansteel ESCO mainly deploys shared energy-savings model for its EMC projects, under which Ansteel ESCO covers all the project investment and is responsible for project construction work. After completion of the project, Ansteel ESCO oversees the project operation with a shared energy-saving benefit between the ESCO and the client company before the EMC period ends. When the agreed EMC period expires, the ESCO transfers assets under the EMC projects free of charge to the client company; the latter takes charge of the project operation and solely enjoys the energy-saving benefit.

44. **Table 14** lists 7 selected energy-saving projects that Ansteel ESCO intends to apply for financing from the proposed ADB loan. These projects are allocated in different locations with various technologies adopted. The projects bundling not only could help energy efficient projects with small amount of investment to obtain financing, but also negotiate energy-saving benefit sharing method with clients to ensure the investment to be paid back within a short and reasonable period, to ensure the sustainable development of Ansteel ESCO.

Table 14: Energy Saving Projects of Ansteel Group
(EMC shared saving period being 6 years)

No.	Project Name	Technology Adopted	Benefit sharing Ratio of Ansteel ESCO (%)	Payback Period (Year)
1	Waste Heat Recovery from Flue Gas of Heating Furnace at Chaoyang Steel Plant	To recover waste heat from flue gas with heat exchanger	70	2.2
2	Industrial Waste Heat Recovery for Residential District Heating in Anshan	Low-temperature waste heat in replacing high-temperature steam for heating with water source heat pump	90	3.9
3	Reconstruction of 100-ton Mechanical Vacuum Degassing in Anshan	Mechanical vacuum degassing in replacing steam vacuum degassing	70	2.2
4	Energy-Saving Reconstruction on High-Pressure Quenching Water Pump at Bayuquan Heavy Plate Mill	Water Pump reconstruction with permanent magnet speed-adjustment device	80	3.1
5	Draft Fan Frequency Adjustment at Bayuquan Pelletizing Plant	Draft fan frequency adjustment	80	3.1
6	Water Pump Replacement at Anshan Steel Plant	Replacement of water pump of higher efficiency	70	3.3
7	Replacement of Circulating Water Pump and Engine of Blasting Furnace at Anshan Steel Plant	High-efficient water pump or engine in replace of general water pump	70	3

Note: EMC = energy management contracting.

45. **Waste Heat Recovery from Flue Gas of Heating Furnace at Chaoyang Steel Plant**. In Chaoyang Steel Co., Ltd. (Chaoyang Steel), there are two heating furnaces for steel rolling process and both use mixed gas as the fuel. Based on the measurement at ambient temperature of 1°C, the average exhaust gas temperature is 450°C and the maximum is 500°C. Since there is no waste heat recovery equipment, the heating energy is currently wasted. The project will recover waste heat from flue gas from the two heating furnaces and to lower the exhaust gas temperature. The recovered heat generates medium-pressure saturated steam that is connected to the heat system. The reconstruction work is to keep the original flue pipe system and add a twinning high-temperature flue pipe with waste heat recovery equipment. The flue gas from the heating furnace is around 450°C. The flue gas will flow via the twining flue pipe (the motorized damper of the main flue pipe closes) and then enters waste heat recovery equipment for heat exchange. After heat exchange, the temperature of flue gas will be around 145°C, then flue gas

will flow back to the main flue pipe by the induced draft fan and then exhausts via the existing chimney. The steam generated through waste heat recovery from flue gas amounts to 23 (11.5×2) ton per hour (t/h), with annual operation time of 7,200 hours, pressure of 1.3 MPa and temperature of 194°C. The waste heat recovery equipment uses waste heat boiler with heat pipe for heat exchange. The generated steam is then sent to the existed superheated steam pipe network of the steel rolling plant. The energy output of the project equals to 15,707.8 tce and the energy consumption is 1,874.8 tce, resulting to the net amount of energy saving of 13,833.0 tce.

46. **Industrial Waste Heat Recovery for Residential District Heating in Anshan.** Current space heating for Lingshan District is supplied by An Steel through a long-distance steam pipeline (called No. 41 pipeline). The steam is generated by blast furnace gas. The steam flow at Ansteel is about 65 t/h and decreased to 39 t/h when it arrives at Lingshan District due to the pressure and heat loses along the pipeline. The proposed project will use the waste heat of cooling water from the Heavy Plate Mill and Wire Rod Plant of Anshan Steel Plant to replace the steam from Ansteel for space heating. Water-source heat pumps will be used to increase the 23–35 °C cooling water to 63–65 °C hot water. Two heat exchange facilities will supply 53–55 °C hot water for space heating during winter season. A heat pump is designed to transfer thermal energy from one place to another place by absorbing heat from a warmer place and releasing it to the cold one using a small amount of electricity. The #41 pipeline will be removed after the project. A total of 523,497.6 GJ of steam will be saved during the 4-month heating season. The saved blast furnace gas generated steam will be sent to a combined cycle power plant to generate more electricity. A total of 61.2 GWh power will be generated by the saved gas. The heat pump system will consume 20.2 GWh power per year.

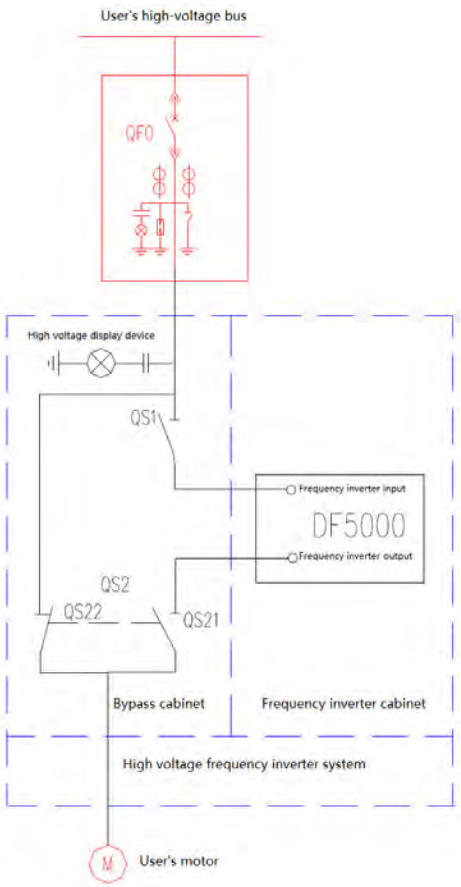
47. **Reconstruction of 100-ton Mechanical Vacuum Degassing in Anshan**: Due to the aging of current steam vacuum degassing system, the cost of the annual steel production of 900,000 tons is relatively high, with the annual steam and electricity consumption being 69,840 tons and 6.255 million kWh. In contrast, mechanical vacuum degassing is competent with low operation cost and higher energy efficiency. The project is to combine pumps at different levels by mainly applying roots pumps and screw pumps: five primary-level roots pumps + five secondary-level roots pumps + three third-level screw pumps + three fourth-level screw pumps. With the degassing capacity of 160,000 m^3/h, the pump unit adopts variable frequency controller that fits with the technical processes and operation methods under various conditions. High-efficiency, low-energy consumption, low-thermal load and long-life cycle are the features of the pump units. The connection of four-level pump units could efficiently avoid pump's compression ratio being too high. Pumps at each level could operate isolated. The malfunction of one pump will affect neither the operation of other pumps nor regular production process. The entire project adopts dry vacuum degassing system instead of steam vacuum degassing, greatly lowering the production cost per ton of steel. As the steam saved could generate electricity of 6.285 million kWh, while the dry vacuum degassing system consumes 0.9 million kWh of electricity, the net-saved electricity amounts to 5.385 million kWh.

48. **Energy-Saving Reconstruction on High-Pressure Quenching Water Pump at Bayuquan Heavy Plate Mill**. Bayuquan Heavy Plate Mill is equipped with four high pressure quenching water pumps that could be launched directly, among which three are in operation and one for back-up. No matter whether the quenching process is undergoing, the water pumps are in operation all the time, resulting in energy waste. To reduce cost, enhance energy efficiency and save energy, the project is to improve water pumps' operation efficiency during non-quenching period. The plan is to install a set of permanent magnet speed-adjustment device between each of the engines and water pumps to build up contactless torque transfer between engines and load. The operation speed of the engine remains the same; water flux and water

pressure are under continuous control as the operation speed of the water pump being regulated by the adjustment of the air gap. The annual electricity consumptions before and after reconstruction are 5.161 million kWh and 2.464 million kWh.

49. **Draft Fan Frequency Adjustment at Bayuquan Pelletizing Plant**. The project is to conduct frequency adjustment to draft fans at the Pelletizing Plant, nine engines, including annular cooler, heat recovery ventilator, dedusting fan and main exhauster are under reconstruction. It is a common phenomenon in the design and operation of draft fans chosen by steel companies that most of the selections on engines are made upon the largest load capacity, making the engine's rate of power larger than the load's shaft power. In real operations, on the contrary, the engines rarely work in full speed. A variable speed drive (VSD) is used in electro-mechanical drive systems to control AC motor speed and torque by varying motor input frequency and voltage. The fixed-speed motor load applications (operating under non-full speed condition) that are supplied directly from AC line power can save energy when they are operated at variable speed by means of variable frequency drive (VFD). For example, at the speed of 63% a motor load consumes only 25% of its full-speed power. When the VSD defaults or is out of operation, the system manually switches to power frequency operation, under which the engine is either launched directly, or by existing liquid resistance starter. The typical primary circuit after reconstruction is illustrated in **Figure 2**. The electricity consumptions before and after reconstruction are 34.805 million kWh and 28.976 million kWh.

Figure 2: Typical primary circuit after reconstruction



50. **Water Pump Replacement at Anshan Steel Plant.** 19 sets and 39 units of water pumps

(including pumps in operation and for back-up) in Anshan steel plant need to be reconstructed. Most of the pump stations and water treatment equipment were built during 1998-2003 with high energy consumption and low energy efficiency. During long-time operation, along with the abrasion of the equipment sealing and machine vibration, part of the components, such as bearings and sealing components, in the pumps and machines are wearing out, causing inner leaking in some parts of the system and leading to large energy loss. The project is to replace some of the pump units with water pumps of higher energy efficiency. The electricity consumptions before and after reconstruction are 51.383 million kWh and 43.916 million kWh.

51. **Replacement of Circulating Water Pump and Engine of Blasting Furnace at Anshan Steel Plant.** The project is to conduct the reconstruction by replacing existing ordinary water pumps with water pumps or engines of higher energy efficiency. In addition, metering devices will be installed to monitor the operation data and electricity consumption. For better maintenance and compatibility, the devices are suggested to be of the same type. Meanwhile, some of the valves will be changed as needed. The electricity consumptions before and after reconstruction are 55.606 million kWh and 48.412 million kWh.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Location

52. The subproject will be implemented in Liaoning Province, China.

Figure 3: Liaoning Province in China

Source: https://en.wikipedia.org/wiki/Liaoning

B. Liaoning Province Overview

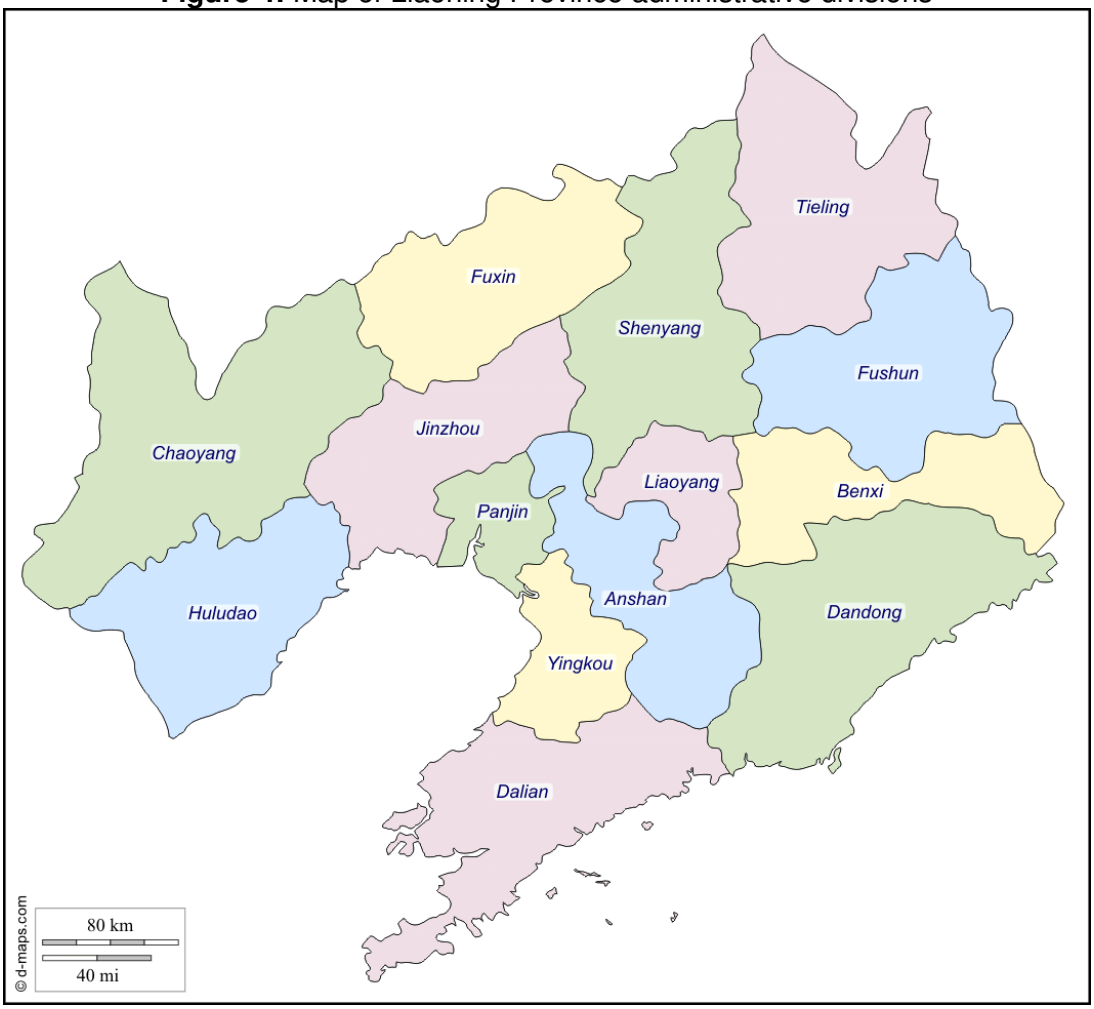
53. Liaoning Province is located on the northeast coast of the Asian continent at 118°51'–125°47' E and 38°43'–43°29' N with a width of 374 kilometers (km) from east to west and 530 km from south to north. The climate is continental monsoon, with mean annual precipitation from 1,200 millimeters (mm) to 400 mm, decreasing from the southeast to northwest. Liaoning is also known in Chinese as "the Golden Triangle" from its shape and strategic location, with the Yellow Sea (Korea Bay and Bohai Sea) in the south, North Korea's North Pyongan and Chagang provinces in the southeast, Jilin to the northeast, Hebei to the southwest, and Inner Mongolia to the northwest. The Yalu River marks its border with North Korea, entering into the

Korea Bay between Dandong in Liaoning and Sinuiju in North Korea.

54. Liaoning can be divided into three approximate geographical regions: the highlands in the west, plains in the middle, and hills in the east. The highlands in the west are dominated by the Nulu'erhu Mountains, which roughly follow the border between Liaoning and Inner Mongolia. The entire region is dominated by low hills. The central part of Liaoning consists of a basin drained by rivers such as the Liao, Daliao, and their tributaries. This region is mostly flat and low-lying. The eastern part of Liaoning is dominated by the Changbai Shan and Qianshan ranges, which extend into the sea to form the Liaodong Peninsula. The highest point in Liaoning, Mount Huabozi (1,336 m), is found in this region.

55. Liaoning is divided into fourteen prefecture-level divisions, all prefecture-level cities (including two sub-provincial cities, **Figure 4**). These prefecture-level cities are in turn divided into 100 county-level divisions (56 districts, 17 county-level cities, 19 counties, and 8 autonomous counties), which are then further subdivided into 1,511 township-level divisions (613 towns, 301 townships, 77 ethnic townships, and 520 subdistricts).

Figure 4: Map of Liaoning Province administrative divisions



Source: http://d-maps.com

56. Liaoning has a continental monsoon climate with an average rainfall between 440 mm to 1,130 mm annually. Summer is the rainy season while the other seasons are relative dry. The

average annual temperature is 10.1°C.

57. Natural resources in Liaoning include coal, iron, limestone, and petroleum. Agricultural products include oil plants, fruits, rice, corn, apples, pears, peanuts, and other cash crops. Liaohe oil field is the third largest in the PRC, with crude oil and natural gas reserves accounting for 15% and 10% of the total of the PRC, respectively. Despite having significant energy resources, the project area is a net energy importer. Conventional petroleum and natural gas reserves are declining, and coal production is declining and insufficient to meet energy demand in an environmentally acceptable manner. Liaoning is a traditional heavy industrial base of the PRC, with severe air, water, and soil pollution. Air quality has been improving in the subproject area in recent years, but still does not meet the designated ambient quality standards on a year-round basis.

58. Main agricultural products of Liaoning include maize, sorghum, and soybeans. The region around Dalian produces three-quarters of China's exported apples and peaches. Cotton is also produced in the province. Liaoning's fruits include apples from Dalian and Yingkou, golden peaches from Dalian, pears from Beizhen of Jinzhou, white pears from Huludao and Suizhong, and apricots and plums from Gushan of Dandong.

59. Liaoning has the most iron, magnesite, diamond, and boron deposits among all provinces of China. Liaoning is also an important source of petroleum and natural gas. Salt is produced along the coastal areas. Along with Liaoning's rich mineral reserves, the province also has abundant deposits of crude oil, especially in the Liaohe Oilfield.

60. Liaoning is one of China's most important industrial bases, covering a wide range of industries, such as machinery, electronics, metal refining, petroleum, chemical industries, construction materials, coal, and so on.

61. The sea off Dalian abounds with quality seafood, such as abalones, sea cucumbers, scallops, prawns, crabs, and sea urchins. The big fish of Dandong, the jellyfish of Yingkou, and the clams of Panjin are known worldwide for their good tastes and seafood products made in Liaoning are exported domestically and internationally.

62. The population of Liaoning is mostly Han Chinese with minorities of Manchus, Mongols, Hui, Koreans and Xibe.

63. Liaoning’s nominal GDP for 2016 was CNY 2.20 trillion, making it the 14th largest in China (out of 31 provinces). Its per capita GDP was CNY 50,287. Among the three provinces of Northeast China, Liaoning is the largest in terms of GDP.

64. The province has 33.16 billion m^3 of water resources with an average 757 m^3 per capita in 2016. The groundwater resources of Liaoning are large, but are being exploited at an unsustainable rate. In 2016, ground water resource in Liaoning was 12.094 billion m^3 and 5.695 billion m^3 of water consumption is from ground water sources. The demand for groundwater resources will continue to increase in the future with rising population and economic development.

C. Site Physical Resources

1. Anshan City

65. Anshan is the third largest prefecture level city in Liaoning province. Situated in the central area of the province, Anshan is about 92 kilometers south of Shenyang, the provincial capital. Anshan is on the boundary between the Mountains of eastern Liaoning and the plains of the west. The prefecture has a population of 3,584,000 people and covers an area of about 9,252 km^2. The distance from the east to the west of the prefecture is 133 km. The area contains the famous Qianshan National Park. The city's name is derived from the shape of a nearby mountain that resembles the shape of a horse's saddle, which can be seen on the left (west) about five minutes before the northbound train arrives at Anshan Station. Anshan is the home of Anshan Iron and Steel Group, one of the largest steel producers in the PRC.

66. **Geology and Topography**. Sited on the edge of the Liao River plains, Anshan has wide flat lands in the west and central regions that develop into hilly and the mountainous terrain on the eastern fringes. The terrain of Anshan city inclines downwards from the southeast to the northwest. Its landform can be divided into three parts. The southeastern part is mountainous and hilly region, the central is undulant plains and the northwestern part is alluvial plain. The area is rich in mineral wealth including iron ore, coal, magnesite, talcum and jade. The plains of western Anshan are good for agriculture. The large flat fields make it ideal for modern agriculture. In total, Anshan contains 24,480 hectares of arable land accounting for 26.4% of the total land area (**Figure 4**). The No 2, 3, 6 and 7 ESCO project sites are located in Ansteel Plant, which is located in Tiexi District, the urban core of Anshan City and topography in this area is generally flat.

Figure 4: Anshan topography

Source: Google map, 2017

67. **Meteorology and Climate.** Anshan has a monsoon-influenced humid continental climate (Köppen Dwa) characterized by hot, humid summers, due to the monsoon, and rather long, cold, and very dry winters, due to the Siberian anticyclone. The four seasons here are distinctive. Nearly half of the annual rainfall occurs in July and August.

68. **Temperature**. The monthly 24-hour average temperatures range from −8.6 °C in January to 25.0 °C in July, while the annual mean is 9.60 °C. Sunshine is generous and amounts to 2,543 hours annually, while relative humidity averages 58%, ranging from 47% in March and April to 75% in July and August. Extreme temperatures have ranged from −26.9 °C up to 36.5 °C.

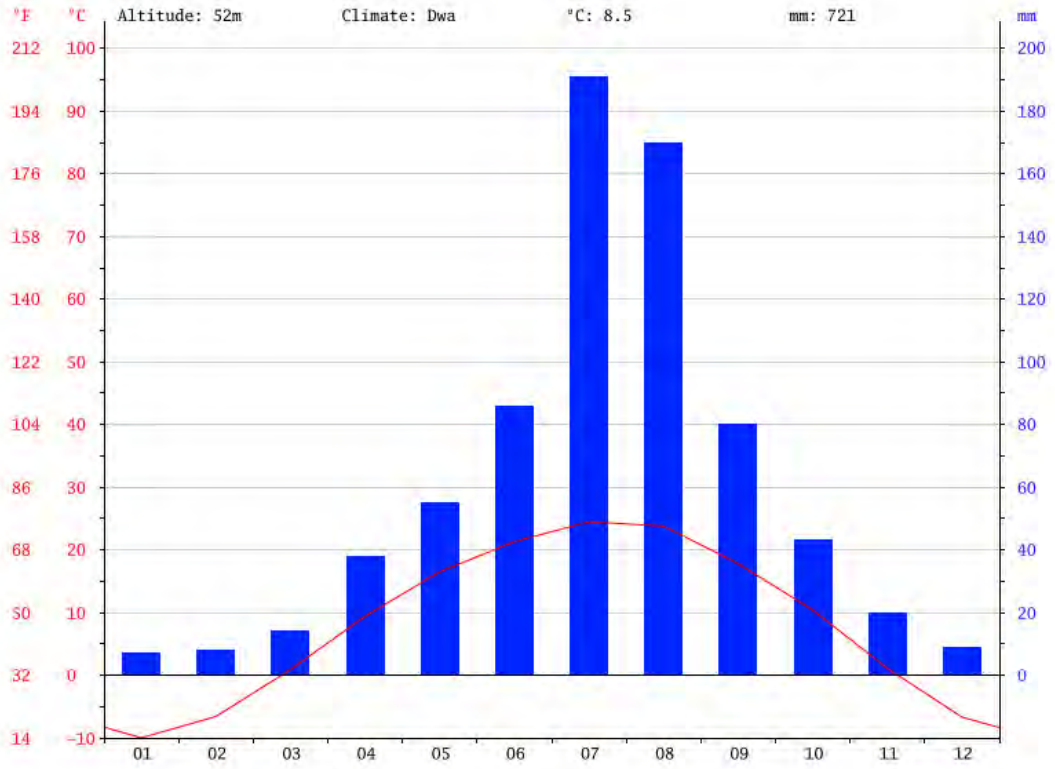
69. **Precipitation.** Annual average precipitation in Anshan from 1971-2011 was 712 mm, of which 61.0 % occurs in the June through August period. The lowest recorded annual precipitation was 384.8 mm in 1989 and the highest was 1,042 mm in 1986.

Table 15: Average Climatic Conditions in Anshan (1971-2011)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high, °C	-4	0	7	17	24	27	29	29	24	17	7	-1	14
Average low, °C	−14	-10	-3	6	13	18	21	20	14	6	-3	-10	4
Average precipitation, mm	8	8	16	36	57	84	178	172	78	44	21	10	712

Source: http://www.tianqihoubao.com/qihou/anshan.htm

Figure 5: Average Climate Profile in Anshan



Source: https://en.climate-data.org/location/2205/

70. **Frost-free Days.** There is an average of 166 frost free days per year in Anshan. The first frost typically occurs in the first 10 days of October and typically ends in the last 10 days of April.

71. **Wind.** The Anshan city has a monsoon-influenced humid continental climate. The dominant wind direction of the area is south, accounting for 11% of the total windy days per year (based on data from 2002-2011) and the secondary wind direction is southeast, accounting for 9%. Annual average wind speed is 2 m/s.

72. **Water Resources.** There are 35 rivers in Anshan. The six big rivers in Anshan are Liao River mainstream, Hun River, Taizi River, Raoyang River, Daliao River and Dayang River. The total length of rivers in Anshan is 1,421.6 km. In 2016, Anshan city has 3.4 billion m^3 of water

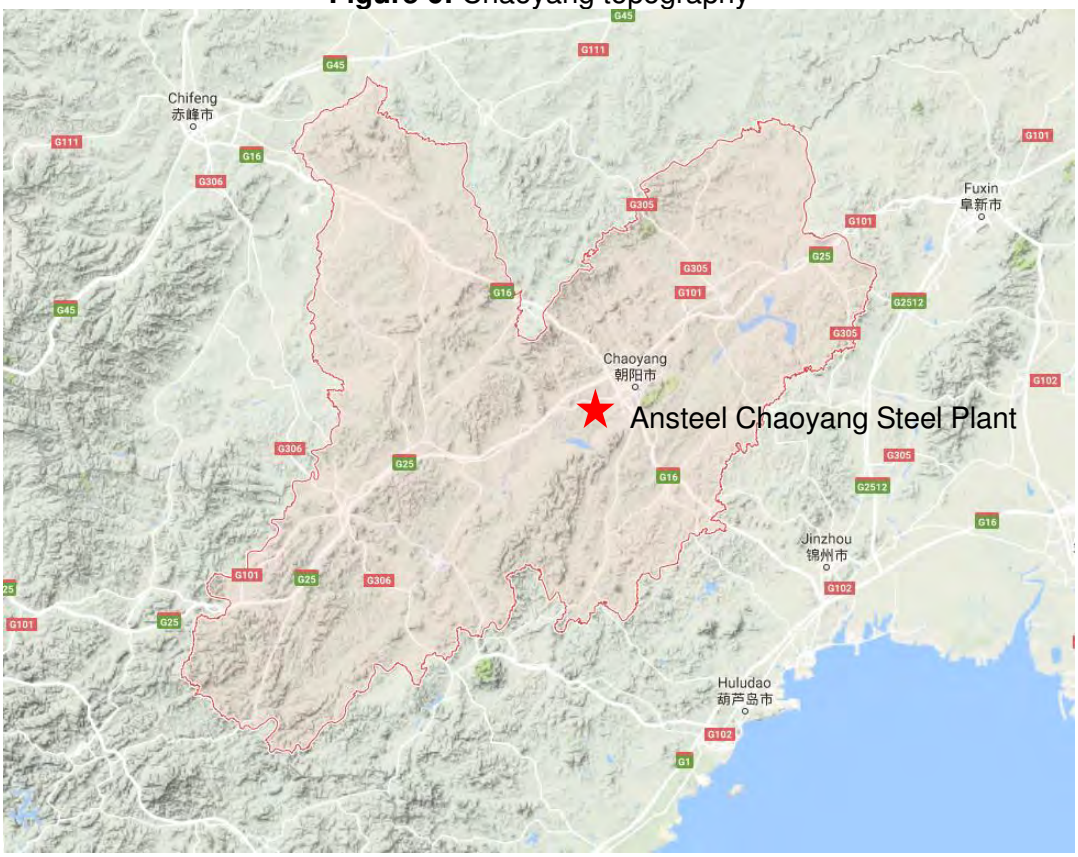
resources and 983 m^3 per capita.

2. Chaoyang City

73. Chaoyang is a prefecture-level city of Liaoning province. With a vast land area of 19,736 km^2, it is by area the largest prefecture-level city in Liaoning, and Chaoyang City is bordered by Hebei Province in the south and neighbors Inner Mongolia in the north. It is a coastal city in western Liaoning, adjacent to Shenyang and Anshan in Central Liaoning.

74. **Geology and Topography**. Chaoyang is situated in the intermediate area between the loess plateau of Inner Mongolia and Songliao Plain, and its terrain generally declines from the northwest to the southeast (**Figure 6**). Low mountains and hills make up the main framework of the city. Among the mountain ranges are dotted fluvial plains and basins. The No 1 ESCO project site is located in Ansteel Plant Chaoyang Branch, which is near the urban core of Longcheng District and topography in this area is generally flat.

Figure 6: Chaoyang topography



Source: Google map, 2017

75. **Meteorology.** Chaoyang has a rather dry, monsoon-influenced humid continental climate (Köppen Dwa), with cold but very dry winters, and hot, humid summers; spring and autumn are relatively brief. The city features great temperature differences during a day, long sunlight hours, light rainfall and four distinct seasons.

76. **Temperature**. The monthly 24-hour average temperature ranges from −9.7°C in January to 24.8°C in July, for an annual average of 9.04°C. The hot season lasts for 4.3 months, from

May 10 to September 20, with an average daily high temperature above 25°C. The hottest day of the year is July 19, with an average high of 32.2°C and low of 20°C. The cold season lasts for 3.0 months, from November 24 to February 25, with an average daily high temperature below 4°C. The coldest day of the year is January 16, with an average low of -14.5°C and high of -3.3 °C. Extreme high temperature was 43 °C occurred in July 2000 and extreme low temperature was -34 ºC occurred in January 1990.

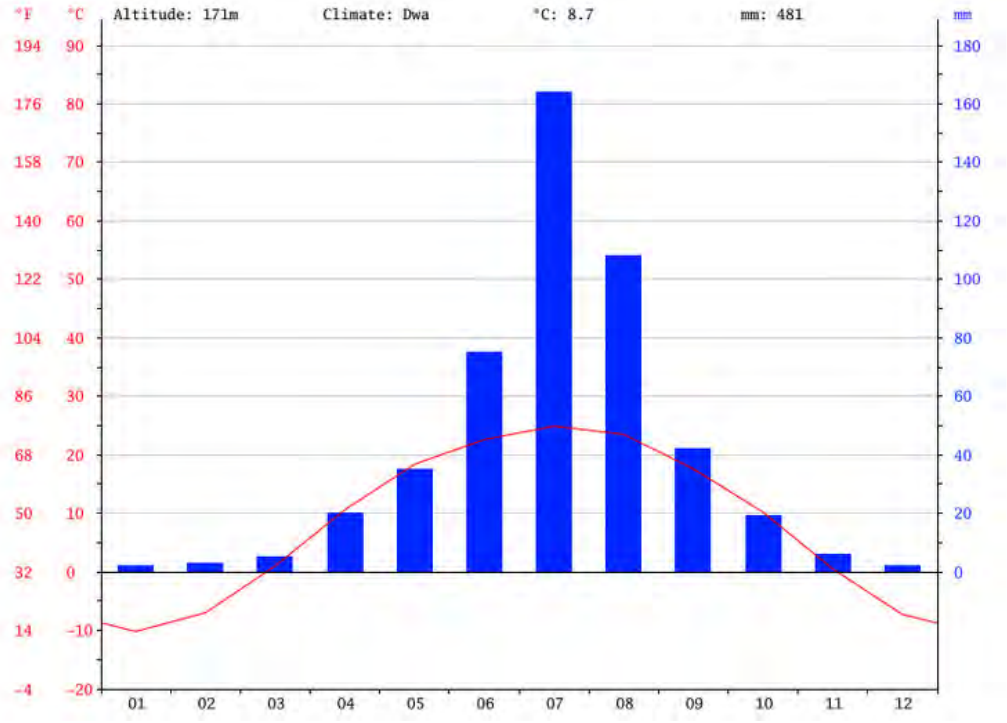
77. **Precipitation.** Annual average precipitation in Chaoyang was 480.6 mm, of which 70.0 % occurs in the June through August period. The lowest recorded annual precipitation was 298.5 mm in 1981 and the highest was 728.3 mm in 1994. With monthly percent possible sunshine ranging from 50% in July to 71% in January, the city averages 2,748 hours of bright sunshine annually.

Table 16: Average Climatic Conditions in Chaoyang (1971-2000)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high, °C	-2.1	1.9	9.3	18.9	25.2	28.9	30.1	29.2	24.8	17.6	7.6	0.4	16.0
Average low, °C	−16.2	-12.8	-5.2	4.3	11.3	16.6	19.9	17.9	10.8	3.3	-5.3	-13	2.7
Average precipitation, mm	1.5	1.6	6.5	20.0	42.4	81.1	153.8	101.4	44.7	18.2	6.5	2.9	480.6
Average relative humidity (%)	43	38	37	38	44	59	73	74	64	53	49	46	51.5
Mean monthly sunshine hours	206	207	243	249	263	243	227	235	245	235	199	191	2,748

Source: China Meteorological Administration

Figure 7: Average Climate Profile in Chaoyang



Source: https://en.climate-data.org/location/2230/

78. **Frost-free Days.** There is an average of 144 frost free days per year in Chaoyang. The first frost typically occurs in the first 10 days of October and typically ends in the last 10 days of April.

79. **Wind.** The average hourly wind speed in Chaoyang experiences mild seasonal variation over the course of the year. The windier part of the year lasts for 4.8 months, from January 12 to June 5, with average wind speeds of more than 5.5 miles per hour. The windiest day of the year is April 20, with an average hourly wind speed of 6.8 miles per hour.

80. The calmer time of year lasts for 7.2 months, from June 5 to January 12. The calmest day of the year is August 15, with an average hourly wind speed of 4.2 miles per hour. The calmer time of year lasts for 8.2 months, from June 4 to February 9. The calmest day of the year is August 17, with an average hourly wind speed of 4.6 miles per hour. The dominant wind direction of the city is south, accounting for 16% of the total windy days per year and the secondary wind direction is northwest, accounting for 12.3%. Annual average wind speed is 2.8 m/s.

81. **Water Resources.** There are 69 rivers in Chaoyang with a water area of 19,777 km^2. The four major rivers in Chaoyang are Daling River, Xiaoling River, Qinglong River and Laoha River. The total length of rivers in Chaoyang is 2,560 km. In 2016, Chaoyang city has 1.359 billion m^3 of water resources and 398 m^3 per capita. In 2016, gross storage capacity of Chaoyang was 4.99 billion m^3. In 2016, total water supply in Chaoyang was 4.606 billion m^3, in which 13.3% was from surface water, 85.7% was from ground water and 1.0% was from wastewater recycle.

3. Yingkou City

82. Yingkou is a prefecture-level city of Liaoning province. It is a port city of the Bohai Sea, and is the location of the mouth of the Liao River.

83. **Geology and Topography**. Yingkou is located in the northwestern part of the Liaodong Peninsula, and on the left bank of the Liaohe River, which enters the sea in the city. To the west is the Liaodong Bay of the Bohai Gulf, and the city thus looks across to Jinzhou and Huludao. Bordering prefecture cities are: Anshan (N and NE), Dalian (S), and Panjin (NW). The city's metro area is located 166 km from the provincial capital of Shenyang, 204 km from Dalian, 84 km from Anshan, and 70 km from Panjin. The city is located at latitude 39° 55'−40° 56' N and longitude 121° 56'−123° 02' E. At its greatest width, the city spans 111.8 km from north to south and 50.7 km from east to west. The total area of the city is 5,365 km^2, occupying a mere 4.9% of the provincial area. The city has a total coastline of 122 km and a total sea area of 1,542 km^2.

84. The terrain of the city basically slopes downwards from southeast to northwest, with low mountains, hills and plains as its main types of landform. The Liaohe River winds southwards through the city and then runs into the Bohai Sea. The eastern region of Yingkou is mainly mountain with an altitude from 100-1000 m, middle region is mainly hill with an altitude from 50-200 m and eastern region is mainly plain with an altitude from 2-10 m. Mountain land accounts for 27% of Yingkou area, hilly accounts for 31.6% and plain accounts for 41.4%. The highest altitude is Buyun Mountain with an altitude of 1,130.7 m while the lowest is one river beach in Sigua Village, Shifo Town with an altitude of 1.2 m. The No 4 and 5 ESCO project sites are located in Ansteel Bayuquan Branch, which is in the urban core of Bayuquan District and topography in this area is generally flat (**Figure 8**).

Figure 8: Yingkou topography

Source: Google map, 2017

85. **Meteorology.** Yingkou has a four-season humid continental climate (Köppen Dwa) with strong monsoonal influences. Though the climate is somewhat tempered by the city's location on the Bohai Gulf, the summers are long, warm, humid, wet, and partly cloudy and the winters are freezing, dry, windy, and mostly clear. The warm season lasts for 4.1 months, from May 22 to September 26. The hottest day of the year is August 3. The cold season lasts for 3.0 months, from December 1 to March 1. The coldest day of the year is January 18.

86. **Temperature**. The monthly 24-hour average temperature ranges from −8.5°C in January to 25.0°C in July, while the annual mean is 9.48°C. Extreme high temperature was 35 °C occurred in July 1958 and extreme low temperature was - 28 °C occurred in January 1985. Precipitation is somewhat enhanced by the coastal location, with a majority of the annual rainfall occurring in July and August alone. With monthly percent possible sunshine ranging from 51% in July to 68% in three months, the city receives 2,774 hours of bright sunshine annually.

Table 17: Average Climatic Conditions in Yingkou (1971-2000)

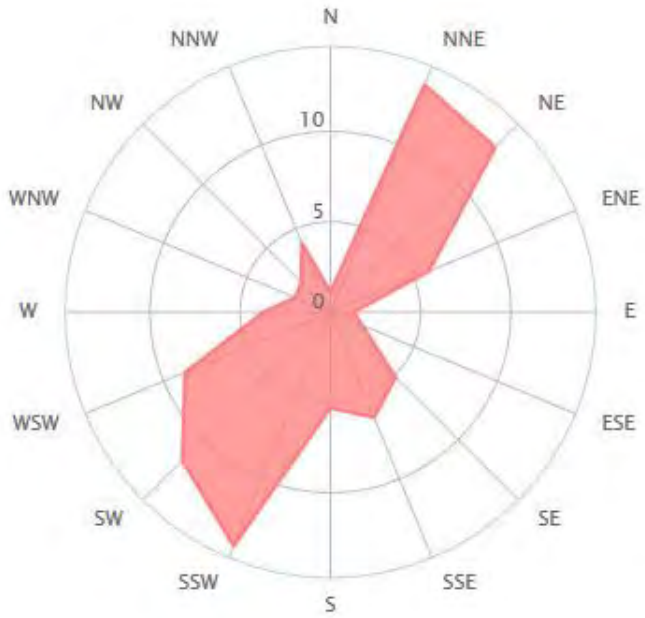
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high, °C	-3.2	-0.1	6.6	15.3	21.6	25.9	28.5	28.1	23.7	16.2	6.8	-0.4	14.1
Average low, °C	−13.1	-9.9	-2.5	5.8	12.5	18.2	21.7	20.5	14.1	6.3	-2.1	-9.2	5.2
Average precipitation, mm	6.8	6.3	12.1	31.5	53.9	69.0	175.3	149.4	67.9	41.1	21.5	8.5	643.3
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Average relative humidity (%)	62	59	58	58	61	70	79	79	72	67	66	64	66.3
Mean monthly sunshine hours	200	204	243	257	278	262	234	239	254	232	186	184	2,774

Source: China Meteorological Administration

87. **Frost-free Days.** There is an average of 194 frost free days per year in Yingkou. The first frost typically occurs in the first 10 days of October and typically ends in the first 10 days of April.

88. **Wind.** The average hourly wind speed in Yingkou experiences mild seasonal variation over the course of the year. The windier part of the year lasts for 3.8 months, from February 9 to June 4, with average wind speeds of more than 5.7 miles per hour. The windiest day of the year is April 15, with an average hourly wind speed of 6.8 miles per hour. The calmer time of year lasts for 8.2 months, from June 4 to February 9. The calmest day of the year is August 17, with an average hourly wind speed of 4.6 miles per hour. The dominant wind direction of the city is south-southwest, accounting for 14% of the total windy days per year and the secondary wind direction is north-northeast, accounting for 13.6%. Annual average wind speed is 3.9 m/s.

Figure 9: Yingkou Wind Rose



Source: www.windfinder.com/windstatistics/yingkou

89. **Water Resources.** There are 113 rivers in Yingkou with a water area of 414 km^2. The ten

major rivers in Yingkou are Daliao River, Daqing River, Huzhuang River, Xiongyuei River, Fudu River, Dahan River, Sha River, Laodong River, Minxing River and Biliu River. The total length of rivers in Yingkou is 1,801.4 km. In 2016, Yingkou city has 1.05 billion m^3 of water resources and 453 m^3 per capita.

D. Environmental Monitoring

1. Air Quality Monitoring

90. Air quality monitoring data from Anshan EPB, Chaoyang EPB and Yingkou EPB air quality monitoring station was collected over a 7-day period in mid-April 2017. Monitoring was undertaken for a minimum of 18 hours per day, allowing 24 hour averaging periods for SO_2, NO_2, $PM_{2.5}$ and PM_{10}. The results are presented in **Table 18**, which show that all parameters except 24-hr mean PM_{10} concentration of 18 April, 2017 in Chaoyang were in compliance with Class II of *Ambient Air Quality Standards* (GB3095-2012).

91. It is noted that site specific air quality monitoring will be undertaken during domestic EIA preparation.

Table 18: Air quality monitoring results (ug/m^3)

Location	Date	24-hr mean PM_{10}	24-hr mean $PM_{2.5}$	24-hr mean SO_2	24-hr mean NO_2
Anshan	18 April 2017	110	25	14	26
	19 April 2017	24	88	24	42
	20 April 2017	105	38	17	30
	21 April 2017	101	42	19	42
	22 April 2017	91	30	21	28
	23 April 2017	58	21	13	28
	24 April 2017	75	40	10	38
Chaoyang	18 April 2017	268	32	8	9
	19 April 2017	80	32	14	23
	20 April 2017	123	27	13	16
	21 April 2017	73	34	13	28
	22 April 2017	127	33	13	19
	23 April 2017	54	21	10	6
	24 April 2017	61	23	10	15
Yingkou	18 April 2017	83	19	6	12
	19 April 2017	46	19	16	26
	20 April 2017	95	55	16	45
	21 April 2017	56	26	10	19
	22 April 2017	64	30	15	22
	23 April 2017	48	20	15	23
	24 April 2017	84	50	20	42
	Limit	**150**	**75**	**150**	**80**

Note: Shading denotes a standard exceedance.
Source: www.aqistudy.cn

2. Surface Water

92. The surface water body near the subproject site in Anshan is Yunliang River (**Figure 10**). Yunliang River is close to the north boundary of Anshan Steel Plant and is 3,750 m away from the subproject site in north direction.

93. Surface water quality of Yunliang River in Anshan City should meet the Class IV of Environmental Quality Standards for Surface Water (GB 3838-2002). Surface water quality data was collected by PPTA consultant. Water quality monitoring was undertaken at upstream and downstream of Yunliang River from 25 May 2016 to 27 May 2016. The results were presented in **Table 19**.

94. From **Table 19**, it is concluded that Yunliang River in Anshan City cannot meet the Class IV of Environmental Quality Standards for Surface Water (GB 3838-2002). The major pollutants are chemical oxygen demand and ammonia nitrogen.

Figure 10: Surface water near Anshan Steel Plant

Source: Google map, 2017

Table 19: Surface water quality monitoring results (mg/l)

Date	Location	pH	COD	BOD	NH_3-N	Petroleum
25 May, 2016	Upstream	6.99	22	2.5	3.0	0.025
	Downstream	7.01	37	1.5	2.19	0.195
26 May, 2016	Upstream	7.01	10	6.4	7.92	0.038
	Downstream	7.04	59	1.7	2.2	0.027
27 May, 2016	Upstream	6.99	14	4.0	2.06	0.040
	Downstream	7.01	62	3.6	1.62	0.035
Limit		**6-9**	**30**	**6**	**1.5**	**0.5**

Note: Shading denotes a standard exceedance. COD = chemical oxygen demand; BOD_5 = 5 days biochemical oxygen demand; NH_3-N= ammonia nitrogen; SS= Suspended solids.
Source: Anshan EPB

95. The surface water body near the subproject site in Yingkou is Bohai Sea (**Figure 10**). Bohai Sea is close to Ansteel Bayuquan Steel Plant.

96. Sea water quality monitoring near the wastewater emission point of Ansteel Bayuquan Steel Plant was conducted by Yingkou Environment Monitoring Station in 15 March, 2016. Sea water samples were collected from nine monitoring points was. Detailed information of the nine monitoring points was presented in **Table 20**.

97. Monitoring parameters were pH, suspended solids、chemical oxygen demand (COD), dissolved oxygen (DO), cyanide, volatile phenol, petroleum, sulfide and copper. Monitoring results were presented in **Table 21**. From **Table 21**, it is concluded that sea water quality near Ansteel Bayuquan Steel Plant were compliance with Category IV of *Sea Water Quality Standard* (GB 3097-1997).

Figure 11: Surface water near Ansteel Bayuquan Steel Plant

Source: Google map, 2017

Table 20: Location of sea water quality monitoring points (mg/l)

No	Coordinate
1	N：40º18′38″ E：122º06′56″
2	N：40º18′50″ E：122º07′15″
3	N：40º19′01″ E：122º07′36″
4	N：40º18′48″ E：122º06′44″
5	N：40º19′01″ E：122º07′07″
6	N：40º19′13″ E：122º07′33″
7	N：40º18′58″ E：122º06′30″
8	N：40º19′13″ E：122º05′58″
9	N：40º19′28″ E：122º07′28″

Source: Yingkou EPB

Table 21: Sea water quality monitoring results (mg/l)

No	Parameter	Monitoring result	Standard
1	pH	8.45-8.56	6.8-8.8
2	dissolved oxygen	7.32-7.65	4
3	suspended solids	7.5-23.3	100
4	COD	0.52-2.52	4
5	cyanide	<0.0005	0.1
6	volatile phenol	0.0017-0.0043	0.01
7	petroleum	0.0125-0.0497	0.3
8	sulfide	<0.0002	0.1
9	copper	0.0048-0.0067	0.05

Source: Yingkou EPB

3. Noise

98. Noise quality monitoring data at the site boundaries of the three steel plants was provided by the subborrower. **Table 22** presents the monitoring data. The data shows that all the monitoring data is compliance with relevant standard: Class III of Emission standard for industrial enterprises noise at boundary (GB 12348-2008).

Table 22: Noise Monitoring Results

Monitoring date	Location	Monitoring point	Daytime dB(A)	Nighttime dB(A)
20 June, 2015	Anshan Steel Plant	East boundary	64.7	54.2
		South boundary	64.1	53.9
		West boundary	63.8	54.4
		North boundary	58.1	53.6
6 March, 2016	Ansteel Bayuquan Steel Plant	East boundary	58	53.7
		South boundary	63.7	54.5
		West boundary	61.2	51.6
		North boundary	59.5	49.2
6 June, 2016	Ansteel Chaoyang Steel Plant	East boundary	53.4	45.4
		South boundary	47.0	42.4
		West boundary	49.2	43.1
		North boundary	47.5	42.3
Standard			**65**	**55**

Source: Subborrower

E. Ecological Resources

99. Based on site survey by PPTA consultant, there are no known ecological and/or sensitive resources near the subproject site.

100. The subproject area is located in existing industrial areas. Virtually no original habitat remains. Habitats are rated as Ecological Impact Grade III (the lowest level) under the PRC's Technical Guideline on EIA Regarding Ecological Impact (HJ 19-2011).

1. Flora and Fauna at Subproject Site

101. The subproject site has little or no vegetation cover (**Figure 12**)**.** There are no known rare or endangered flora or fauna, parks, nature reserves or areas with special national, regional or local ecological significance within or adjacent to the subproject site.

Figure 12: Subproject site conditions

(i) Site condition near the No. 7 ESCO project

(ii) Site condition near the No. 4 ESCO project

2. Sensitive Receptors

6. The subproject is located within Anshan Steel Plant and there are some sensitive receptors for air quality and noise impacts near Anshan Steel Plant.

7. **Table 23** and **Figure 13** present sensitive areas near the subproject site. The surface water body near the subproject site is presented in **Figure 10**.

Figure 13: Sensitive areas in Anshan

Table 23: Sensitive areas in Anshan

Sensitivity	Area	Direction	Distance(m)	Function	Standard
Air quality	Xiaoying Village	W	1,300	Residential Area	Category II
	Lisantai Village	SW	900	Residential Area	Category II
	Qihong Community	S	600	Residential Area	Category II
	Wuyi Community	SE	900	Residential Area	Category II
Noise	Renzhang Village	E	1,300	Residential Area	Category II
	Sunjiatun Village	NE	900	Residential Area	Category II
	Wujiazhai Village	N	600	Residential Area	Category II
	Lutianyi Village	SW	900	Residential Area	Category II
Surfacewater	Irrigation Canal	E, S	750	Agricultural irrigation	Category IV

Figure 14: Sensitive areas in Chaoyang

Table 24: Sensitive areas in Chaoyang

Sensitivity	Area	Direction	Distance(m)	Function	Standard
Air quality	Xidayingzi Town	N	500	Residential Area	Category II
	Lalatun Village	NE	1,500	Residential Area	Category II
	Guojia Village	SE	560	Residential Area	Category II
	Lawopu Village	SW	950	Residential Area	Category II
Noise	Xidayingzi Town	N	500	Residential Area	Category II
	Lalatun Village	NE	1,500	Residential Area	Category II
	Guojia Village	SE	560	Residential Area	Category II
	Lawopu Village	SW	950	Residential Area	Category II

Figure 15: Sensitive areas in Yingkou

Table 25: Sensitive areas in Yingkou

Sensitivity	Area	Direction	Distance(m)	Function	Standard
Air quality	Fantun Village	E	3,200	Residential Area	Category II
	Shangtai Village	NE	6,500	Residential Area	Category II
	Dingtun Village	S	2,800	Residential Area	Category II
	Shenjingzi Village	SE	2,100	Residential Area	Category II
	Lutun Town	SE	5,800	Residential Area	Category II
	Xiaodongtun Village	N	1,800	Residential Area	Category II
Noise	Fantun Village	E	3,200	Residential Area	Category II
	Shangtai Village	NE	6,500	Residential Area	Category II
	Dingtun Village	S	2,800	Residential Area	Category II
	Shenjingzi Village	SE	2,100	Residential Area	Category II
	Lutun Town	SE	5,800	Residential Area	Category II
	Xiaodongtun Village	N	1,800	Residential Area	Category II
Sea water	Irrigation Canal	W	2,050	Industrial	Category IV

F. Socio-economic and Cultural Resources

1. Anshan City

102. Anshan is a prefecture-level city comprised of four districts, one town, one county and one autonomous county (**Figure 16**) with a total area of 9,249 km^2. Its population was 3.46 million at the end of 2015 (**Table 26**).

Figure 16: Map of Anshan City administrative divisions

Source: https://en.wikipedia.org/wiki/Anshan

Table 26: Data on Anshan City administrative divisions

Subdivision	Land Area (km²)	Population (2015)	Population Density (persons/km²)
Tiedong District	30	506,400	16880
Tiexi District	34	308,000	9060
Lishan District	55	424,600	7720
Qianshan District	503	284,300	565
Haicheng City	2,732	1,169,800	428
Tai'an County	1,393	315,600	227
Xiuyan Manchu Autonomous County	4,502	451,200	100

Source: Anshan Statistical Bureau, 2016

103. There are 31 ethnicities including Hui, Mongolian, Korean, Zang, uyghur and Manchu. Ethnic minorities account for 14.96% of the total population in Anshan and the rest is Han ethnicity. None of them will be affected by the subproject.

104. **Economy.** The north east of China is a major industrial zone and Anshan is one of the key sites of the northeast. The city is renowned as "China's capital of iron and steel". Prior to the

development of the Iron and Steel industries, Anshan was a relatively small city of little importance. As the steel mills expanded, so did the city. Spin off industries developed around the steel plant making the area a centre of heavy industry.

105. Anshan is rich in other mineral resources. The southern and south eastern areas of Anshan are rich in magnesite. Reserves of magnesite are equivalent to a quarter of all worldwide reserves. Anshan also has the world's largest reserve of talcum, accounting for fully one third of the entire world supply. The Xiuyan area of Anshan is known for the production of the precious stone, Jade.

106. In 2015, the city's GDP was CNY 234.9 billion, of which the primary sector accounted for 5.8% or CNY 13.6 billion; the secondary sector accounted for 47.5% or CNY 111.6 billion; and the tertiary sector accounted for 46.7% or CNY 109.70 billion.

107. **Transportation** .Anshan has no river or sea port. The nearby military airport, Anshan Teng'ao Airport, also accepts commercial domestic flights. Currently there are two routes in operation, Anshan–Beijing and Anshan–Shanghai, with one flight each per day throughout the year.

108. Anshan is beside the Shenyang–Dalian Expressway (part of the G15 Shenyang–Haikou Expressway), a privately funded eight-lane toll highway and was the first road of its kind in the PRC. The Liaozhong Ring Expressway (G91) passes just a few kilometers north of Anshan city. It connects east to Benxi and west onto the Jingshen Expressway (G1). The Panhai and Danxi Expressways (together forming the G16) pass through Anshan's counties of Haicheng and Xiuyan, connecting them to Yingkou and Panjin in the west and Dandong to the east.

109. Anshan is connected to the Chinese rail network with rail routes to Beijing, Dalian, and to the northeastern provinces of Jilin and Heilongjiang as well as to eastern Inner Mongolia, and even a direct, albeit slow, train to Hong Kong. As of December 2012, the new Harbin–Dalian High-Speed Railway serves Anshan West Railway Station and Haicheng West Railway Station. It connects south to Dalian and north east to Shenyang, Changchun and Harbin. This line was the world's first alpine high-speed rail line. In summer it runs at its full speed of 300kph but in winter speeds are restricted to 200kph. High-speed services also run via Anshan to Beijing.

110. **Physical Cultural Resources.** The area of Anshan has been inhabited since prehistoric times. The area remained of little significance, a small city in Liaoning province, overshadowed by neighbouring Liaoyang city, until the city became "China's capital of iron and steel" in the mid 20th Century. The project activities are all in highly developed and modified industrial areas. There are no known physical cultural resources (PCRs) in the subproject site.[4]

4 Physical cultural resources (PCRs) are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings and may be above or below ground or under water. Their cultural interest may be at the local, provincial, national, or international level. Within the Project area these could include:

- Funeral site: graves, cemeteries, shrines, stupas.
- Religious buildings: Temples or Pagodas, complete or ruins.
- Religious objects: Buddhist images or sculpture.
- Sacred sites: sacred caves, forest, hills or cliffs.
- Historical sites or objects: artifacts, tools, relics, memorials.
- Spirit sites: sites residents believe are occupied by a spirit (house, tree, stone, etc.).

2. Chaoyang City

111. Chaoyang is divided into 7 administrative areas. The area under Chaoyang's jurisdictional control is split up into two counties (Jianping, Chaoyang), two urban districts (Longcheng, Shuangta), two county-level cities (Beipiao, Lingyuan), and the Harqin Zuoyi Mongolian Autonomous County. (**Figure 17**) with a total area of 9,249 km^2. Its population was 3.41 million at the end of 2015 (**Table 27**).

Figure 17: Map of Chaoyang City administrative divisions

Source: https://en.wikipedia.org/wiki/Chaoyang,_Liaoning

Table 27: Data on Chaoyang City administrative divisions

Subdivision	Land Area (km²)	Population (2016)	Population Density (persons/km²)
Shuangta District	500	387,840	776
Longcheng District	641	208,837	326
Beipiao City	4,469	596,676	134
Lingyuan City	3,297	646,399	196
Chaoyang County	3,751	566,843	151
Jianping County	4,838	576,787	119
Harqin Zuoyi Mongolian Autonomous County	2,240	427,618	191

Source: Chaoyang Statistical Bureau, 2016

112. There are 33 ethnicities including Hui, Mongolian, Korean, and Manchu. Ethnic minorities account for 7.64% of the total population in Chaoyang and the rest is Han ethnicity. None of them will be affected by the subproject.

113. **Economy.** Agriculture forms the backbone of Chaoyang's economy. In addition to wheat, corn, beans, and potatoes, Chaoyang is also an important region for the growing of cotton and fruit. The city has also begun to venture into the production of shaji (sea-buckthorn berries), which have become popular in China because of their dual use as food and as medicine. Chaoyang is home to the largest man-made thicket of shaji. Chaoyang has more than 1,600 industrial enterprises, manufacturing a wide range of products including steel, machinery, textiles, diesel engines, automobiles, and paper. Lingyuan Iron and Steel Works and the Liaoning Tyre Factory are two of the largest such enterprises.

114. In 2016, Chaoyang's GDP was CNY 70.89 billion, of which the primary sector accounted for 26.0% or CNY 1.84 billion; the secondary sector accounted for 22.6% or CNY 1.60 billion; and the tertiary sector accounted for 51.4% or CNY 36.44 billion.

115. **Transportation**. Chaoyang is about 300 kilometers from Shenyang. After completion of the Shenyang-Beijing high speed railway project around 2019, the time between Chaoyang and Beijing will be shortened from three to two hours. Then Chaoyang will be connected to the Chinese rail network with rail routes to Beijing, Dalian, and to the northeastern provinces of Jilin and Heilongjiang. As of December 2012, the new Harbin–Dalian High-Speed Railway connects south to Dalian and north east to Shenyang, Changchun and Harbin. Chaoyang is beside the Changchun–Shenzhen Expressway (G25), Beijing–Shenyang Expressway (G101) and Dandong–Xilinhaote Expressway (G16) which connected Chaoyang to Chinese expressway with routes to Beijing, Shenyang, Chanchun and Dalian.

116. **Physical Cultural Resources.** Chaoyang has a long and rich history. The discovery of the over five-thousand-year-old Niuheliang Hongshan Cultural Ruins in the region has drawn attention to Chaoyang as one of the birthplaces of ancient Chinese culture Chaoyang, has become the focus of great interest in the world of palaeontology. During the 1990s, many new, unique and fascinating fossils were discovered in this region. The ESCO project activities are all in highly developed and modified industrial areas. There are no known PCRs in the ESCO project site.

3. Yingkou City

117. Yingkou prefecture is into four districts(Zhan Qian district, Xi Shi district, Lao Bian district and Bayuquan district), two county-level cities(Da Shi Qiao city and Gai Zhou city) (**Figure 18**) with a total area of 4,970 km^2. Its population was 2.44 million at the end of 2016 (**Table 28**).

Figure 18: Map of Yingkou City administrative divisions

Source: https://en.wikipedia.org/wiki/Yingkou

Table 28: Data on Yingkou City administrative divisions

Subdivision	Land Area (km^2)	Population (2016)	Population Density (persons/km^2)
Zhanqian District	70	275,826	3940
Xishi District	20	169,739	8487
Baoyuquan District	268	318,261	1188
Laobian District	306	137,913	451
Dashiqiao City	1,379	763,826	554
Gaizhou City	2,928	774,435	264

Source: Yingkou Statistical Bureau, 2016

118. There are 39 ethnicities including Hui, Mongolian, Korean, Zang, uyghur and Manchu. Ethnic minorities account for 7% of the total population in Yingkou and the rest is Han ethnicity. None of them will be affected by the subproject.

119. **Economy**. Yingkou, in the process of the 50 years development in China, has became an industrial city with completed industrial sectors ,including textile, machinery, electronics, petrol-chemistry, medicine, construction material and home appliances. In the city, there are more than 3,000 enterprises in 40 industrial sectors with 1700 kinds of products. The production capacities of textile, dyeing and nylon yarn in Yingkou rank the first in Liaoning Province. The salt chemical industry in Yingkou has a long history. The paper making and cigarette sectors in Yingkou have important positions in China. And the alarming equipments, mini-motors, medium plate rolling, cement, fluid equipments in Yingkou city are well known in Liaoning Province.

120. In 2015, Yingkou's GDP was CNY 151.4 billion, of which the primary sector accounted for 7.3% or CNY 11.1 billion; the secondary sector accounted for 48.1% or CNY 72.8 billion; and the tertiary sector accounted for 44.6% or CNY 67.5 billion.

121. Yingkou is rich in natural resources, which makes Yingkou have an important economic position and development potential. The magnesite reserve, among the 32 kinds of minerals explored in Yingkou, is one of the four largest magnesite reserves in the world. Dashiqiao, the magnesite metropolis of China, is located in the east part of Yingkou City. The reserves of talcum, boron, feldspar, silicon and gold rank in the front in China. The reserve of oil and natural gas is also very rich. Yingkou has 122 km long coastline, and 973,236 acres of tidal flat areas. The sea salt product is 800,000 tons per year on the one hundred miles circled slat fields.

122. Yingkou is well-known for its agricultural and sideline products such as rice, fruits and aquatic products. The rice fields in Dashiqiao and fruit orchards in Gaizhou are very famous in the nation. The annual output of rice is 400,000 tons, output of fruits such as apple, grape, peach, plum and apricot is 400,000 tons, and output of more than 80 kinds of aquatic products such as jellyfish, shrimp, crab and river crab is 160,000 tons. The development and utilization of some agricultural resources has had a certain scale, such as the crab cultivation in paddy fields, greenhouse fruits and flowers. Yingkou is also the base of fine hair goats, tussah and deer.

123. **Transportation**. Yingkou is the second largest beautiful port city in the region. Since then Yingkou City has enjoyed the advantage of one city with two ports. Now, the annual handling capacity of Yingkou Port is up to 20 million tons, one of the ten largest ports in China. Until now, Yingkou Port has opened the navigation courses with more than one hundred ports of more than 40 countries and regions, the international container cargo shipping lines have been put into

operation as well. After the third phase of construction of Yingkou Port has been finished, its handling capacity will reach to 50 million tons a year.

124. Yingkou is also one of the areas with the most advanced land transportation. The railway and highway in northeast China pass through the whole city, which connected Yingkou into the communication networks between northeast Asia and east Europe. Anshan is connected to the Chinese rail network with rail routes to Beijing, Dalian, and to the northeastern provinces of Jilin and Heilongjiang as well as to eastern Inner Mongolia, and even a direct, albeit slow, train to Hong Kong. By Shenyang-Dalian Expressway, it is easy to go to the other larger industrial cities in the Province or to the other place from Yingkou. It takes about two hours to get to Shengyang or Dalian International Airport and six hours to Beijing by car.

125. **Physical Cultural Resources.** Yingkou has a very long history, which can be traced back to 280,000 years ago. Yingkou was historically known as Newchwang in postal romanization; it was one of the Treaty Ports opened under the Treaties of Tianjin of 1858. Yingkou has become an industrial city with completed industrial sectors, including textile, machinery, electronics, petrol-chemistry, medicine, construction material and home appliances. The ESCO project activities are all in highly developed and modified industrial areas. There are no known PCRs in the ESCO project site.

V. ANTICIPATED IMPACTS AND MITIGATION MEASURES

126. Anticipated positive and negative environmental impacts of the proposed subproject were assessed based on the FSR ; a technical due diligence review of the FSR undertaken by ADB PPTA specialists; and site visits, surveys and consultations undertaken by ADB PPTA consultants.

127. Environmental impacts during pre-construction, construction and operation phases were considered separately. The results of the assessment indicate that during the pre-construction phase environmental issues are very limited, and are mostly associated with ensuring appropriate incorporation of mitigation measures into the subproject design.

128. Potential negative environmental impacts during construction phase are short-term and localized, and are associated with soil erosion, construction noise, fugitive dust, disruption of traffic and community services, and risks to worker health and safety. Potential negative impacts during operation phase are associated with boiler emissions, odor, waste and wastewater, noise, and health and safety risks to workers.

129. Potential positive operation phase impacts are significant and long-term, and are associated with energy saving and emission reduction. The subproject will in total replace 35,887.6 tce, equaling to 100,135.1 tons of CO_2, 8,668.6 tons of SO_2, 272.2 tons of NO_X, and 1,464.6 tons of PM.

A. Measures to be Implemented during Detailed Design During Pre-Construction Phase

1. Siting and Land Acquisition

130. Because the subproject is located in existing Anshan Steel Plant, Ansteel Bayuquan Steel Plant and Ansteel Chaoyang Steel Plant, the subproject will not result in any involuntary land acquisition, resettlement or physical displacement, and there will be no loss of personal property, structures, crops, trees or other assets. There are also no potential adverse impacts on disadvantaged or vulnerable groups, including the poor, women and children, and Indigenous Peoples.

2. Mitigation Measures and Monitoring during Detailed Design

131. Mitigation measures to be adopted during detailed design to minimize the environmental impacts are as follows:

(i) Detailed Design. Environmental mitigation measures included in this IEE, the EMP and the domestic EIA will be incorporated into the detailed design.

(ii) Bidding Documents and Contracts. Environmental mitigation measures included in this IEE, the EMP and the domestic EIA will be included in contracts for civil works and equipment installations. All contractors will be required to strictly comply with the EMP.

3. Grievance Redress Mechanism

132. In accordance with the GRM presented in Chapter VIII of the IEE, a staff member from subborrower will be assigned overall responsibility for the GRM; GRM training will be provided to

subborrower; and the GRM access point phone numbers, fax numbers, addresses and emails will be disclosed to the public.

4. Training and Capacity Building

133. An institutional strengthening and training program will be delivered by environmental consultants and experts (see **Table 4** in **Appendix I**). The training will focus on ADB's and PRC's environmental, health and safety laws, regulations and policies; implementation of the EMoP; the GRM; and international good EHS practices. Training will be provided to the subborrower, relevant staff and contractors and the construction supervision company personnel.

5. Permitting

134. All necessary permits will be obtained from the relevant authorities before construction.

B. Anticipated Impacts and Mitigation Measures during Construction Phase

1. Erosion and Spoil

135. Only No. 1 and No. 2 project will have civil work which is for heat exchange facilities construction. Construction activities such as land leveling, excavation and filling activities may lead to surface erosion. The most vulnerable soil erosion areas in the construction site include excavation sites, leveling sites, spoil sites, temporary construction sites, and other areas where surface soil is disturbed. Soil erosion can also be more serious on slopes or near water bodies. Soil erosion can also occur after the completion of construction if site restoration is inadequate. Finally, construction activities may generate surplus spoil.

136. These impacts can be mitigated through typical good construction practice, erosion controls and site maintenance:

(i) At construction site, the potential for storm water runoff will be assessed and appropriate storm water drainage systems to minimize soil erosion will be implemented, including perimeter bunds and establishment of temporary detention and settling ponds to control topsoil runoff if needed.
(ii) Land excavation and filling will be balanced to minimize the requirement for fill transportation.
(iii) During earthworks, the area of soil exposed to potential erosion at any one time will be minimized through good project and construction management.
(iv) Spoil will be reused on-site to the maximum extent feasible as fill. Temporary spoil storage sites will be identified, designed, and operated to minimize impacts. Spoil sites will be restored after the completion of storage activities. Excess spoil that cannot be used on-site will be transported to an approved spoil disposal site.
(v) Spoil and aggregate piles will be covered with landscape material and/or regularly watered.
(vi) Waste construction materials will be used for backfill at the sites to the maximum extent feasible.
(vii) Construction and material handling activities will be limited or halted during periods of rains and high winds.
(viii) Once construction is complete disturbed surfaces will be properly restored.

2. Wastewater

137. Waste water generated during construction phase will be domestic wastewater and construction wastewater. Because only No. 1 and No.2 ESCO project will have civil work, construction work camps will be built for these two ESCO projects. For No. 1 and No. 2 ESCO project, domestic wastewater will be from construction worker camps and workers and construction wastewater will from drainage of excavation and drilling, washing aggregates, washing construction equipment and vehicles, pouring and curing concrete, and oil-containing wastewater from machinery repairs. For other ESCO projects, domestic wastewater will be mainly from construction workers and construction wastewater will be mainly oil-containing wastewater from equipment installation and clean.

138. Inappropriate disposal of domestic wastewater or construction wastewater may cause soil, surface and/or groundwater resources contamination.

139. These impacts can be mitigated through typical good wastewater management practices:

(i) For No. 1 and No. 2 ESCO projects, wastewater from construction worker camps will be discharged to existing sewer and treated in existing WWTPs.

(iii) For all ESCO projects, existing sanitary facilities with septic tanks will be provided for construction workers and domestic wastewater from construction workers will be discharged to existing sewers and treated in existing WWTPs.

(iv) For No. 1 and NO. 2 ESCO projects, construction wastewater will be directed to temporary detention and settling ponds. Areas where construction equipment is being washed will be equipped with water collection basins and sediment traps. After settling, supernatant will be recycled and sediment will be periodically excavated, and either reused if possible as fill, disposed at official landfill. All construction wastewater will be discharged to existing sewer and treated in existing WWTPs.

(v) For other ESCO projects, construction wastewater which is mainly oil-containing wastewater will be collected and discharged to existing sewer and treated in existing WWTPs.

(vi) For all ESCO projects, maintenance of construction equipment and vehicles will not be allowed on site so as to reduce wastewater generation.

3. Air Pollution Impact

140. Because No. 1 and No.2 ESCO project will have civil work, anticipated sources of air pollution from construction activities of No. 1 and NO. 2 ESCO project include: (i) dust generated from earth excavation, filling, loading, hauling and unloading; (ii) dust generated from disturbed and uncovered construction areas, especially on windy days; (iii) dust generated from construction material storage areas, especially on windy days; (iv) dust generated by the movement of vehicles and heavy machinery on unpaved access and haul roads; (v) dust generated from aggregate preparation and concrete-mixing; and (vi) emissions from construction vehicles (gaseous CO and NO_2) and heavy diesel machinery and equipment.

141. To reduce air quality impacts from No. 1 and No. 2 ESCO project during the construction period, the following air quality management measures will be implemented:

(i) Project site under construction will be fully enclosed by fence prior to the commencement of construction.

(ii) Water will be sprayed on active construction sites including where fugitive dust is being generated on a daily basis, and more frequently during windy days.

(iii) All construction piles (spoil, aggregate other construction materials) with the potential to generate dust will be covered and/or regularly watered.
(iv) Construction activities will be halted during high wind events. Once construction is complete disturbed surfaces will be properly restored.
(v) Transport vehicles will be limited to low speeds in construction sites.
(vi) Loads will be covered during truck transportation to avoid spillage or fugitive dust generation. Fine materials will be transported in fully contained trucks.
(vii) Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds.
(viii) Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical.

142. For other ESCO projects, air pollution during construction period will be limited and mainly from hauling and unloading and emissions from transportation vehicles.

143. To reduce air quality impacts from other ESCO projects during the construction period, the following air quality management measures will be implemented:
(i) Transport vehicles will be limited to low speeds in construction sites.
(ii) Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds.
(iii) Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical.

4. Noise Impacts

144. Because No. 1 and No.2 ESCO project will have civil work, during construction phase of No.1 and No.2 ESCO project, noise and vibration will be generated by on site construction activities using heavy equipment such as bulldozers, excavators, and by the transport of construction materials. Construction equipment is considered a point noise source, and the predictive model is as follows:

(a) $$L_i = L_0 - 20\lg\frac{R_i}{R_0} - \Delta L$$

(b) Where, L_i and L_0 are equipment noise sound levels at R_i and R_0, respectively, ΔL is additional decrement produced by barriers, vegetation and air.

145. For the impact of multiple construction machines on a location, sound level superposition uses the following formula:

$$L = 10\lg\Sigma 10^{0.1\times L_i}$$

146. A significant increase in localized noise is expected during construction. Construction activities will involve excavators, bulldozers, concrete-mixing plants, loaders, graders, rollers, and other heavy machinery, as well as noise from goods and material transportation. Noise during construction will be generated by construction activities.

147. The construction phase of No. 1 and NO. 2 ESCO project can be divided into 4 stages: earthworks, foundation construction, structure construction and final finishing:
- The main noise sources during the earthwork stage will be non-directive mobile

sources including excavators, bulldozers, loaders and transport vehicles.

- The main noise sources during foundation construction stage will be stationary, including pile machines, land levelers, etc. Although the foundation construction phase period is short, predicted noise levels are high, ranging from 95-105 dB(A).
- The structure construction stage is the longest period in the construction phase. There are a variety of noise sources in this phase including concrete mixers, heavy equipment, cranes, etc.
- The final finishing stage is also lengthy. Main noise sources include electrical saws, drills, cutting machines etc. Noise levels from these noise sources range from 85-95 dB(A) and are short in duration.
- Materials and equipment transport can occur in all four phases.

148. Though noise levels may be high, the impacts will be temporary and localized, and can be further mitigated.

149. To ensure construction activities meet PRC noise standards and to protect workers, the following mitigation measures will be implemented of No. 1 and No. 2 ESCO project:

(i) Construction activities, and particularly noisy ones, are to be limited to reasonable hours during the day and early evening. Construction activities will be strictly prohibited during the nighttime (22:00 h to 07:00 h). Exceptions will only be allowed in special cases, and only after getting approval of the surrounding residents, local EPB and other relevant departments.

(ii) Simultaneous high-noise activities will be avoided, and high noise activities will be scheduled during the day rather than evening hours. Similarly, construction sites will be planned to avoid multiple high noise activities or equipment from operating at the same location.

(iii) Low-noise equipment will be selected as much as possible. Equipment and machinery will be equipped with mufflers and will be properly maintained to minimize noise.

(iv) Noise personnel protective equipment (PPE) will be provided to workers.

(v) Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and rush hours.

(vi) Vehicles transporting construction materials or waste will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals.

(vii) Based on the site visit, the nearest sensitive receptors near the subproject site are presented in

(viii) **Table 23** and **Table 24**. Special attention will be paid to protect sensitive sites near the subproject: high noise construction activities will be positioned as far away from sensitive sites as possible. Based on noise monitoring result in **Table 22**, estimated noise level generated in high noise construction activities and formula above, the noise level at the sensitive receptors during high noise construction activities can be compliance with relevant standard without temporary or permanent noise barriers.

150. For other ESCO projects, noise during construction period will be limited and mainly from hauling and unloading activities, equipment installation and transportation vehicles.

151. To reduce noise impacts from other ESCO projects during the construction period, the following noise management measures will be implemented:

(i) Transport vehicles will be limited to low speeds in construction sites.

(ii) PPE will be provided to workers.
(iii) Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and rush hours.
(iv) Vehicles transporting construction materials and equipment will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals.

5. Solid Waste

152. For No. 1 and No.2 ESCO project, solid waste generated in the construction phase will include construction and domestic waste. Construction wastes include fill, various building materials such as steel, timbers, rubble, waste pipe, waste thermal insulation materials and waste from equipment and pipeline cleaning. An estimated of 0.5 kg/day per worker of domestic waste will be generated from construction workers and 2.0 kg/m^2 construction waste will be generated from construction activities.

153. For No. 3, 4 and 5 ESCO projects, solid waste generated in the construction phase will include construction waste and domestic waste. Construction wastes are mainly from equipment cleaning. An estimated of 0.5 kg/day per worker of domestic waste will be generated from construction workers.

154. For No. 6 and 7 ESCO projects, solid waste generated in the construction phase will include replaced equipment, construction waste and domestic waste. Construction wastes are mainly from equipment cleaning. An estimated of 0.5 kg/day per worker of domestic waste will be generated from construction workers.

155. Inappropriate waste storage and disposal could affect soil, groundwater, and surface water resources, and hence, public health and sanitation. To avoid solid wastes impacts, the following solid waste management measure will be implemented:

(i) For all ESCO projects, littering by workers will be prohibited.
(ii) For all ESCO projects, existing domestic waste containers will be used for domestic waste collection at work sites. Domestic waste will be collected on a regular basis by the local sanitation departments and transported for recycling, reuse, or disposal at licensed landfills, in accordance with relevant PRC regulations and requirements.
(iii) For all ESCO projects, construction waste dumpsters will be provided at all work sites. Construction waste will be collected on a regular basis by a licensed waste collection company and transported for recycling, reuse, or disposal at licensed landfills, in accordance with relevant PRC regulations and requirements.
(iv) For all ESCO projects, contractors will be held responsible for proper removal and disposal of any significant residual materials, wastes, and contaminated soils that remain on the site after construction
(v) For No.1 and No. 2 ESCO projects, construction wastes generated during civil work will be reused or recycled to the extent possible and other construction wastes will be collected on a regular basis by licensed waste collection companies and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements.
(vi) For No.3, No. 4, No. 5, No. 6 and No. 7 ESCO projects, construction wastes be collected on a regular basis by licensed waste collection companies and with transported for recycling, reuse, or disposal at a licensed landfill, in accordance

with relevant PRC regulations and requirements.

(vii) For No.3, No. 4, No. 5, No. 6 and No. 7 ESCO projects, construction wastes be collected on a regular basis by licensed waste collection companies and transported for recycling, reuse, or disposal at a licensed landfill, in accordance with relevant PRC regulations and requirements.

(viii) For No. 6 and No. 7 ESCO projects, replaced equipment will be collected, transported by licensed companies in accordance with relevant PRC regulations and requirements.

(ix) For all ESCO projects, there should be no final waste disposal on site. Waste incineration at or near the site is strictly prohibited.

6. Hazardous and Polluting Materials

156. Inappropriate transportation, storage, use and spills of petroleum products and hazardous materials can cause soil, surface and groundwater contamination. To prevent this, the following mitigation measures will be implemented:

(i) A hazardous material handling and disposal protocol that includes spill emergency response will be prepared and implemented by contractors.

(ii) Because the subproject will be implemented in three existing steel plants, fuels, oil, chemicals and other hazardous materials will be stored at existing hazardous storage facilities with appropriate safety measures signs and information on type and name of chemicals and hazardous materials.

(iii) Suppliers of chemicals and hazardous materials must hold proper licenses and follow all relevant protocols and PRC regulations and requirements.

(iv) Because the subproject will be implemented in three existing steel plants and the steel plants have hired some Liaoning EPB certificated hazardous treatment companies (the list can be found in www.lnepb.gov.cn/zfxxgk/tzgg/wxfwjgfglgg/201707/t20170703_76781.html) to collect, transport, and dispose of hazardous materials, these companies will be hired to collect, transport, and dispose of hazardous materials in accordance with relevant PRC regulations and requirements also hazardous waste.

7. Impacts to Flora and Fauna

157. Typical construction impacts on flora and fauna include removal of vegetation and disruption of the ecosystem during construction. If present, rare or endangered flora or fauna may also be impacted. However, the subproject construction site is located in existing industrial areas. There is no known rare or endangered flora or fauna, parks, nature reserves or areas with special ecological significance which will be impacted by the subproject.

8. Impacts on Community Disturbance and Safety

158. Project construction activities have the potential to cause community disturbance such as traffic congestion or delays, and public safety risks from heavy vehicles and machinery traffic. Mitigations will be implemented to address traffic and other community disturbance issues.

(i) Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and rush hours.

(ii) Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations, such as residential communities, schools and hospitals.

(iii) Because construction activities are all inside existing steel plants, the public will not have access to the construction sites. To protect workers of the existing steel plants, signs will be placed at construction sites in clear view of workers, warning of potential dangers such as vehicle moving.

9. Occupational Health and Safety

159. Construction may cause physical hazards to workers from noise and vibration, dust, handling heavy materials and equipment, falling objects, work on slippery surfaces, fire hazards, chemical hazards such as toxic fumes and vapors, and others.

160. Contractors will be required to implement adequate precautions to protect the health and safety of their workers:

(i) Each contractor will implement the relevant construction phase EHS plan.
(ii) Identify and minimize the causes of potential hazards to workers. Implement appropriate safety measures.
(iii) Provide training to workers on occupational health and safety, emergency response, especially with respect to using potentially dangerous equipment and storage, handling and disposal of hazardous waste.
(iv) Ensure that all equipment is maintained in a safe operating condition.
(v) Provide appropriate PPE to workers.
(vi) Implement work practices to limit workers' exposure to high noise or heat working environments in compliance with PRC noise standards for construction sites (GB 12523-2011).
(vii) Ensure regular safety meetings with staff.
(viii) For No. 1 and No. 2 ESCO projects, ensure that material stockpiles or stacks, such as, pipes are stable and well secured to avoid collapse and possible injury to workers.

10. Physical Culture Resources

161. Based on a site visit there are no known cultural heritage or archaeological sites at or near the subproject site. However, construction activities have the potential to disturb unknown underground cultural relics. To address this issue, a construction phase chance find procedure will be established and activated if physical culture resources (PCRs) are encountered:

(i) construction activities will be immediately suspended if any PCRs are encountered;
(ii) destroying, damaging, defacing, or concealing PCRs will be strictly prohibited in accordance with PRC regulations;
(iii) local Cultural Heritage Bureau will be promptly informed and consulted; and,
(iv) construction activities will resume only after thorough investigation and with the permission from the local Cultural Heritage Bureau.

C. Anticipated Impacts and Mitigation Measures During Operation Phase

162. The subproject may cause some adverse environmental impacts during operation including noise from subproject operation, production of wastewater and solid wastes, and fire and safety hazards.

1. Air Pollution

163. For the seven ESCO projects, no exhaust gas will be generated during subproject operation, thus there is no anticipated air pollution impact from exhaust gas emission.

2. Wastewater

164. The No.1 ESCO project will use municipal water as domestic water and production water. Domestic wastewater will be from workers. Production wastewater will mainly from water demineralization for waste heat boiler. The No.2 ESCO project will use municipal water as domestic water and production water. Domestic wastewater will be from workers. Production wastewater will mainly from water demineralization for hear supply. For other ESCO projects, domestic water will be municipal water and no production water is needed. Domestic wastewater will be from workers.

165. The following measures will be taken to address production and domestic wastewater:

(i) For all ESCO projects, existing sanitary facilities with septic tanks will be provided for workers and domestic wastewater from workers will be discharged to existing sewer and treated in existing WWTP.
(ii) For No.1 ESCO project, production wastewater will be reused or recycled at Ansteel Chaoyang Steel Plant as much as possible.
(iii) For No.2 ESCO project, production wastewater will be reused or recycled at Anshan Steel Plant as much as possible.

3. Solid Waste

166. The subproject will generate domestic waste and production waste. To mitigate this risk, the following measures will be implemented:

(i) For all ESCO projects, domestic waste bins will be provided and domestic waste will be routinely collected by the local sanitation department for recycling, if possible, or final disposal at an approved waste disposal site.
(ii) For all ESCO projects, no permanent on-site solid waste disposal will be permitted at project site.
(iii) For all ESCO projects, no burning of wastes will be permitted at project site.
(iv) For all ESCO projects, waste oil from equipment maintenance will be collected, transported and treated by Liaoning EPB certificated 3rd hazardous waste treatment companies (the certificated companies list can be found in www.lnepb.gov.cn/zfxxgk/tzgg/wxfwjgfglgg/201707/t20170703_76781.html) hired by the three steel plants.
(v) For No.1 ESCO project, waste resin will be collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company (the certificated companies list can be found in www.lnepb.gov.cn/zfxxgk/tzgg/wxfwjgfglgg/201707/t20170703_76781.html) hired by Ansteel Chaoyang Steel Plant.

4. Noise

167. Noise sources during operation will mainly be from noise from equipment operation. To mitigate noise impacts the subproject will implement the following measures:

(i) Low-noise equipment will be used as far as possible, and noise reduction measures such as noise elimination, shock absorption, insulated enclosures and sound dampening materials on exterior walls will be implemented.
(ii) All equipment will be properly maintained to minimize noise.
(iii) Appropriate noise PPE will be provided to the workers who are likely to be exposed to high noise level environments.
(iv) For No.1 ESCO project, layout for boiler building will be reasonable planned to reduce noise.
(v) For No. 2 ESCO project, layout for heat exchange facilities will be reasonable planned to reduce noise.

5. Occupational and Community Health and Safety

168. Plant operation poses risks to workers and community. Accidental release of chemicals and hazardous materials may present health and safety risks to workers and community.

169. To mitigate potential health and safety risks, the following measures will be taken:
(i) Operation phase EHS plans including fire prevention and control will be developed and implemented, and workers will be trained regularly on their implementation.
(ii) PPEs including goggles, gloves, safety shoes, will be provided to workers.
(iii) Material Safety Data Sheet (MSDS) for hazardous materials in a given work area will be made available to any worker who is in the area. This may be a paper or electronic system.
(iv) No unauthorized personnel should be allowed into the process area.
(v) Provide training to workers on occupational health and safety and emergency response.
(vi) Drivers will be required to follow traffic management regulations.

6. Emergency Response Plan

170. An emergency risk and response plan will be established in accordance with the "National Environmental Emergency Plan" (24 January 2006) and other relevant PRC laws, regulations and standards and will include measures in the World Bank EHS Guidelines with respect to occupational and community health and safety. Regular review of emergency response plan will be conducted.

D. Anticipated Positive Impacts during Operation Phase

171. **Waste heat recovery from flue gas of heating oven at Chaoyang Steel Plant.** This project consumes 183,600 tons softened water, 100.8 tons cooling water, 7,200 tons fresh water and 7.26 GWh electricity to recover 165,600 tons steam with the temperature at 194℃ and pressure at 1.3 MPa (or 460,368 GJ) per year from flue gas. The subproject will save 13,849.5 tce energy annually. The coal-fired boiler and coal-fired power plant are reference cases for emission reduction calculation. The coal-fired boiler will consume 19,634.7 tce of coal to generate 460,368 GJ of steam and emit CO_2, SO_2, NOx and PM by 51,364.4, 8,639.3, 245.4, and 1,458.9 tons, respectively. The electricity consumed by the project will emit CO_2, SO_2, NOx, and PM by 5,516.1, 3.41, 3.12 and 0.65 tons, respectively. The project will reduce emission of CO_2, SO_2, NOx, and PM by 45,848.3, 8635.9, 242.3, and 1458.3 tons, respectively.

172. **Waste heat recovery for resident space heating at Ansteel.** This project will save

551,050 GJ blast furnace gas to generate 61.2 GWh power. Deducting the 20.2 GWh electricity consumed by the heat pump system, the project will generate 41.0 GWh more electricity that equal to 13,038 tce savings. It will reduce CO_2, SO_2, NOx, and PM by 31,992.3, 19.27, 17.63, and 3.69 tons, respectively.

173. **Other five projects.** These projects will all save electricity. The thermal power plant is the reference case for energy savings and pollutant mitigation calculations. The total energy savings and emission reduction is summarized in **Table 29**.

174. Overall, the seven selected projects will in total replace 35,887.6 tce, equaling to 100,135.1 tons of CO_2, 8,668.6 tons of SO_2, 272.2 tons of NO_X, and 1,464.6 tons of PM.

Table 29: Energy Savings and Pollutant Mitigation

Project name	**Energy Savings (tce)**	**CO_2 (t)**	**SO_2 (t)**	**NO_x (t)**	**PM (t)**
Waste Heat Recovery from Flue Gas of Heating Furnace at Chaoyang Steel Plant	13,849.5	45,848.3	8635.9	242.3	1458.3
Industrial Waste Heat Recovery for Residential District Heating in Anshan	13,038 (41 GWh)	31,992.3	19.27	17.63	3.69
Reconstruction of 100-ton Mechanical Vacuum Degassing in Anshan	1,696.3 (5.385 GWh)	4,201.9	2.53	2.32	0.48
Energy-Saving Reconstruction on High-Pressure Quenching Water Pump at Bayuquan Heavy Plate Mill	849.6 (2.697 GWh)	2,104.5	1.27	1.16	0.24
Draft Fan Frequency Adjustment at Bayuquan Pelletizing Plant	1836.0 (5.8287 GWh)	4,548.1	2.74	2.51	0.52
Water Pump Replacement at Anshan Steel Plant	2,352.1 (7.467 GWh）	5,826.5	3.51	3.21	0.67
Replacement of Circulating Water Pump and Engine of Blasting Furnace at Anshan Steel Plant	2,266.1 (7.194 GWh)	5,613.5	3.38	3.09	0.65
Total	35,887.6	100,135.1	8,668.6	272.2	1,464.6

Note: GWh = gigawatt per hour, t = ton, tce = ton of coal equivalent.
Source: PPTA consultant estimates.

VI. ANALYSIS OF ALTERNATIVES

175. An analysis of subproject alternatives was undertaken during the feasibility stage to determine the most financially and technically feasible way of achieving the project objectives while minimizing environmental and social impacts.

A. No Project Alternative

176. **Table 30** shows the comparison of energy and emission intensity between Ansteel Group and international and domestic advanced level. It can be seen that there are still gaps in Ansteel Group. Implementation of the subproject will: (i) significantly reduce energy consumption; (ii) improve air quality; (iii) reduce GHG emissions; and (iv) effective utilization of waste heat. For these reasons, the "no project" alternative is considered unacceptable.

Table 30: Comparison in per ton emission of key iron and steel companies

kgce/ton kg/ton	2001	2012	2015	International and domestic advanced level
Power	906(2000)	601	572	470 (Ping'an Steel Company, China, 2016)
SO_2	4.64	1.53	0.85	0.44 (Nippon Steel &Sumitomo Metal, Japan 2009)
PM	4.59	0.99	0.81	0.42 (ThyssenKrupp AG, Germany, 2009) 0.14 (POSCO, South Korea, 2009)

Note: kg/ton = kilogram per ton, kgce/ton = kilogram per coal equivalent per ton, PM = particulate matter, SO_2 = sulfur dioxide.
Source: Li (2015),[5] Pages 68, 261. China Environment Newspaper, July 21, 2016

B. Project rational

177. With the vision of "energy efficient market led by financing, industrial development led by market" and the integration of Ansteel Engineering Technology's technical expertise and energy saving projects' short payback period, Ansteel ESCO has obtained a domestic loan in the amount of CNY451.6 million for its EMC projects. By far, its client base has extended outside of Ansteel Group, covering several other steel enterprises in the PRC. In recent years, Ansteel ESCO mainly develops energy-saving service projects in the following fields: waste heat and energy recovery, renovation of industrial boiler systems, and system improvement of industrial furnace, electric motor driving, dedusting equipment and water system. By the end of 2015, 44 EMC projects have been completed by Ansteel ESCO, among which 38 have been put into operation with an investment of CNY633 million, generating CNY309 million of energy-saving revenue for the Group.

178. The iron and steel industry is the fundamental industry that supports society development. The PRC will continue to maintain the top ranking as the world's largest iron and steel industry for a long time to come. Long production process, large consumption of various raw materials and energy during the process and high pollutant emissions are the main characteristics of the iron and steel industries in the PRC. By years of endeavor, energy consumption per unit of GDP and emission intensity of PRC's iron and steel industry have

[5] Li Xinchuang (2015), *How to Transform and Upgrade China's Steel Industry*, ISBN 978-7-5024-6795.1 (in Chinese)

dropped drastically, but there is still a big gap between the PRC and international advanced level (**Table 30**) and the PRC has great potential in emission reduction. According to 2015 Annual Statistic Report on Environment in China, pollutant emissions, namely SO_2, NOx, and PM, from the iron and steel industry are 1.368 million tons, 551,000 tons, and 724,000 tons, respectively, taking up 7.4%, 3.0%, and 4.7% of national total emissions. Iron and steel industry has become the third most polluting industry after electricity industry and cement industry. Among the top four provinces with the highest emission of the three pollutants, three are from the greater BTH Region. Among the provinces with the pollutant emissions exceeding 1 million tons, almost all are located in Greater BTH Region. Therefore, lowering the energy consumption and pollutant emissions from iron and steel companies will be of great contribution to the air quality improvement of greater BTH Region.

179. A series of emission standards and national standards of energy consumption released by Ministry of Environmental Protection in 2012 regulate strictly on pollutant emission and energy intensity of iron and steel companies. Hence, Super ESCOs, like Ansteel ESCO, are needed for iron and steel companies to provide comprehensive one-stop service in energy saving and emission reduction.

180. As a subsidiary of Ansteel Group, Ansteel ESCO is very familiar with the production process and technology used in iron and steel industry. In addition, with its years of EMC experience in several other steel companies, Ansteel ESCO is capable of being the super ESCO of iron and steel industry.

181. PRC will continue to maintain its top ranking as the world's leading iron and steel producer and exporter for a long time to come. Being an energy intensive and heavy-polluting industry, the PRC's iron and steel industry has great potential in energy saving and emission reduction. In comparison to the energy consumption limit in national standards and international advanced levels, the energy saving potential of iron and steel production process ranges between 20% and 300% (see **Table 29**). As iron and steel companies need a Super ESCO that could provide comprehensive one-stop service, Ansteel ESCO arises to meet this need.

C. Overall Alternative Analysis

182. Based on the analysis of alternatives, the subproject has selected the most appropriate ESCO company and projects. The seven selected projects will in total replace 35,887.6 tce, equaling to 100,135.1 tons of CO_2, 8,668.6 tons of SO_2, 272.2 tons of NO_X, and 1,464.6 tons of PM. The establishment of a Super ESCO like Ansteel ESCO will enable companies in iron and steel industry to be renovated and improved using various technologies that are accumulated by Ansteel ESCO. Supporting such kind of Super ESCO will make significant contributions to the energy conservation and emission reduction of iron and steel sector. It will also help transformation and upgrade of steel industry in the PRC. The model of Ansteel ESCO is exemplary to other steel companies or companies of high energy consumption.

VII. INFORMATION DISCLOSURE AND PUBLIC CONSULTATION

A. PRC and ADB Requirements for Disclosure and Public Consultation

1. PRC Requirements

183. Relevant provisions in the PRC *Environmental Impact Assessment Law* (2003) and the *Regulations on the Administration of Construction Project Environmental Protection* (No. 253 Order of the State Council, 1998) require that an EIA study for a construction project shall solicit opinions from affected residents, as well as other organizations and concerned stakeholders. However, the requirements for public consultation are different for various sectors and projects. For an environmental Category A project a full EIA report is required including two rounds of public consultations, while for a Category B project only a simplified tabular EIA is required without the need for public consultation.

184. The "Provisional Regulations on Public Participation in Environmental Impact Assessment" (2006) promulgated by State Environmental Protection Administration further specifies the requirements for public participation in EIA in China. It provides detailed requirements for the public participation process, including information disclosure standards, consultation methods, and public enquiry process. It is significant since it was the first document clearly requiring public participation as a part of the EIA in China.[6]

185. In 2014, the MEP released "Guiding Opinions on Promoting Public Participation in Environmental Protection" (2014, No. 48) which defines public participation as 'citizens, legal persons and other organizations' voluntary participation in environmental legislation, enforcement, judicature and law obedience, and the development, utilization, protection and transformation activities related to environment'.

186. The public disclosure and consultation process undertaken during the preparation of the EIA will be undertaken in compliance with the relevant PRC requirements, including the requirements specified above.

2. ADB Requirements

187. ADB's SPS 2009 has specific requirements for information disclosure and public consultation. Information disclosure involves delivering information about a proposed project to the general public and to affected communities and other stakeholders, beginning early in the project cycle and continuing throughout the life of the project. Information disclosure is intended to facilitate constructive engagement with affected communities and stakeholders over the life of the project.

188. SPS 2009 requires that borrowers take a proactive disclosure approach and provide relevant information from environmental assessment documentation directly to affected peoples and stakeholders. In addition, in order to make key documents widely available to the general public, the SPS requires submission to ADB for posting on the ADB website as follows:

6 Wang Ya Nan, 2012. Public Participation in EIA, SEA and Environmental Planning in China. Environmental Impact Assessment Research Centre.

(i) a draft full EIA (including the draft EMP) at least 120 days prior to ADB Board consideration for Category A projects, and/or environmental assessment and review frameworks before project appraisal, where applicable;
(ii) the final EIA/IEE;
(iii) a new or updated EIA/IEE, EMP and corrective action plan prepared during project implementation, if any; and
(iv) environmental monitoring reports.

189. SPS 2009 also requires that the borrower carry out consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Consultations should include presentations on environmental impacts, benefits and mitigation measures, the project GRM, and ADB's Accountability Mechanism.

B. Project Information Disclosure

190. The domestic EIA is being prepared by a Liaoning EIA firm. ADB PPTA consultant communicated with the EIA firm on how to undertake public consultation based on ADB SPS's requirements and PRC's requirements.

191. The first public project information notice will be posted on the Ansteel ESCO's website, early in the domestic EIA preparation process. The information in the first public notification is listed below:

(i) Project name and summary of the subproject.
(ii) Name and contact information of the subproject proponent.
(iii) Name and contact information of the institute responsible for preparing the domestic EIA.
(iv) EIA procedures and content.
(v) Request for questions, suggestions and feedback from the public.

192. A second public information notice will be posted on the Ansteel ESCO's website, prior to the submission of the domestic EIA to the Anshan EPB. The notice included Project name and summary of the project:

(i) Name and contact information of the project proponent.
(ii) Name and contact information of the institute responsible for preparing the domestic EIA of the project.
(iii) Potential project environmental impacts and mitigation measures.
(iv) Key conclusions of the domestic EIA.
(v) Contact information to get abridged versions of the domestic EIA.

193. Besides, during the domestic EIA preparation, Anshan EPB will post the domestic EIA report on its website. The information to be disclosed will include:

(i) project name and project information summary;
(ii) name and contact information of the project proponent;
(iii) name and contact information of the institute responsible for preparing the EIA;
(iv) potential project environmental impacts and mitigation measures;
(v) key conclusions of the EIA report;
(vi) contact information and a request for questions, suggestions and feedback from the public.

194. In addition, the subborrower will also post the domestic EIA and this IEE report on its website.

195. This IEE will be disclosed on the ADB website.

C. Public Consultation Meetings

196. Because the domestic EIA preparation just started, no public consultation meeting was held. Based on information from the Liaoning EIA firm, a public consultation meeting will be held during the domestic EIA preparation process.

197. During the public consultation meeting information will be presented about the subproject status, potential environmental impacts and proposed mitigation measures. Questions and subsequent discussions will focus on environmental issues of the subproject and benefits of the subproject.

198. Meeting participants will be asked to complete a questionnaire as shown in **Table 31**.

Table 31: Subproject public consultation questionnaire (2017)

Name		**Sex**		**Age**	
Nationality		**Education level**		**Occupation**	
Company		**Title**		**Contact number**	
1. What is the main environment pollution near your living areas in your opinion (multiple choice)? A. Surface water B. Ambient air C. Noise D. Ground water E. Solid waste F. Others					
2. Do you know this project? A. Yes B. No					
3. If you know this project, project information is obtained by which way? A. Internet B. Newspaper C. Information signs D. Other person E. Other					
4. Distance between your working place and project site A. <1 km B. 1-3 km C. 3-5 km D. > 5km					
5. Distance between your house and project site A. <1 km B. 1-3 km C. 3-5 km D. > 5km					
6. Do you understand this project like project information, project component, project benefit etc, A. Yes B. No C. Not clear					
7. Do you understand environment impacts of this project? A. Yes B. No C. Not clear					
8. What is environmental issue of highest concern during construction period? A. Surface water B. Ambient air C. Noise D. Dust/PM E. Ground water F. Solid waste G. Traffic problems H. Ecological environment I. Others					
9. What is environmental issue of highest concern during operation period? A. Surface water B. Ambient air C. Noise D. Dust/PM E. Ground water F. Solid waste G. Ecological environment H. Others					
10 Based on construction phase mitigation measures proposed in EIA, do you accept the impacts to environment?					
10.1 Ambient air (PM, dust included) A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.2 Noise A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.3 Surface water A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.4 Groundwater A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.5 Solid waste A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.6 Ecological environment A. Accept B. Barely accept C. Do not accept D. Have no idea					
10.7 Other (traffic problem and inconvenient by project construction) A. Accept B. Barely accept C. Do not accept D. Have no idea					
11 Based on operation phase mitigation measures proposed in EIA, do you accept the impacts to environment?					
11.1 Ambient air (PM, dust included) A. Accept B. Barely accept C. Do not accept D. Have no idea					
11.2 Noise A. Accept B. Barely accept C. Do not accept D. Have no idea					
11.3 Surfacewater A. Accept B. Barely accept C. Do not accept D. Have no idea					
11.4 Groundwater A. Accept B. Barely accept C. Do not accept D. Have no idea					
11.5 Solid waste A. Accept B. Barely accept C. Do not accept D. Have no idea					
11.6 Ecological environment A. Accept B. Barely accept C. Do not accept D. Have no idea					
12. Do you think construction of this project can improve local economic development or not? A. Yes B. No C. Not clear					

13. Do you think whether construction of this project can improve your living quality? A. Yes B. No C. Not clear

14. After comprehensive analysis of project advantages and disadvantages, do you agree with the construction of this project? A. Yes B. No C. Not clear
Suggestions or requirements of the project:
Suggestions or requirements for environment protection of the project:

D. Future Consultation Activities

199. The subborrower will continue to undertake public consultation activities and conduct regular community liaison activities during the construction and operations phases as needed, including the implementation of the GRM (see Chapter VIII). Ongoing consultation will ensure that public concerns are understood and dealt with in a timely manner.

VIII. GRIEVANCE REDRESS MECHANISM

A. Introduction

200. A project grievance can be defined as an actual or perceived project related problem that gives ground for complaint by APs. As a general policy, a Project Management Office (PMO) will be established by the subborrower and will work proactively toward preventing and addressing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. In addition, as the project has strong public support and will not involve any involuntary land or property acquisition or resettlement, significant grievances are unlikely to happen. Nonetheless, during construction and operation it is possible that unanticipated impacts may occur if the mitigation measures are not properly implemented, or unforeseen issues arise. In order to address complaints if or when they arise, a GRM will be developed in accordance with the requirements of ESMS, ADB and Government practices. A GRM is a systematic process for receiving, recording, evaluating and addressing AP's project-related grievances transparently and in a reasonable timeframe.

B. ADB's GRM Requirements

201. ADB's SPS 2009 requires a project to establish a GRM to receive and facilitate resolution of AP's concerns and complaints about the project's environmental performance during construction and operation phase of the project. The GRM should be scaled to the risks and adverse impacts of the project; should address APs concerns and complaints promptly, using an understandable and transparent process; should be readily accessible to all sections of the community at no cost and without retribution; and, should not impede access to the PRC's judicial or administrative remedies.

C. Current GRM Practices in the PRC

202. At the national level a framework to address grievance has been established. State Council Decree No. 431 "Regulations on Letters and Visits" (January 2005)" codifies a complaint mechanism at all levels of government, and safeguards the complainants from any retaliation. The MEP's "Decree No. 34 Environmental Letters and Visits System" provides specific guidelines to establish a system and address environmental complaints. When APs are negatively affected by project activities, they may complain to the contractors and the project company by themselves or through their community organizations, or complain directly to local EPBs. If the issue is not resolved they may take legal action, though that is typically considered as a last option.

D. Subproject GRM

203. The objective of the subproject GRM is to address community concerns, reduce risks, and assist the subproject to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the subproject level GRM has been designed to (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the subproject; (ii) demonstrate concern about community members and their environmental well-being; and (iii) prevent and mitigate any adverse environmental

impacts on communities caused by subproject implementation and operations. The GRM will be accessible to all members of the community.

204. The overall approach of the GRM is to deal with grievances at a local level first in an efficient manner, and escalate to higher level of authority if the grievance cannot be resolved. The designated person from the PMO will be responsible for implementation of the GRM. The PMO will be the key contact point for residents, businesses, government departments and other stakeholders who may require information about the subproject or who have an issue they would like to discuss.

205. The GRM will be implemented through five escalating steps, advancing to the next level only if the grievance was unable to be redressed at the previous level.

(i) **Step 1**: If a concern arises, the AP should try to resolve the issue of concern either directly with the contractor or with the contactor via GRM access points (community leaders, neighborhood organizations, local EPB) during construction phase, and/or the operator during operation phase. If the concern is resolved successfully no further follow-up action is required. Nonetheless, the contractor (during construction) and/or the operator (during operation) shall record any complaint and actions taken to resolve the issues and report the results to the PMO. If no solution is found within 10 working days or if the complainant is not satisfied with the suggested solution under Step 1, proceed to Step 2. The AP may also skip step 1 and directly file the complaint with the PMO.

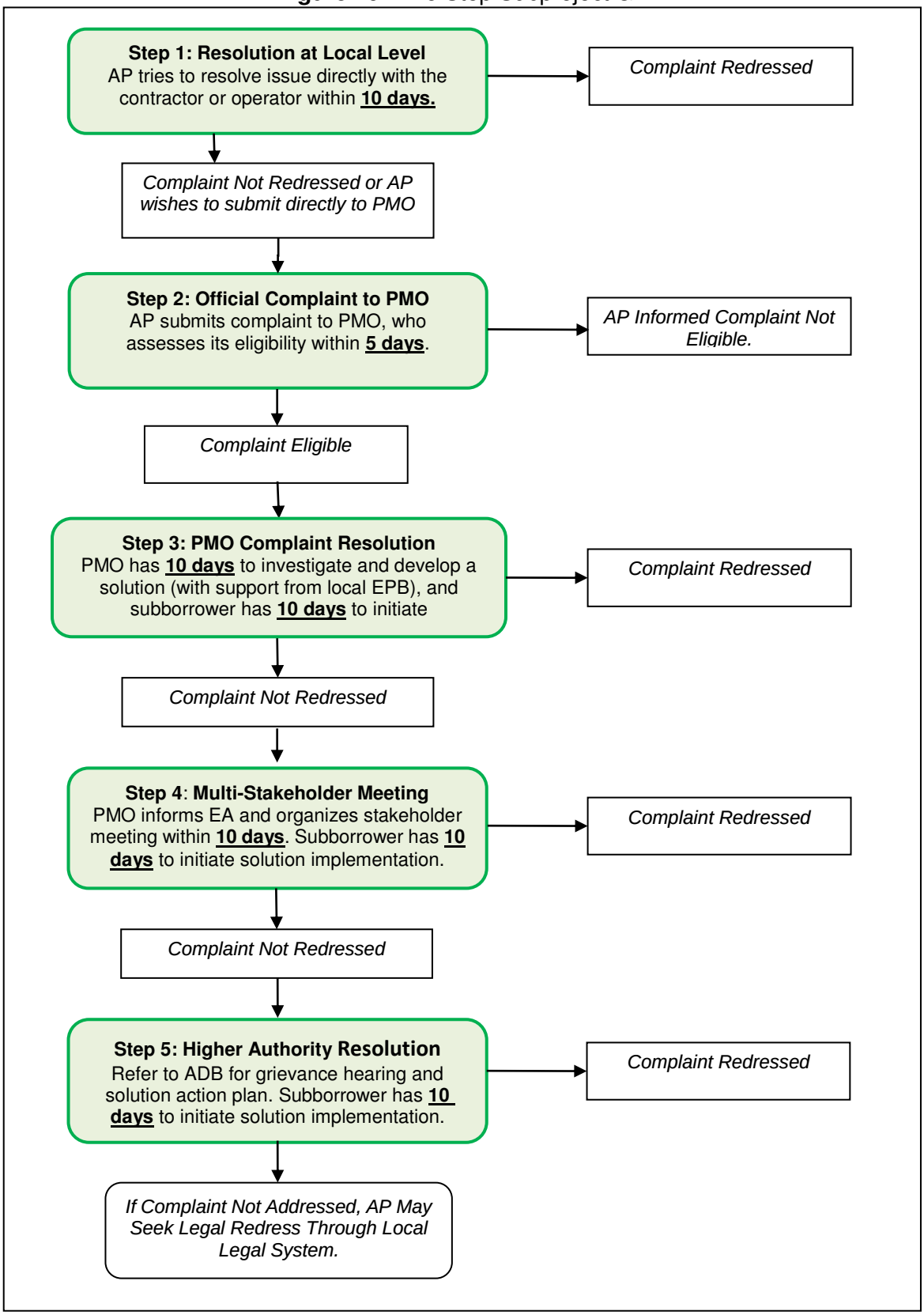
(ii) **Step 2:** The AP will submit the grievance to the PMO, who will record the grievance, assess its eligibility and report back to the AP within 5 working days. If the grievance is eligible, proceed to step 3.

(iii) **Step 3:** The PMO will investigate the complaint, and consult with the subborrower, local EPB, and other stakeholders as appropriate to identify a solution. The PMO will give a clear reply to the AP within 10 working days with the suggested solution, and the subborrower will ensure that implementation of the agreed-upon redress solution begins within 10 working days. If no solution is found or if the complainant is not satisfied with the suggested solution under Step 3, proceed to Step 4.

(iv) **Step 4:** The PMO will inform the EA as to the grievance, and will organize a multi-stakeholder meeting within 10 days, where all relevant stakeholders, including the complainant, the EA, subborrower, and local EPB, can discuss the issue. The multi-stakeholder meeting will aim to find a solution acceptable to all, and identify responsibilities and an action plan. The subborrower will ensure that the implementation of agreed-upon redress solution begins within 10 working days of the completion of the multi-stakeholder meeting.

(v) **Step 5:** If the complainant is not satisfied with the suggested solution under Step 4, the grievance will be directed to ADB. ADB will direct the EA to organize a hearing process and shall determine a solution acceptable to all. Based on the hearing results, an action plan shall be developed and the subborrower will ensure that the implementation of the agreed-upon redress solution begins within 10 working days of the completion of the hearing.

Figure 19: Five Step Subproject GRM.



IX. CONCLUSIONS

206. This is the IEE report for Super ESCO subproject of the proposed Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—CECEP's Regional Emission-Reduction and Pollution-Control Facility. The subproject will support seven ESCO projects in Anshan Steel Plant in Anshan, Chaoyang and Yingkou cities.

207. The subproject is expected to have a number of significant positive long-term direct benefits, including reducing energy consumption and GHG emissions and improving local air quality. When compared to the equivalent energy consumption through "No Project" alternative, once operational the subproject will: (i) result in annual energy savings equivalent to 35,887.6 tce, thereby providing a global public good by avoiding the annual emission of 100,135.1 tons of CO_2; (ii) improve local air quality through the estimated annual reduction of emissions of SO_2 by 8,668.6 tons, NO_x by 272.2 tons and PM by 1,464.6 tons.

208. Through the environmental assessment process, it is concluded that the subproject has: (i) selected appropriate ESCO company and ESCO projects to reduce energy consumption and emission; (ii) identified potential negative environment impacts and appropriately established mitigation measures; (iii) established effective subproject GRM procedures; and (iv) prepared a comprehensive EMP including environmental management and supervision structure, environmental mitigation and monitoring plans, and capacity building and training.

209. Based on the analysis conducted it is concluded that overall the subproject will result in significant positive socioeconomic and environmental benefits, and will not result in significant adverse environmental impacts that are irreversible, diverse, or unprecedented. Overall, any minimal adverse environmental impacts associated with the subproject can be prevented, reduced, or minimized through the appropriate application of mitigation measures. It is therefore recommended that:

(i) the subproject is classified as environment category B;
(ii) the subproject will undertake public consultation based on requirements from ADB SPS and PRC;
(iii) the subproject will be supported by ADB, subject to the implementation of the commitments contained in the EMP and allocation of appropriate technical, financial and human resources by the subborrower to ensure these commitments are effectively and expediently implemented.

APPENDICES

APPENDIX I : ENVIRONMENTAL MANAGEMENT PLAN
APPENDIX II: EXISTING AND ASSOCIATED FACILITY DUE DILIGENCE ENVIRONMENTAL AUDITS AND REVIEWS

APPENDIX I: ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

1. The objectives of the EMP are to ensure (i) implementation of identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environment impacts; (ii) implementation of environmental monitoring plan; and (iii) compliance with the PRC's relevant environmental laws, standards and regulations and ADB's SPS 2009. Organizational responsibilities and budgets are clearly identified for implementation, monitoring and reporting.

2. The EMP is to be implemented in all phases of the subproject design, pre-construction, construction, and operation. In the detailed design stage, the EMP will be used by the design institution for incorporating mitigation measures into the detailed designs.

3. The EMP will be included as a separate annex in all bidding and contract documents. The contractors will be informed of their obligations to implement the EMP, and to provide for EMP implementation costs in their bids for project works.

B. Potential Impacts and Mitigation Measures

4. The potential impacts of the subproject during pre-construction, construction and operation have been identified and appropriate mitigation measures have been developed (**Table A-1**).

Table A-1: Environmental Management Plan

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
Pre-construction						
Transportation and mobilization of construction materials and equipment	Dust generation during vehicle movement	i. Construction material (sand/soil) should be covered while transportation. ii. Water to be sprinkled as needed. iii. Emissions from vehicles and equipment should comply with national standards.	Air quality	PRC ambient air quality standards	Subborrower	Subproject design
	Noise generation	i. Movement of vehicles should be restricted during day time. ii. Noise levels from vehicles and equipment to comply with noise standards.	Noise levels	PRC noise standards	Subborrower	Subproject design
Construction						
Subproject Construction	Wastewater generation-surface and groundwater contamination from construction and domestic wastewater	– For all ESCO projects, existing sanitary facilities with septic tanks will be provided for construction workers and domestic wastewater from construction workers will be discharged to existing sewers and treated in existing WWTPs. – For No. 1 and No. 2 ESCO projects, wastewater from construction worker camps will be discharged to existing sewer and treated in existing WWTPs. – For No. 1 and No. 2 ESCO projects, construction wastewater will be directed to temporary detention and settling ponds. Areas where construction equipment is being washed will be equipped with water collection basins and sediment traps. After settling, supernatant will be recycled and sediment will be periodically excavated, and either reused if possible as fill, disposed at official landfill. All construction wastewater will be discharged to existing sewer and treated	Subproject construction site	PRC's Ambient Surface Water Quality Standard (GB3838-2002)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		in existing WWTPs. – For other ESCO projects, construction wastewater which is mainly oil-containing wastewater will be collected and discharged to existing sewer and treated in existing WWTPs. – For all ESCO projects, maintenance of construction equipment and vehicles will not be allowed on site so as to reduce wastewater generation.				
Transportation of construction materials and subproject construction	Increase in air pollution - dust, vehicle emissions	For No. 1 and No. 2 ESCO projects with civil work: – Water will be sprayed on active construction sites including where fugitive dust is being generated on a daily basis, and more frequently during windy days. – All construction piles (spoil, aggregate other construction materials) with the potential to generate dust will be covered and/or regularly watered. – Construction activities will be halted during high wind events. Once construction is complete disturbed surfaces will be properly restored. – Transport vehicles will be limited to low speeds at construction site. – Loads will be covered during truck transportation to avoid spillage or fugitive dust generation. Fine materials will be transported in fully contained trucks. – Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds.	Project construction site	PRC's Air Pollutant Integrated Emission Standard (GB 16297-1996)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		– Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical. For other ESCO projects: – Transport vehicles will be limited to low speeds at construction site. – Construction site roads will be well maintained, and watered and swept on an as-needed basis. Construction site road entry points will be equipped with truck drive through wash ponds. Transport routes will avoid residential neighborhoods and other sensitive areas to the maximum extent practical.				
Mechanized construction and vehicle movement	Increase in noise levels	For No. 1 and No. 2 ESCO projects, – Construction activities will be strictly prohibited during the nighttime (22:00 h to 07:00 h). Exceptions will only be allowed in special cases, and only after getting approval of the surrounding residents, local EPB and other relevant departments. – Simultaneous high-noise activities will be avoided, and high noise activities will be scheduled during the day rather than evening hours. Similarly, construction sites will be planned to avoid multiple high noise activities or equipment from operating at the same location. – Low-noise equipment will be selected. Equipment and machinery will be equipped with mufflers and will be properly maintained to minimize noise. – PPE will be provided to workers. – Transportation routes and delivery	Subproject construction site	PRC's Noise Standards for Construction Site Boundary (GB 12523-2011)	Contractor, subborrower, CEPCE	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		schedules will be planned to avoid densely populated and sensitive areas and rush hours. – Vehicles transporting construction materials/waste will slow down and not use their horn when passing through or nearby sensitive locations. – For other ESCO projects, – Transport vehicles will be limited to low speeds in construction sites. – PPE will be provided to workers. – Transportation routes and delivery schedules will be planned during detailed design to avoid densely populated and sensitive areas and rush hours. – Vehicles transporting construction materials/waste will slow down and not use their horn when passing through or nearby sensitive locations.				
Subproject construction	Solid waste generation	– For all ESCO projects, littering by workers will be prohibited. – For all ESCO projects, existing domestic waste containers will be used for domestic waste collection at work sites. Domestic waste will be collected on a regular basis by the local sanitation departments and transported for recycling, reuse, or disposal at licensed landfills. – For all ESCO projects, construction waste dumpsters will be provided at all work sites. Construction waste will be collected on a regular basis by licensed waste collection companies and transported for recycling, reuse, or disposal at licensed landfills.	Subproject construction site	PRC's Standards for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB 18599-2011)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		– For all ESCO projects, contractors will be held responsible for proper removal and disposal of any significant residual materials, wastes, and contaminated soils that remain on the site after construction. – For No.1 and No. 2 ESCO projects, construction wastes generated during civil work will be reused or recycled to the extent possible and other construction wastes will be collected on a regular basis by licensed waste collection companies and transported for recycling, reuse, or disposal at licensed landfills. – For No.3, No. 4, No. 5, No. 6 and No. 7 ESCO projects, construction wastes be collected on a regular basis by licensed waste collection companies and transported for recycling, reuse, or disposal at licensed landfills. – For No. 6 and No. 7 ESCO projects, replaced equipment will be collected, transported by a licensed company in accordance with relevant PRC regulations and requirements. – For all ESCO projects, there should be no final waste disposal on site. Waste incineration at or near the site is strictly prohibited.				
Subproject construction	Hazardous and Polluting Materials	– A hazardous material handling and disposal protocol that includes spill emergency response will be prepared and implemented by contractors. – Fuels, oil, chemicals and other hazardous materials will be stored at existing hazardous storage facilities with appropriate safety measures signs and information on type and name of	Subproject construction site	PRC's General Specifications of Engineering and Technology for Hazardous Waste Disposal (HJ 2042 -2014)	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		chemicals and hazardous materials. – Suppliers of chemicals and hazardous materials must hold proper licenses and follow all relevant protocols and PRC regulations and requirements. – Liaoning EPB certificated companies will be hired to collect, transport, and dispose of hazardous materials.				
Subproject construction	Community Disturbance and Safety	– Transportation routes and delivery schedules will be planned to avoid densely populated and sensitive areas and rush hours. – Vehicles transporting construction materials or wastes will slow down and not use their horn when passing through or nearby sensitive locations. – Signs will be placed at construction sites in clear view of the workers, warning workers of potential dangers such as vehicles moving.	Subproject construction site	NA	Contractor, subborrower, CECEP	Whole construction stage
Subproject construction	Worker Occupational Health and Safety - Risk to workers	– Each contractor will implement the relevant construction phase EHS plan. – Identify and minimize the causes of potential hazards to workers. Implement appropriate safety measures. – Provide training to workers on occupational health and safety, emergency response, especially with respect to using potentially dangerous equipment and storage, handling and disposal of hazardous waste. – Ensure that all equipment is maintained in a safe operating condition. – Provide PPE to workers.	Subproject construction site	NA	Contractor, subborrower, CECEP	Whole construction stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		– Implement work practices to limit workers' exposure to high noise or heat working environments in compliance with PRC noise standards for construction sites. – Ensure regular safety meetings with staff. – For No. 1 and No. 2 ESCO projects, ensure that material stockpiles or stacks, such as pipes are stable and well secured to avoid collapse and possible injury to workers.				
Evacuation and earthworks	Damage to PCRs	– Construction activities will be immediately suspended if any PCRs are encountered; – Destroying, damaging, defacing, or concealing PCRs will be strictly prohibited in accordance with PRC regulations; – Local Cultural Heritage Bureau will be promptly informed and consulted; and, – Construction activities will resume only after thorough investigation and permission from local Cultural Heritage Bureau.	Subproject construction site	NA	Contractor, subborrower, CECEP	Whole construction stage
Operation						
Subproject operation	Discharge of production and domestic wastewater	– For all ESCO projects, existing sanitary facilities with septic tanks will be provided for workers and domestic wastewater from workers will be discharged to existing sewer and treated in existing WWTP. – For No.1 ESCO project, production wastewater will be reused or recycled at Ansteel Chaoyang Steel Plant as much as possible. – For No.2 ESCO project, production	Subproject operation site	PRC's Wastewater Quality Standards for Discharge to Municipal Sewers (CJ 343-2010)	Subborrower, CECEP	Whole operation stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		wastewater will be reused or recycled at Anshan Steel Plant as much as possible.				
Subproject operation	Solid waste	– For all ESCO projects, domestic waste bins will be provided and domestic waste will be routinely collected by the local sanitation department for recycling, if possible, or final disposal at an approved waste disposal site. – For all ESCO projects, no permanent on-site solid waste disposal will be permitted at project site. – For all ESCO projects, no burning of wastes will be permitted at project site. – For all ESCO projects, waste oil from equipment maintenance will be collected, transported and treated by Liaoning EPB certificated 3rd hazardous waste treatment companies hired by the three steel plants. – For No.1 ESCO project, waste resin will be collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Ansteel Chaoyang Steel Plant.	Subproject operation site	PRC's Standards for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB 18599-2011)	Subborrower, CECEP	Whole operation stage
Equipment operation	Noise impact	– Low-noise equipment will be used as far as possible, and noise reduction measures such as noise elimination, shock absorption, insulated enclosures and sound dampening materials on exterior walls will be implemented. – All equipment will be properly maintained to minimize noise. – Appropriate noise PPE will be provided to the workers who are likely to be exposed to high noise level environments.	Subproject operation site	PRC's Industrial Enterprise Boundary Noise Emission Standard (GB12348-2008)	Subborrower, CECEP	Whole operation stage

Project Activity	Potential Impacts	Mitigation Measures	Monitoring Scope	Standards	Institutional Responsibility	Implementation Schedule
		– For No.1 ESCO project, layout for boiler building will be reasonable planned to reduce noise. – For No. 2 ESCO project, layout for heat exchange facilities will be reasonable planned to reduce noise.				
Subproject operation	Occupational and community health and safety - risks to Workers and community	– Operation phase EHS plans including fire prevention and control will be developed and implemented, and workers will be trained regularly on their implementation. – PPEs including goggles, gloves, safety shoes, will be provided to workers. – MSDS for hazardous materials in a given work area will be made available to any worker who is in the area. This may be a paper or electronic system. – No unauthorized personnel should be allowed into the process area. – Provide training to workers on occupational health and safety and emergency response. – Regular review of emergency response plan will be conducted. – Drivers will be required to follow traffic management regulations.	Subproject operation site	Regulation on Electric Apparatus Design for Explosion and Fire Risk Environment (GB50058-92)	Subborrower, CECEP	Whole operation stage

Source: ADB PPTA consultants.

C. Implementation Arrangements

5. CECEP will be the executing agency (EA) and the implementing agency (IA) of the FI loan. CECEP Huayu Fund Management Co. Ltd. (CECEP Huayu) will manage the Loan. The EA will form a PMO at CECEP Huayu including an Environment Officer and a Social Officer.

6. The PMO Environment Officer will be responsible for regular internal inspections of mitigation measures at the construction site, in accordance with the EMoP. A third party environmental monitoring entity will be engaged by the subborrower and will undertake construction and operation phase ambient environmental monitoring per EMoP.

7. The Subborrower will be responsible for implementing relevant mitigation measures during construction. Following the award of each construction contract, the contractor will prepare the construction EMP (CEMP) and associated subplans which detail the means by which the Contractor will comply with the EMP. The Contractor will identify a lead focal point for environmental issues (e.g. Chief Site Engineer), will implement the CEMP, and will take all reasonable measures to minimize the impact of construction activities on the environment. The Contractor will also submit semi-annually environmental records to the subborrower on EMP implementation, including the EMoP. They are also required to report any spills, accidents, and grievances received, and any actions taken.

8. ADB will conduct due diligence of environment issues during review missions. ADB will review the semi-annual and annual environmental monitoring reports submitted by the PMO and will disclose the reports on its website. If the subborrower fails to meet safeguards requirements described in the EMP, ADB will require the subborrower to take corrective measures and advise the PMO on items in need of follow-up actions.

9. The subproject implementation organization and the roles and responsibilities of the participating agencies are presented in **Table A-2**.

Table 2: Subproject implementation and management organizations

Organization	Role and Responsibility
CECEP	- Will serve as the EA/IA and project contact point for ADB. - Responsible for coordinating project implementation activities among government agencies such as finance bureau, development and reform commission, environmental protection bureau, etc. - Coordinating the activities of and meeting the requirements of the ADB review missions.

CECEP Huayu	- On behalf of the executing agency, a PMO will be set up including a safeguard unit with qualified and experienced full time staff. PMO will be responsible for all subproject organization and implementation activities, including the following:
	  - Formulating subproject management and operating procedures, implementation plans, and budgets.
	  - Ensuring subproject's compliance with loan and project agreements and with the safeguards requirements as specified in the ESMS.
	  - Managing the activities of the design institutes, procurement agents, and consultants in accordance with government and ADB regulations.
	  - Taking part in capacity development and training.
	  - Overseeing the implementation of different subproject outputs.
	  - Monitoring subproject's physical and financial progress and compliance with subproject's reporting requirements, ensuring subproject progress reports are prepared and submitted to ADB on time.
	  - Addressing complaints received from APs.
	  - Coordinating the activities of and meeting the requirements of ADB review missions.
	  - Supervising the implementation of EMP and EMoP.

	- Conducting regular site visits and safeguard review missions in accordance with the requirements set forth in the ESMS developed for the FI Loan. - Preparing and submitting consolidated semi-annual and annual environmental monitoring reports as required by the ESMS to ADB. - Requiring subborrowers to prepare corrective action plans in the event of noncompliance with EMP or EMoP.
Subborrower	- Main responsibilities include: - Contracting and administering contractors and suppliers. - Supervising construction and monitoring quality control. - Ensuring compliance with EMP, EMoP, engaging external environmental safeguard consultants as needed. - Preparing subproject progress reports for submission to the PMO. - Monitoring subproject's physical and financial progress and preparing regular progress reports to PMO. - Testing and commissioning of completed subproject facilities. - Identifying and implementing O&M arrangements. - Coordinating with and assisting the PMO in developing subproject management procedures and detailed implementation plan, and monitoring achievement thereof. - Arranging the commissioning of the constructed facilities. - Preparing progress reports for submission to the executing agency and/or PMO. - Preparing semi-annual and annual environmental monitoring reports and submitting to PMO.
Environmental Monitoring Company (EMC)	- A qualified independent environmental monitoring company will be recruited to implement the ambient monitoring portion of the EMoP.
ADB	- Responsible for the following: - Providing the EA/IA and PMO with guidance to ensure smooth subproject implementation and achieve the desired development impacts and their sustainability. - Conducting regular review missions. - Monitoring the implementation of EMP and EMoP. - Monitoring status of compliance with loan and project covenants, including safeguards. - Reviewing environmental monitoring reports and disclosing them on ADB website. - Regularly updating the subproject performance review reports with the assistance of executing and implementing agencies. and - Regularly updating the subproject information documents for public disclosure at ADB website, including the safeguards documents. - Requiring CECEP Huayu to develop corrective action plan for any non-compliance issues.

Note: ADB = Asian Development Bank, EMP = Environmental Management Plan, O&M = operation and maintenance, PMO = project management office.

D. Environment Monitoring Plan

10. An EMoP to monitor the environmental impacts of the subproject and assess the effectiveness of mitigation measures is presented in **Table A-3.** The EMoP includes both compliance inspection undertaken by the PMO Environment Officer, and ambient air, noise, and wastewater monitoring undertaken by the 3rd party environmental monitoring entity. Ambient monitoring will be conducted in compliance with relevant PRC regulations, methods and technical specifications.

11. The data and results of environmental compliance inspection and monitoring activities will be used to assess: (i) the extent and severity of actual environmental impacts against the predicted impacts and baseline data collected before the subproject implementation; (ii) performance or effectiveness of environmental mitigation measures or compliance with pertinent environmental rules and regulations; (iii) trends in impacts; (iv) overall effectiveness of EMP implementation; and (v) the need for additional mitigation measures and corrective actions if

non-compliance is observed.

E. Institutional Strengthening and Capacity Building

12. The institutional strengthening and capacity building focuses on the safeguards requirements of relevant PRC laws and regulations and ADB's SPS 2009. The training will focus on SPS 2009; PRC safeguard requirements; development and implementation of EHS plans during construction and operation; implementation of the EMP, the EMoP, and the GRM; and occupational and community health and safety issues and measures (**Table A-4).**

Table A-3: Environmental Monitoring Plan (EMoP)

Subject	Parameter	Location	Frequency	Implemented by	Supervised by
A. Construction Phase					
Air Pollution	Ambient dust monitoring (TSP)	Construction site of No. 1 and No .2 ESCO projects	Quarterly during construction season	3rd party environmental monitoring entity	PMO and CECEP
	Compliance inspection of implementation of air pollution control measures	Construction site of No. 1 and No .2 ESCO projects	Monthly during construction season	Contractor and Subborrower	PMO and CECEP
Wastewater	Compliance inspection of implementation of wastewater management measures	Construction site	Monthly during construction season	Subborrower	PMO and CECEP
Noise	Ambient noise monitoring (day and night Leq dB(A))	Construction site	Quarterly during construction season	3rd party environmental monitoring entity	PMO and CECEP
Solid Waste	Compliance inspection of implementation of solid waste management measures	Waste collection and disposal sites.	Monthly during construction season	Contractor and Subborrower	PMO and CECEP
Hazardous and Polluting Materials	Compliance inspections of implementation of hazardous materials management measures	Existing storage facilities for fuels, oil, chemicals and other hazardous materials. Vehicle and equipment maintenance areas.	Monthly during construction season	Contractor and Subborrower	PMO and CECEP
Socioeconomic Impacts	Compliance inspection of implementation of traffic control measures	Construction site roads. Transportation routes.	Monthly during construction season	Contractor and Subborrower	PMO and CECEP
	Compliance inspection of implementation of Occupational and Community Health and Safety measures and an Emergency Response	Construction site	Monthly during construction season	Contractor and Subborrower	PMO and CECEP

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Subject	Parameter	Location	Frequency	Implemented	Supervised
	Plan				
B. Operation Phase					
Wastewater	Compliance with operation phase waste water management measures	Project site	Semi-annual	Subborrower	PMO and CECEP
Noise	Compliance with operation phase noise management measures	Project site	Semi-annual	Subborrower	PMO and CECEP
Solid Waste	Compliance with operation phase solid waste management measures	Project site	Semi-annual	Subborrower	PMO and CECEP
Hazardous and Polluting Materials	Compliance with operation phase Hazardous Materials Management Plans (HMMPs)	Project site	Semi-annual	Subborrower	PMO and CECEP
Health and Safety and Emergency Response	Compliance with operation phase occupational and community health and safety management measures and implementation an Emergency Response Plan	Project site	Semi-annual	Subborrower	PMO and CECEP

Table A-4: Institutional strengthening and training program

Training Topic	Trainers	Attendees	Contents	Times	Days	# Persons	Budget (USD)
Construction Phase Environment, Health and Safety Training	Environmental expert	Contractors, subborrower	**ADB and PRC laws, regulations and policies** – ADB's safeguard policy statement – Project applicable PRC environmental, health and safety laws, policies, standards and regulations – International environmental, health and safety management practice **GRM** – GRM structure, responsibilities, and timeframe – Types of grievances and eligibility assessment **Implementation of Construction Phase EMP** – Impacts and mitigation measures – Monitoring and reporting requirements – Non-compliance and corrective actions	3 (once prior to start of construction, and then once during years 2 to 3)	2	30	**Training Development** Fixed costs: $2000 per course delivery x 3 = $ 6,000
Operation Phase Environment, Health and Safety Plan Training	Environmental expert	subborrower	**ADB and PRC laws, regulations and policies** – ADB's safeguard policy statement – Project applicable PRC environmental, health and safety laws, policies, standards and regulations – International environmental, health and safety management practice **GRM** – GRM structure, responsibilities, and timeframe – Types of grievances and eligibility assessment **Implementation of Operation Phase EMP** – Impacts and mitigation measures – Monitoring and reporting requirements – Non-compliance and corrective actions	3 (once prior to start of operation, and then once during years 2 and 3)	2	30	**Training Development** Fixed costs: $2000 per course delivery x 3 = $6,000
			Total	**6**		**60**	**$12,000**

F. Reporting Requirements

13. The subborrower will prepare subproject environmental monitoring reports semi-annually during construction and annually during operation and submit them to the PMO. The PMO will review them and then submit them to the ADB. The environmental reporting requirements are summarized in the **Table A-5**.

Table A-5: Reporting Requirements

Report	Prepared by	Submitted to	Frequency
A. Construction Phase			
Environmental monitoring reports	Subborrower	EA reviews and submits to ADB	Semi-annually
B. Operation Phase			
Environmental monitoring reports	Subborrower	EA reviews and submits to ADB	Annually

G. Performance Indicators

14. Performance indicators (**Table** A-**6**) have been developed to assess the implementation of the EMP. These indicators will be used to evaluate the effectiveness of environmental management.

Table A-6: Performance Indicators

No.	Description	Indicators
1	Staffing	(i) PMO established with appropriately qualified staff including Environmental Officer. (ii) 3rd party environmental monitoring entity engaged.
2	Budgeting	(i) Environment mitigation cost during construction and operation is sufficiently and timely allocated. (ii) Environment monitoring cost is sufficiently and timely allocated. (iii) Budget for capacity building is sufficiently and timely allocated.
3	Monitoring	(i) Compliance monitoring is conducted by PMO as per EMP and EMoP. (ii) Construction phase and operation phase ambient and effluent monitoring is conducted by 3rd party environmental monitoring entity.
4	Supervision	(i) PMO reviews the implementation of EMP; (ii) ADB reviews consolidated environmental monitoring reports.
5	Reporting	(i) Semi-annual EMP implementation reports during construction phase and annual reports during operation phase prepared by the subborrower are submitted to PMO.
6	Capacity Building	(i) Training on ADB safeguard policy, EMP implementation, and GRM is provided during project implementation.
7	Grievance Redress Mechanism	(i) GRM contact persons are designated at all subborrowers and the PMO, and GRM contact information disclosed to the public before construction.

No.	Description	Indicators
		(ii) All complains are recorded and processed within the set time framework in the GRM of this IEE.
8	Compliance with PRC standards	(i) Subproject complies with the PRC's environmental laws and regulations and meets all required standards.

H. Estimated Budget for EMP Implementation

15. The estimated budget for EMP implementation of the project is presented in **Table** A-**7**. Costs are presented for mitigation implementation, ambient monitoring, capacity building, and GRM implementation. The costs do not include salaries of PMO staff.

I. Mechanisms for Feedback and Adjustment

16. The effectiveness of mitigation measures and monitoring plans will be evaluated through a feedback reporting system. If, during compliance inspections and monitoring, substantial deviation from the EMP is observed, then the PMO will consult with the subborrower and propose appropriate changes to the EMP monitoring and mitigation plan.

17. Any major EMP adjustments will be subject to ADB review and approval and ADB may pursue additional environmental assessment and, if necessary, further public consultation. The revised EMP with ADB confirmation is subject to reposting on the ADB's website as the ADB public communications policy requires. The revised EMP will be passed on to the subborrower for implementation.

Table A-7: Estimated Budget for Implementing EMP

Construction Phase								
1. Ambient Monitoring	**Unit**		**Unit Cost**	**# Times**		**Cost USD**	**Cost RMB**	**Source of Funds**
Air - TSP	Quarterly	$	300	12	$	3,600	¥24,512	Counterpart Financing
Noise	Quarterly	$	200	18	$	3,600	¥24,512	
Subtotal					***$***	***7,200***	***¥49,025***	
2. Capacity Building	**Unit**		**Course Cost**	**# Times**		**Cost USD**	**Cost RMB**	
Construction Phase HSE Plan Development and Training	HSE Plan Development	$	2,000	8	$	16,000	¥108,944	Counterpart Financing
	HSE Course Development	$	2,000	1	$	2,000	¥13,618	
	HSE Course Delivery	$	4,000	1	$	4,000	¥27,236	
Subtotal					***$***	***22,000***	***¥149,798***	
TOTAL Construction Phase					***Cost USD***		***Cost RMB***	
					$	***29,200***	***¥198,823***	
Operation Phase (first 2 years)								
	Unit		**Unit Cost**	**# Times**		**Cost USD**	**Cost RMB**	
1. Ambient Monitoring	**Unit**		**Unit Cost**	**# Times**		**Cost USD**	**Cost RMB**	
Noise	Semi annual	$	-	28	$	-	¥0	
Wastewater	Semi annual	$	-	16	$	-	¥0	
Subtotal					***$***	***-***	***¥0***	
2. Capacity Building	**Unit**		**Course Cost**	**# Times**		**Cost USD**	**Cost RMB**	
Construction Phase HSE Plan Development and Training	HSE Plan Development	$	2,000	8	$	16,000	¥108,944	Counterpart Financing
	HSE Course Development	$	2,000	1	$	2,000	¥13,618	
	HSE Course Delivery	$	4,000	1	$	4,000	¥27,236	
Subtotal					***$***	***22,000***	***¥149,798***	
TOTAL Operation Phase					***Cost USD***		***Cost RMB***	
					$	***22,000***	***¥149,798***	
GRAND TOTAL Construction + Operation					***Cost USD***		***Cost RMB***	
					$	***51,200***	***¥348,621***	

Note: Based on information from subborrower, the three steel plants already have their own environmental monitoring system, thus the ambient monitoring during operation phase will be included in their exiting monitoring systems without any extra cost.

APPENDIX II: EXISTING AND ASSOCIATED FACILITY DUE DILIGENCE ENVIRONMENTAL AUDITS AND REVIEWS

A. Environmental Audit of Anshan Steel Plant

B. Environmental Audit of Ansteel Chaoyang Steel Plant

C. Environmental Audit of Ansteel Bayuquan Steel Plant

Appendix II-A: Environmental Audit of Anshan Steel Plant

A. Introduction

1. This is a due diligence environmental audit of the Anshan Steel Plant (hereafter referred to as the Ansteel), being conducted as part of the preparatory assistance for the development of the proposed PRC: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei (BTH) Region—Regional Emission-Reduction and Pollution-Control Facility.

2. The No. 2, No. 3, No. 6 and No. 7 ESCO projects will be located within the premises of the existing Anshan Steel Plant and No. 2 ESCO project will source waste heat from waste heat of cooling water from the Heavy Plate Mill and Wire Rod Plant of Anshan Steel Plant. As per the ADB SPS 2009, the Anshan Steel Plant is an existing facility for No. 2, No. 3, No. 6 and No. 7 ESCO projects, and an environmental audit of the existing facility is required. In addition, the Heavy Plate Mill and Wire Rod Plant are associated facilities of No. 2 ESCO project, and due diligence environmental review is required and is included in this report.

B. Environmental Audit Approach

3. This report is based on a site visit, consultations with Ansteel managers and technical staff, and a review of plant environmental and technical documentation. The site visit was undertaken May 12th 2017.

4. Documentation reviewed during and after the facility visit included:

- PRC Project EIA reports;
- EIA approvals from Anshan EPB;
- Project Environmental Acceptance Approvals (Anshan EPB);
- 3rd party stack emission monitoring reports;
- 3rd party noise monitoring reports;
- 3rd party ISO Certifications; and
- Environment, Health and Safety regulations and manuals.

C. Project Description

1. Type

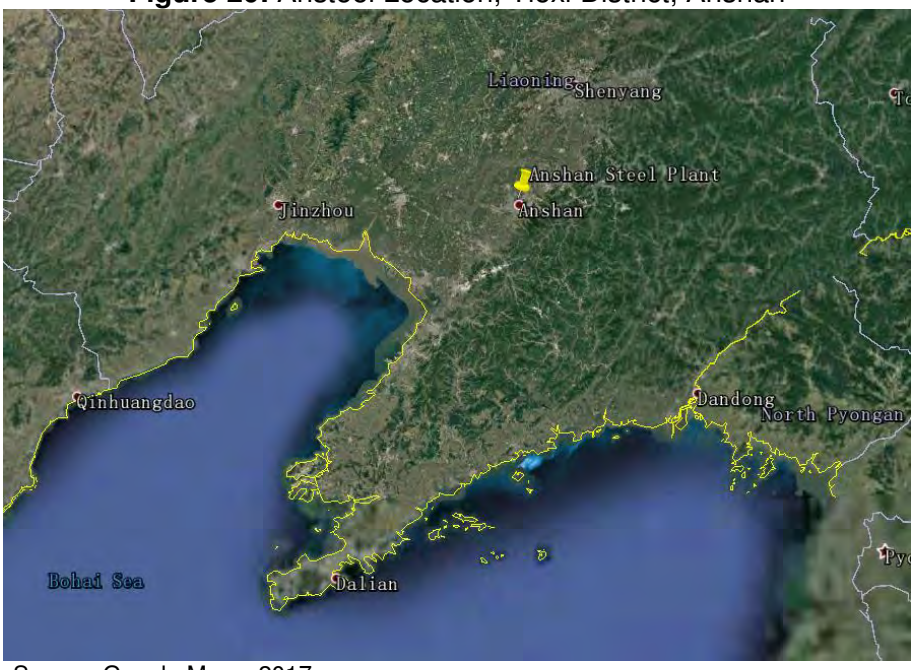
5. The Ansteel is an existing steel plant for iron and steel manufacture in Tiexi District of Anshan City, Liaoning Province. It is owned and operated by the Ansteel Group.

6. Ansteel Group, headquartered in Anshan City, was reorganized from Anshan Steel and Iron Group Corporation and Panzhihua Iron & Steel Group Corporation in May 2010, being a State-owned Enterprises (SOE) under State-owned Assets Supervision and Administration Commission of the State Council of the PRC. After the reorganization, Ansteel Group has formed cross-regional, multi-bases and international operation layout and become a steel enterprise with the greatest resource advantages in the PRC.

2. Location

7. The Ansteel is located on a 120 km^2 site at No 1 Huangang Road, Tiexi District, Anshan City (**Figure 20**). The area is industrial area. The Ansteel is bordered to the north by Yunliang River; to the west by Gangxi Road, with a residential area to the west of Gangxi Road; to the south by Qianshanxi Road area; and to the east by a railway and then Jianguo Road (**Figure 21**). Anshan Teng'ao Airport is 9.0 km to the southwest.

Figure 20: Ansteel Location, Tiexi District, Anshan



Source: Google Maps, 2017.

Figure 21: Ansteel and Surrounding Area

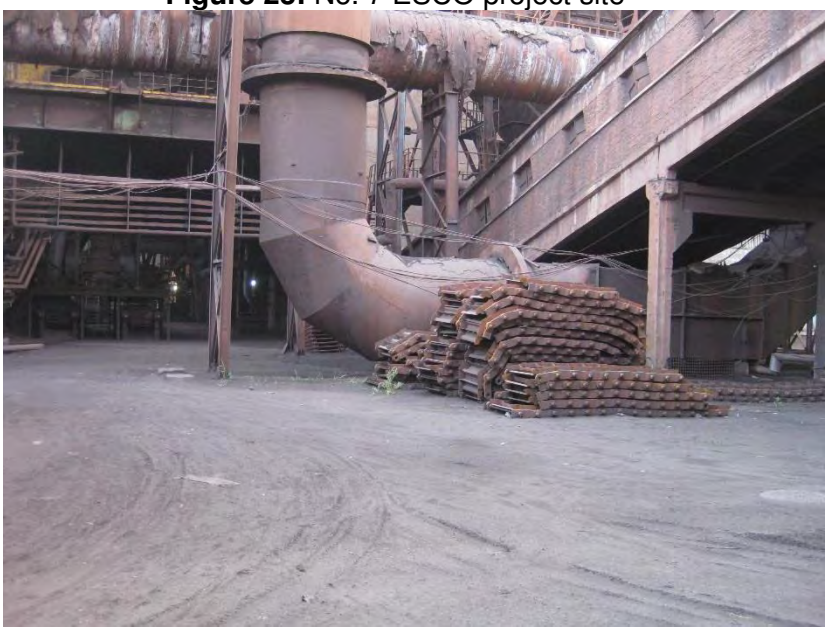
Source: Google Maps, 2017 and Consultants.

8. **Figure 22** shows an aerial view of the Ansteel including the location of No. 2, No. 3, and No. 7 ESCO projects because No. 6 ESCO project is located at many different places and is hard to be marked in **Figure 22**.

Figure 22: Ansteel Layout

Source: Google Maps, 2017 and Consultant.

Figure 23: No. 7 ESCO project site



Source: Consultant.

3. Purpose and Capacity

9. The Ansteel was originally constructed in 1916 as steel plant. Ansteel Group was reorganized from Anshan Steel and Iron Group Corporation and Panzhihua Iron & Steel Group Corporation in May 2010. After the reorganization, Ansteel Group has formed cross-regional, multi-bases and international operation layout and become a steel enterprise with the greatest resource advantages in the PRC. Now the annual production capacity was 19.8 million tons sinter, 2 million tons pellet, 18 million tons cast iron and 18 million tons steel billet.

10. The main equipment of Ansteel is presented in **Table 32**.

Table 32: Main Equipment

Item	Description
Iron plant	
Sintering machine	2 x 360 m^2, 2 x 325 m^2 and 2 x 265 m^2
Pelletizing machine	1x 321.6 m^2
Blast furnace	3 x 3200 m^3 and 5 x 2580 m^3
Steel Plant	
Converter	3 x 500 tons and 3x 350 tons
Continuous casting machine	6 sets
Vacuum treatment equipment	6 sets

Item	Description
Coking plant	
Coke oven	8 x 6m and 4 x 7m
Coke dry quenching	1x 140 t/h and 1x 190 t/h
Power plant	
Power generator	2x 110 MW (coal fired)
Combined heat and power	1 x 125 MW (coal fired and blast furnace gas fired)

Source: Ansteel and consultant

4. Emission Controls

11. Emission control measures of coking plant are listed below:
- Dust removal equipment (bag filter) is installed at coke pushing, coke dry quenching, coal charging and coke screening process.
- Domestic waste and industrial waste are collected by the local sanitation department for final disposal at an approved landfill.
- Industrial waste is also be collected and transported by certificated companies for final disposal at an approved landfill.
- Wastewater collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Ansteel.
- Domestic wastewater and production wastewater are collected and treated by existing WWTP at Ansteel.
- Low-noise equipment is used as far as possible, and noise reduction measures such as noise elimination, shock absorption and insulated enclosures are implemented.

12. Emission control measures of coking plant are listed below:
- All boilers are installed with selective catalytic reduction (SCR) system for NOx removal. They are also equipped with wet limestone flue-gas desulfurization (FGD) scrubbers for SO_2 removal, and electrostatic precipitator (ESP) to control fly ash.
- Domestic wastewater and production wastewater are collected and treated by existing WWTP at Ansteel.
- Domestic waste is collected by the local sanitation department for final disposal at an approved landfill.
- Industrial waste like fly ash, fly ash, FGD gypsum and coal slag are recycled and sold to construction companies and used for construction materials production.
- Hazardous waste is collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Ansteel.
- Low-noise equipment is used as far as possible, and noise reduction measures such as noise elimination, shock absorption and insulated enclosures are implemented.

13. Emission control measures of iron plant are listed below:
- Sintering machines are installed with spray dry absorber for SO_2 removal and ESP and bag filters to control fly ash.
- Wastewater generated from sintering process is cooling water and is recycled after cooling tower. No production wastewater will be discharged.
- Pelletizing machines are installed with bag filters to control fly ash in ring cooling machine, rotary kiln, grate rotatory kiln and batching room.
- Wastewater generated from pelletizing process is collected and treated by existing WWTP at Ansteel combined with domestic instate. Cooling water is recycled after treated by cooling tower.
- Industrial waste like collected fly ash is recycled and used in batching system.
- Blast furnaces, weighing room, transfer station system, coal pulverizing system and storage facilities are installed with bag filters to control fly ash.
- Blast furnace gas is stored in gas tank after collection and purification
- Production wastewater is collected and treated by existing WWTP at Ansteel combined with domestic instate. Cooling water is recycled after treated by cooling tower.
- Domestic waste is collected by the local sanitation department for final disposal at an approved landfill.
- Iron slag is recycled as building material and ash collected by bag filters is send to sintering for batching.
- Hazardous waste is collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Ansteel.
- Low-noise equipment is used as far as possible, and noise reduction measures such as noise elimination, shock absorption and insulated enclosures are implemented.

14. Emission control measures of steel plant are listed below:
- Converters, feeding system, continuous casting machine, vacuum treatment equipment and storage facilities are installed with bag filters to control fly ash.
- Wastewater generated from converter system is collected and treated by existing WWTP at Ansteel combined with domestic waste. Cooling water is recycled after treated by cooling tower.
- Domestic waste is collected by the local sanitation department for final disposal at an approved landfill.
- Steel slag is recycled as building material and ash collected by bag filters is send to sintering for batching.
- Industrial waste like collected fly ash is recycled and used in batching system.
- Hazardous waste is collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Ansteel.
- Low-noise equipment is used as far as possible, and noise reduction measures such as noise elimination, shock absorption and insulated enclosures are implemented.

Figure 24: One stack in Ansteel

Source: TA Consultant.

5. Fuel

15. Coal is primarily sourced from Liaoning province and transported to Anshan by train and truck. Total annual coal consumption for the plant was 9.7 million tons in 2016. Coal is stored onsite both in a storage building and outside. Coal stored outside is chemically treated to prevent fugitive dust emissions using non-hazardous biodegradable alkyl alcohol and starch based wetting agents.

16.

6. Water Supply and Wastewater

17. The Ansteel sources production and domestic water from the municipal water system. Production water is treated by reverse osmosis and mixed bed ion exchange. Cooling water is treated by cooling tower.

18. Domestic wastewater is discharged to the sewer and treated at the existing WWTP at Ansteel. All cooling water is recycled by cooling tower. Production wastewater are discharged to sewer and treated at the existing WWTP.

7. Solid Wastes

19. The Ansteel produces combustion waste, FGD slag, fly ash and hazardous waste like waste oil. . All combustion waste products and FGD slag are recycled and are sold to construction companies for construction materials production. Fly ash collected by bag filters is recycled or reused.

20. Hazardous waste is collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Ansteel.

D. Environmental Management

8. Environmental Impact Assessment

21. The Ansteel is in compliance with all relevant PRC EIA requirements. The environmental assessment process has been an ongoing one as the plant has been expanded and upgraded. Copies of the EIA Approval and Environmental Acceptance documents were provided to the audit team for review.

Relevant Environmental Standards

22. **Table 34** present a summary of relevant emission standards for Ansteel.

Table 33: Summary of Environmental Pollution Standards

Pollutant	Standards
Stack Emissions of sintering and pelletizing	Emission standard of air pollutants for sintering and pelletizing of iron and steel industry (GB28662-2012)
Stack Emissions of coke plant	Discharge standard of pollutants for coke chemical (GB16171-2012)
Stack Emissions of iron plant	Emission standard of air pollutants for iron smelt industry (GB28663-2012)
Stack Emissions of steel plant	Emission standard of air pollutants for steel smelt industry (GB 28664—2012)
Fugitive PM	Integrated Emission Standard of Air Pollutants (GB 16297-1996)
Noise	Emission Standard for Industrial Enterprises at Site Boundary (GB 12348-2008)
Wastewater	Class A of *Wastewater Quality Standards for Discharge to Municipal Sewers* (CJ 343—2010)

Table 34: PRC *Wastewater Quality Standards for Discharge to Municipal Sewers* (Class A, CJ 343-2010)

No	Pollutant	Maximum acceptable concentration mg/L (except pH)
1	pH	6.5-9.5
2	SS	400
3	COD	500
4	Ammonia nitrogen	45
5	BOD	300
6	Total nitrogen	70
7	Total phosphorus	8

23. **Table 35** presents the relevant ambient air quality standards for the Ansteel surrounding urban area, while **Table 36** presents ambient noise standards. There is no applicable surface water quality standard as all wastewater from the Ansteel is discharged to the sewer and treated in existing WWTP.

Table 35: Applicable ambient air quality standards – *Class II*, *Ambient Air Quality Standards* (GB 3095—2012)

Pollutants	Annual mean (class 2) mg/m^3	24-hr mean (class 2) mg/m^3	1-hr mean (class 2) mg/m^3
TSP	0.200	0.300	--
PM_{10}	0.070	0.150	--
$PM_{2.5}$	0.035	0.075	--
SO_2	0.060	0.150	0.500
NO_2	0.040	0.080	0.200

Table 36: Applicable ambient environment noise standard – *Class III, Environmental Quality Standards for Noise* (GB3096-2008)

Item	Class III
Daytime Noise (06:00-22:00 h)	65 dB(A)
Nighttime noise (22:00-06:00 h)	55 dB(A)

9. Environmental Monitoring and compliance

24. The Ansteel is equipped with a continuous emissions monitoring systems (CEMS) that monitors in real time SO_2, NOx, PM and air flow of each stacks. Data is sent electronically to the Anshan EPB Data Center. The Anshan EPB monitors daily average concentrations, and staff indicates that the EPB can be on site within as little as 1 hour if the CEMS indicates serious noncompliance. Third party stack monitoring is also undertaken. Noise and fugitive dust is also monitored on a quarterly basis, as is wastewater quality.

25. The environmental monitoring results are disclosed on websites of Anshan EPB and Ansteel Group. The links are www.asepb.gov.cn/aspx/newsmore.aspx?channel_id=60&category_id=421&parent_id=358 and www.ansteelgroup.com/a/news.php?pcid=33&cid=36&cid1=36.

26. The consultant reviewed all the environmental monitoring results on the two websites and found that all the results are compliance with relevant standards.

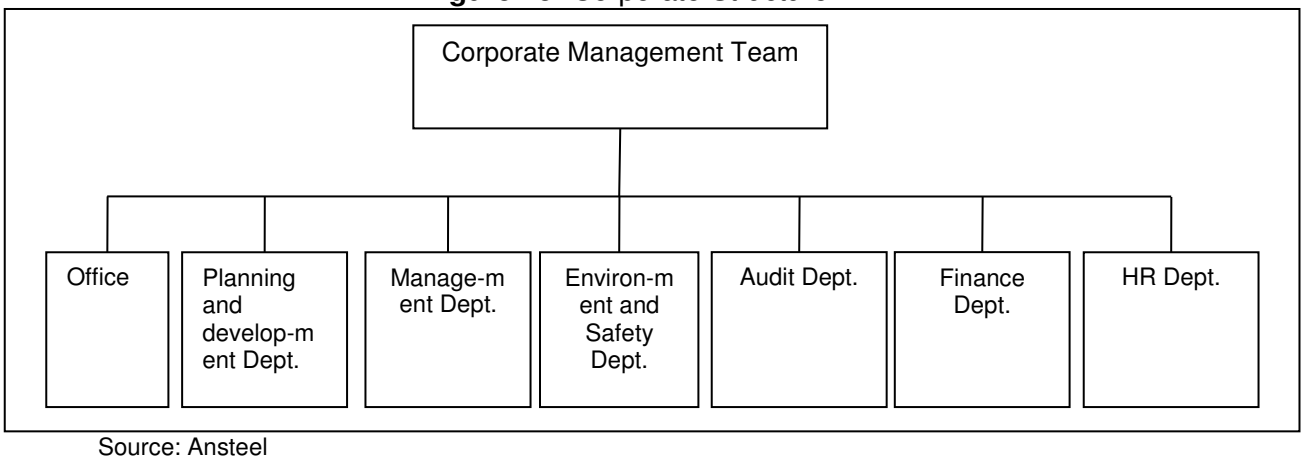
27. It is understood from Ansteel staff that when it became operational the Ansteel was in compliance with relevant emission standards.

10. ISO Certification, Staffing and Environmental Management

28. The Ansteel Group has been third-party certified for ISO 9001 (Quality Management Systems), ISO 14001 (Environmental Management Systems) and ISO 18001 (Occupational Health and Safety).

29. The Ansteel has around 40,000 staff. Environmental, health and safety (EHS) responsibilities are assigned to the Environment and Safety Department, which has a staff of 30 and includes some environment engineers and safety engineers (**Figure 25**).

Figure 25: Corporate Structure



Source: Ansteel

30. The Ansteel has Quality management system (QMS), Safety management system (SMS), Occupational health management system (OHMS) and Environment management system (EMS). All four systems were prepared based on relevant national, provincial and local laws and regulations. All the systems are annually reviewed and updated if necessary.

31. During site visit, safety management regulation is provided to audit team for review. Organization structure of safety and fire protection committee are explained in this Safety management regulation with targets and responsibilities. Organization structure of safety and fire protection system and safety supervision system with detailed responsibilities are explained in this regulation too. Main contents of Safety management regulation are listed below:

- Safety management system;
- Safety and fire protection responsibility;
- Safety management content;
- Check and rectification of potential dangers;
- Safety education for staff;
- Special operation training management;
- Report and treatment procedures for safety accidents;
- Personal protection equipment management;
- Safety production expenses management.

32. Occupational hazards monitoring and management regulation is also provided to audit team for review. Occupational hazards monitoring and management regulation focuses on occupational health and safety and occupational disease prevention and control. Main contents are listed below. Other documents are also provided like personal protection equipment management record, occupational hazardous workplace record table, training and education record etc.

- Responsibilities of relevant departments
- management of occupational hazardous factors
- operation and management of occupational hazard factors protection facilities
- personal protection equipment management
- occupational hazardous factors monitoring
- management of occupational hazardous factors monitoring points
- environment assessment of work place
- notice of occupational hazardous factors
- occupational hazardous factors control and prevention
- emergency plan for occupational hazard accident
- propaganda and education
- noise standard and noise control
- High-temperature control

33. In addition, a copy of some environment documents was provided to the audit team. The list includes Control procedures for identification and assessment of environment factors, Control procedures for acquisition and update of laws, regulations and other requirements, Control procedures for environment policies, targets, indicators and environment management programs, Control procedures for human resource, Control procedures for information communication, Documents control procedures, Operation control procedures, Wastewater emission management and control procedures, Energy and resources control procedures, Monitoring equipment control procedures, Environment operation control procedures, Control procedures for environment monitoring, Control procedures for compliance assessment, Control procedures for emergency preparation and response and Control procedures for prevention and corrective measures.

34. The Ansteel has an emergency response procedure, and regular emergency response training and drills are undertaken.

35. Overall, the Ansteel has an adequate environmental, health and safety management system which involves a lot of regulations and policies. The system and regulations are updated regularly. The Ansteel also has an emergency response procedure and working properly.

E. Conclusion

36. Based on this environmental due diligence audit, the Ansteel has an adequate environmental, health and safety management system and obtained all the necessary approvals for the plant operation. Proper environmental mitigation measures and control devices are up to date to keep pace with more stringent emission standards and the Ansteel plant meets all the necessary environmental standards. Till now, no public complaint has been received. It is concluded that the Ansteel plant is well managed and performs good environmental, health and safety performance.

Appendix II-B: Environmental Audit of Ansteel Chaoyang Steel Plant

A. Introduction

1. This is a due diligence environmental audit of the Ansteel Chaoyang Steel Plant (hereafter referred to as the Chaoyang steel), being conducted as part of the preparatory assistance for the development of the proposed PRC: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei (BTH) Region—China Energy Conservation and Environmental Protection Group (CECEP)'s Regional Emission-Reduction and Pollution-Control Facility.

2. The No. 1 ESCO project will be located within the premises of the existing Chaoyang Steel and will source waste heat from exhaust gas of two heating furnaces. As per the ADB SPS 2009, the Chaoyang Steel is an existing facility for No. 1 ESCO project, and an environmental audit of the existing facility is required. In addition, the two heating furnaces are associated facilities, and due diligence environmental review is required and is included in this report.

B. Environmental Audit Approach

3. This report is based on consultations with Chaoyang Steel managers and technical staff, and a review of plant environmental and technical documentation.

4. Documentation reviewed during and after the facility visit included:
- PRC Project EIA reports;
- EIA approvals from Chaoyang EPB;
- Project Environmental Acceptance Approvals (Chaoyang EPB);
- Third party stack emission monitoring reports;
- Third party noise monitoring reports;
- Third party ISO Certifications; and
- Environment, Health and Safety regulations and manuals.

C. Project Description

1. Type

5. The Chaoyang Steel is an existing steel plant for iron and steel manufacture in Xidayingzi Town, Longcheng District of Chaoyang City, Liaoning Province. It is owned and operated by the Ansteel Group.

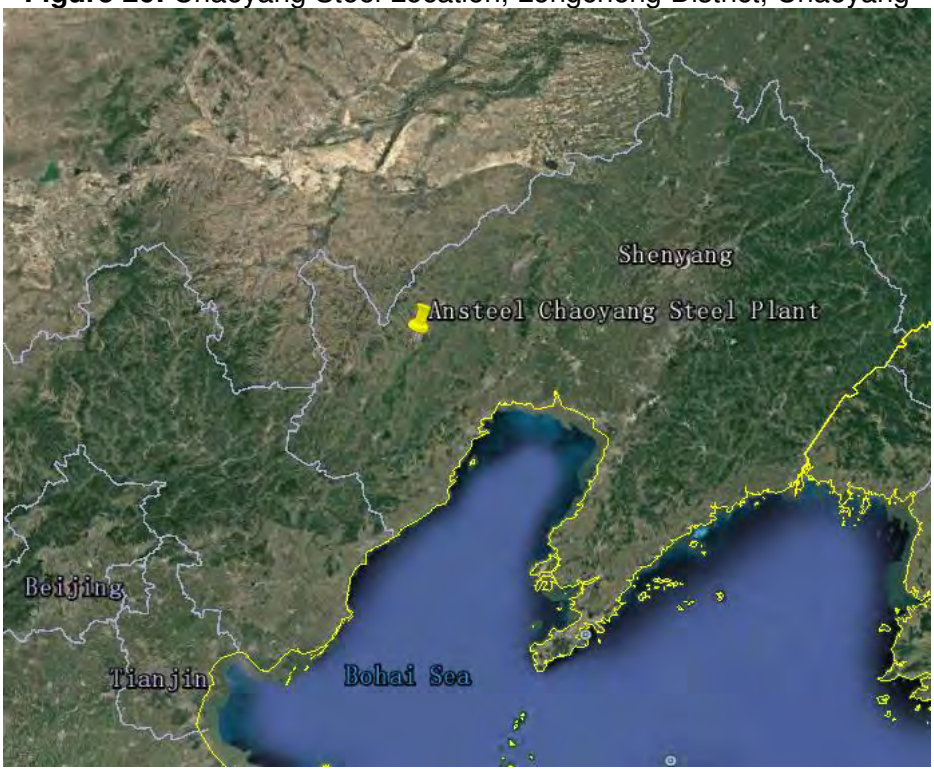
6. Ansteel Group, headquartered in Anshan City, was reorganized from Anshan Steel and Iron Group Corporation and Panzhihua Iron & Steel Group Corporation in May 2010, being a SOE under State-owned Assets Supervision and Administration Commission of the State Council of the PRC. After the reorganization, Ansteel Group has formed cross-regional, multi-bases and international operation layout and become a steel enterprise with the greatest resource advantages in the PRC.

2. Location

7. The Chaoyang Steel is located on a 4 km^2 site at Xidayingzi Town, Longcheng District of Chaoyang City (**Figure 26**). The area is industrial area. The Chaoyang Steel is bordered to the northwest by Beijing-Shenyang Express way; to the northeast by Dandong-Xilinhaote Express

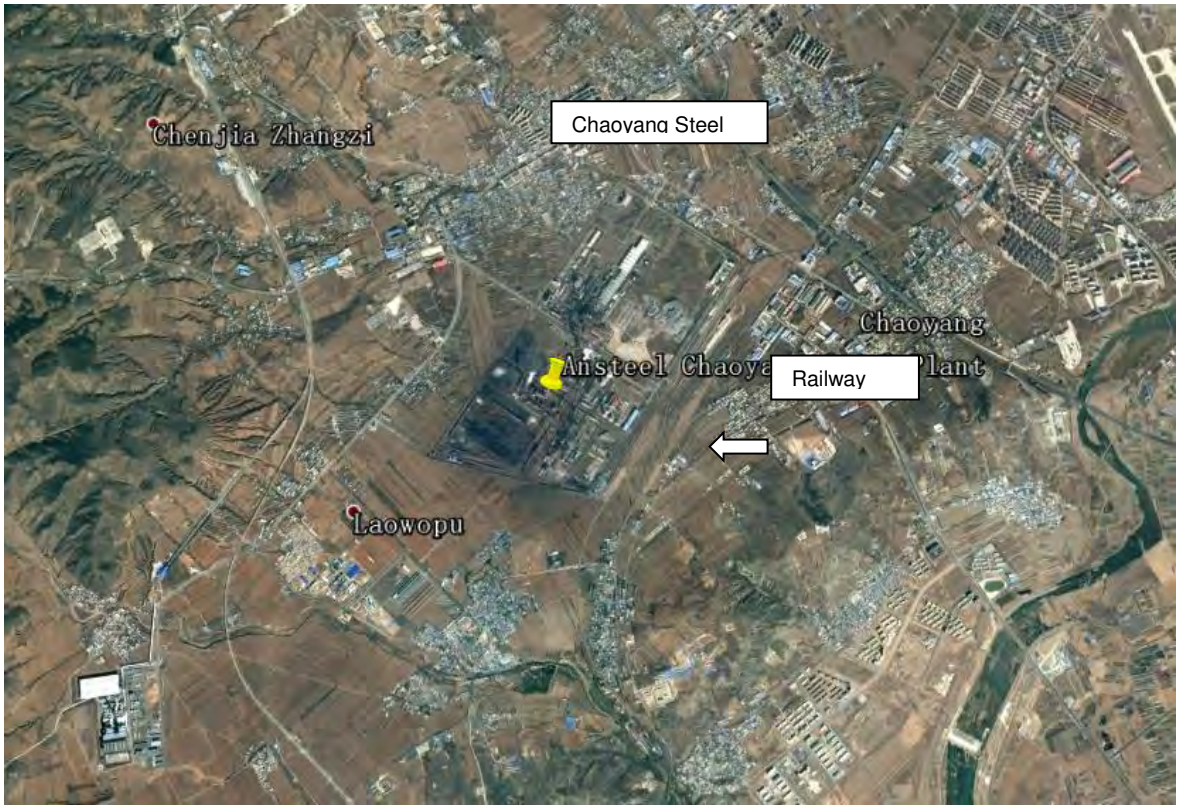
way, to the southwest by a country road; and to the southeast by a railway.

Figure 26: Chaoyang Steel Location, Longcheng District, Chaoyang



Source: Google Maps, 2017.

Figure 27: Chaoyang Steel and Surrounding Area



Source: Google Maps, 2017 and Consultants.

8. **Figure 28** shows an aerial view of the Chaoyang Steel including the location of No. 1 ESCO project.

Figure 28: Chaoyang steel Layout

Source: Google Maps, 2017 and Consultant.

3. Purpose and Capacity

9. The Chaoyang Steel was originally constructed in 2016. Now the annual production capacity was 2 million tons cast iron and 2.05 million tons steel billet.

10. The main equipment of Chaoyang Steel is presented in **Table 37**.

Table 37: Main Equipment

Item	Description
Iron plant	
Sintering machine	1 x 265 m^2
Blast furnace	1 x 2600 m^3
Steel Plant	
Converter	2 x 120 tons
Continuous casting machine	2 sets
Vacuum treatment equipment	2 sets
Coking plant	
Coke oven	2 x 6m
Coke dry quenching	1x 70 t/h
Power plant	
Combined heat and power	3 x 25 MW (coal fired)

Source: Chaoyang Steel and consultant

4. Emission Controls

11. Emission control measures of coking plant are listed below:
- Dust removal equipment (bag filter) is installed at coke pushing, coke dry quenching, coal charging and coke screening process.
- Domestic waste and industrial waste are collected by the local sanitation department for final disposal at an approved landfill.
- Industrial waste is also be collected and transported by certificated companies for final disposal at an approved landfill.
- Wastewater collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Chaoyang Steel.
- Domestic wastewater and production wastewater are collected and treated by existing WWTP at Chaoyang Steel.
- Low-noise equipment is used as far as possible, and noise reduction measures such as noise elimination, shock absorption and insulated enclosures are implemented.

12. Emission control measures of coking plant are listed below:
- All boilers are installed with selective catalytic reduction (SCR) system for NOx removal. They are also equipped with wet limestone flue-gas desulfurization (FGD) scrubbers for SO_2 removal, and electrostatic precipitator (ESP) to control fly ash.

- Domestic wastewater and production wastewater are collected and treated by existing WWTP at Chaoyang Steel.
- Domestic waste is collected by the local sanitation department for final disposal at an approved landfill.
- Industrial waste like fly ash, fly ash, FGD gypsum and coal slag are recycled and sold to construction companies and used for construction materials production.
- Hazardous waste is collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Chaoyang Steel.
- Low-noise equipment is used as far as possible, and noise reduction measures such as noise elimination, shock absorption and insulated enclosures are implemented.

13. Emission control measures of iron plant are listed below:
- Sintering machines are installed with spray dry absorber for SO_2 removal and ESP and bag filters to control fly ash.
- Wastewater generated from sintering process is cooling water and is recycled after cooling tower. No production wastewater will be discharged.
- Wastewater generated from other process is collected and treated by existing WWTP at Chaoyang Steel combined with domestic instate. Cooling water is recycled after treated by cooling tower.
- Industrial waste like collected fly ash is recycled and used in batching system.
- Blast furnaces, weighing room, transfer station system, coal pulverizing system and storage facilities are installed with bag filters to control fly ash.
- Blast furnace gas is stored in gas tank after collection and purification
- Production wastewater is collected and treated by existing WWTP at Chaoyang Steel combined with domestic instate. Cooling water is recycled after treated by cooling tower.
- Domestic waste is collected by the local sanitation department for final disposal at an approved landfill.
- Iron slag is recycled as building material and ash collected by bag filters is send to sintering for batching.
- Hazardous waste is collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Chaoyang Steel.
- Low-noise equipment is used as far as possible, and noise reduction measures such as noise elimination, shock absorption and insulated enclosures are implemented.

14. Emission control measures of steel plant are listed below:
- Converters, feeding system, continuous casting machine, vacuum treatment equipment and storage facilities are installed with bag filters to control fly ash.
- Wastewater generated from converter system is collected and treated by existing WWTP at Chaoyang Steel combined with domestic waste. Cooling water is recycled after treated by cooling tower.
- Domestic waste is collected by the local sanitation department for final disposal at an approved landfill.
- Steel slag is recycled as building material and ash collected by bag filters is send to sintering for batching.
- Industrial waste like collected fly ash is recycled and used in batching system.

- Hazardous waste is collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Chaoyang Steel.
- Low-noise equipment is used as far as possible, and noise reduction measures such as noise elimination, shock absorption and insulated enclosures are implemented.

5. Fuel

15. Coal is primarily sourced from Liaoning province and transported to Chaoyang by train and truck. Total annual coal consumption in 2016 was not available because the Chaoyang Steel Plant was put into operation in November 2016. Coal is stored onsite both in a storage building and outside. Coal stored outside is chemically treated to prevent fugitive dust emissions using non-hazardous biodegradable wetting agents to control fly ash.

6. Water Supply and Wastewater

16. The Chaoyang Steel sources production and domestic water from the municipal water system. Production water is treated by reverse osmosis and mixed bed ion exchange. Cooling water is treated by cooling tower.

17. Domestic wastewater is discharged to the sewer and treated at the existing WWTP at Chaoyang Steel. All cooling water is recycled by cooling tower. Production wastewater are discharged to sewer and treated at the existing WWTP.

7. Solid Wastes

18. The Chaoyang Steel produces combustion waste, FGD slag, fly ash and hazardous waste like waste oil. All combustion waste products and FGD slag are recycled and are sold to construction companies for construction materials production. Fly ash collected by bag filters is recycled or reused.

19. Hazardous waste is collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Chaoyang Steel.

D. Environmental Management

8. Environmental Impact Assessment

20. The Chaoyang Steel is in compliance with all relevant PRC EIA requirements. The environmental acceptance was approved by Chaoyang EPB on 18 November, 2016. Copies of the EIA Approval and Environmental Acceptance documents were provided to the audit team for review.

Relevant Environmental Standards

21. **Table 34** present a summary of relevant emission standards for Chaoyang Steel.

Table 38: Summary of Environmental Pollution Standards

Pollutant	Standards
Stack Emissions of sintering and pelletizing	Emission standard of air pollutants for sintering and pelletizing of iron and steel industry (GB28662-2012)
Stack Emissions of coke plant	Discharge standard of pollutants for coke chemical (GB16171-2012)
Stack Emissions of iron plant	Emission standard of air pollutants for iron smelt industry (GB28663-2012)
Stack Emissions of steel plant	Emission standard of air pollutants for steel smelt industry (GB 28664—2012)
Fugitive PM	Integrated Emission Standard of Air Pollutants (GB 16297-1996)
Noise	Emission Standard for Industrial Enterprises at Site Boundary (GB 12348-2008)
Wastewater	Class A of *Wastewater Quality Standards for Discharge to Municipal Sewers* (CJ 343—2010)

Table 39: PRC *Wastewater Quality Standards for Discharge to Municipal Sewers* (Class A, CJ 343-2010)

No	Pollutant	Maximum acceptable concentration mg/L (except pH)
1	pH	6.5-9.5
2	SS	400
3	COD	500
4	Ammonia nitrogen	45
5	BOD	300
6	Total nitrogen	70
7	Total phosphorus	8

22. **Table 35** presents the relevant ambient air quality standards for the Chaoyang Steel surrounding urban area, while **Table 35** presents ambient noise standards. There is no applicable surface water quality standard as all wastewater from the Chaoyang Steel is discharged to the sewer and treated in existing WWTP.

Table 40: Applicable ambient air quality standards – *Class II*, *Ambient Air Quality Standards* (GB 3095—2012)

Pollutants	Annual mean (class 2) mg/m^3	24-hr mean (class 2) mg/m^3	1-hr mean (class 2) mg/m^3
TSP	0.200	0.300	--
PM_{10}	0.070	0.150	--
$PM_{2.5}$	0.035	0.075	--
SO_2	0.060	0.150	0.500
NO_2	0.040	0.080	0.200

Table 41: Applicable ambient environment noise standard – *Class III, Environmental Quality Standards for Noise* (GB3096-2008)

Item	Class III
Daytime Noise (06:00-22:00 h)	65 dB(A)
Nighttime noise (22:00-06:00 h)	55 dB(A)

9. Environmental Monitoring and compliance

23. The Chaoyang Steel is equipped with a continuous emissions monitoring systems (CEMS) that monitors in real time SO_2, NOx, PM and air flow of each stacks. Data is sent electronically to the Chaoyang EPB Data Center. The Chaoyang EPB monitors daily average concentrations, and staff indicates that the EPB can be on site within as little as 1 hour if the CEMS indicates serious noncompliance. Third party stack monitoring is also undertaken. Noise and fugitive dust is also monitored on a quarterly basis, as is wastewater quality.

24. The environmental monitoring results are disclosed on websites of Chaoyang EPB and Ansteel Group. The links are www.cyhb.gov.cn/ml/?type=list&class=101 and www.ansteelgroup.com/a/news.php?pcid=33&cid1=36&cid=36&id=4156.

25. The consultant reviewed all the environmental monitoring results on the two websites and found that all the results are compliance with relevant standards.

26. It is understood from Chaoyang Steel staff that when it became operational the Chaoyang Steel was in compliance with relevant emission standards.

10. ISO Certification, Staffing and Environmental Management

27. Because Chaoyang Steel was under operation from November 2016, now the Chaoyang Steel is currently working on getting ISO 9001 (Quality Management Systems), ISO 14001 (Environmental Management Systems) and ISO 18001 (Occupational Health and Safety) certification.

28. The Chaoyang Steel has around 679 staff. Environmental, health and safety (EHS) responsibilities are assigned to the Environment and Safety Department, which has a staff of 5 and includes one environment engineer and one safety engineer.

29. The Chaoyang Steel has Quality management system (QMS), Safety management system (SMS), Occupational health management system (OHMS) and Environment management system (EMS). All four systems were prepared based on relevant national, provincial and local laws and regulations. All the systems are annually reviewed and updated if necessary.

30. Environment engineer of the Chaoyang Steel provided a copy of some environment documents to the audit team. The documents include: environment, occupational health and safety management system; operation and management system for environment protection facilities; management regulation on wastewater, exhaust gas, noise and solid waste; environmental protection liability statement; energy metering equipment management; environment protection team structure and responsibilities and control procedures for identification and assessment of environment factors.

31. In addition, a copy of safety document list was provided to the audit team. The twenty five

safety management regulations of safety production supervision and management system are listed below:

Table 42: Summary of safety management regulations

No	Name
1	Management assessment standard
2	Safety production responsibility system
3	Safety production management system
4	Work permit management system
5	Operation permit management system
6	Equipment periodical test and rotation system
7	Operation shift change system
8	Operation patrol inspection system
9	Management system for potential safety hazard check and rectification
10	Fire safety management system
11	Flame operation management system and implementation rules
12	Management system for safety technology measures, labor protection measures and anti-accident measures
13	Management system for accident, barrier and anomaly division
14	Management system for special operators safety training assessment
15	Hazardous chemical safety management system
16	Hoisting machinery and equipment safety management system
17	Scaffold installation, demolition and utilization safety management system
18	Safety production education and training management system
19	Safety production meeting system
20	Maintenance safety management system
21	Project outsourcing management system
22	Electrical safety equipment management system
23	Hydrochloric acid management system
24	Safety management system for heat supply network maintenance and operation
25	Personal protection equipment management system

Source: Chaoyang Steel.

32. The Chaoyang Steel follows emergency management system of Ansteel and has an emergency response procedure. Regular emergency response training and drills are undertaken. A copy of emergency response procedure was provided to the audit team.

33. Overall, the Chaoyang Steel has an adequate environmental, health and safety management system which involves a lot of regulations and policies. The system and regulations are updated regularly. The Chaoyang Steel also has an emergency response procedure and working properly.

E. Conclusion

34. Based on this environmental due diligence audit, the Chaoyang Steel has an adequate environmental, health and safety management system and obtained all the necessary approvals for the plant operation. Proper environmental mitigation measures and control devices are up to date to keep pace with more stringent emission standards and the Chaoyang Steel plant meets all the necessary environmental standards. Till now, no public complaint has been received. It is concluded that the Chaoyang Steel plant is well managed and performs good environmental,

health and safety performance.

Appendix II-C: Environmental Audit of Ansteel Bayuquan Steel Plant

A. Introduction

1. This is a due diligence environmental audit of the Ansteel Bayuquan Steel Plant (hereafter referred to as the Bayuquan Steel), being conducted as part of the preparatory assistance for the development of the proposed PRC: Air Quality Improvement in the Greater Beijing–Tianjin–Hebei (BTH) Region—Regional Emission-Reduction and Pollution-Control Facility.

2. The No. 4 and No. 5 ESCO projects will be located within the premises of the existing Bayuquan Steel. As per the ADB SPS 2009, the Ansteel Bayuquan Steel Plant is an existing facility for No. 4 and No. 5 ESCO projects, and an environmental audit of the existing facility is required.

B. Environmental Audit Approach

3. This report is based on a site visit, consultations with Ansteel managers and technical staff, and a review of plant environmental and technical documentation. The site visit was undertaken May 13th 2017.

4. Documentation reviewed during and after the facility visit included:
   - PRC Project EIA reports;
   - EIA approvals from Yingkou EPB;
   - Project Environmental Acceptance Approvals (Yingkou EPB);
   - Third party stack emission monitoring reports;
   - Third party noise monitoring reports;
   - Third party ISO Certifications; and
   - Environment, Health and Safety regulations and manuals.

C. Project Description

1. Type

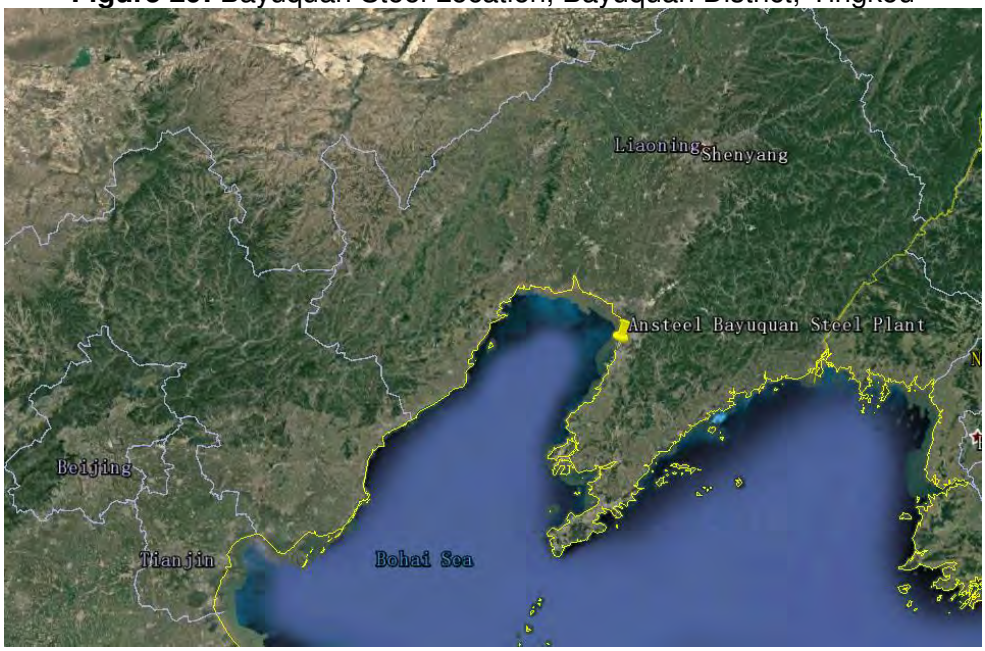
5. The Bayuquan Steel is an existing steel plant for iron and steel manufacture at Binhai Road, Bayuquan District of Yingkou City, Liaoning Province. It is owned and operated by the Ansteel Group.

6. Ansteel Group, headquartered in Anshan City, was reorganized from Anshan Steel and Iron Group Corporation and Panzhihua Iron & Steel Group Corporation in May 2010, being a SOE under State-owned Assets Supervision and Administration Commission of the State Council of the PRC. After the reorganization, Ansteel Group has formed cross-regional, multi-bases and international operation layout and become a steel enterprise with the greatest resource advantages in the PRC.

2. Location

7. The Bayuquan Steel is located on an 8.32 site at Binhai Road, Bayuquan District of Yingkou City (**Figure 26**). The area is industrial area. The Bayuquan Steel is surrounded by Bohai Sea and Binhai Road. There is a railway about 3 km away in south direction.

Figure 29: Bayuquan Steel Location, Bayuquan District, Yingkou



Source: Google Maps, 2017.

Figure 30: Bayuquan Steel and Surrounding Area

Source: Google Maps, 2017 and Consultants.

8. **Figure 28** shows an aerial view of the Bayuquan Steel including the location of No. 4 and No. 5 ESCO projects.

Figure 31: Bayuquan Steel Layout

Source: Google Maps, 2017 and Consultant.

3. Purpose and Capacity

9. The Bayuquan Steel was originally constructed in 2007. Now the annual production capacity was 9.4 million tons sinter, 2 million tons pellet, 6.5 million tons cast iron and 6.5 million tons steel billet.

10. The main equipment of Bayuquan Steel is presented in **Table 27**.

Table 43: Main Equipment

Item	Description
Iron plant	
Sintering machine	2 x 405 m^2
Blast furnace	2 x 4038 m^3
Steel Plant	
Converter	3 x 260 tons
Continuous casting machine	2 sets
Vacuum treatment equipment	3 sets
Coking plant	
Coke oven	4 x 7 m
Coke dry quenching	2x 160 t/h
Power plant	
Combined cycle power plant	1 x 150 MW (coal fired)
Power generator	2x 75 t/h gas boiler and 2× 20MW generators
Sintering waste heat generator	2 x 70 t/h waste heat boiler and 2 x 25MW generators
Steam electric power generator	1 x 8 MW generator
CDQ power generator	2 x 86 t/h waste heat boiler and 2 x 15MW generators
Wind turbine generator	3×1250kW and 8×1500 kW
Solar power	100 kW

Source: Bayuquan Steel and consultant

4. Emission Controls

11. Emission control measures of coking plant are listed below:

- Dust removal equipment (bag filter) is installed at coke pushing, coke dry quenching, coal charging and coke screening process.
- Domestic waste and industrial waste are collected by the local sanitation department for final disposal at an approved landfill.
- Industrial waste is also be collected and transported by certificated companies for final disposal at an approved landfill.
- Wastewater collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Bayuquan Steel.
- Domestic wastewater and production wastewater are collected and treated by existing WWTP at Bayuquan Steel.
- Low-noise equipment is used as far as possible, and noise reduction measures such as noise elimination, shock absorption and insulated enclosures are implemented.

37. Emission control measures of coking plant are listed below:
- All boilers are installed with selective catalytic reduction (SCR) system for NOx removal. They are also equipped with wet limestone flue-gas desulfurization (FGD) scrubbers for SO_2 removal, and electrostatic precipitator (ESP) to control fly ash.
- Domestic wastewater and production wastewater are collected and treated by existing WWTP at Bayuquan Steel.
- Domestic waste is collected by the local sanitation department for final disposal at an approved landfill.
- Industrial waste like fly ash, fly ash, FGD gypsum and coal slag are recycled and sold to construction companies and used for construction materials production.
- Hazardous waste is collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Bayuquan Steel.
- Low-noise equipment is used as far as possible, and noise reduction measures such as noise elimination, shock absorption and insulated enclosures are implemented.

38. Emission control measures of iron plant are listed below:
- Sintering machines are installed with spray dry absorber for SO_2 removal and ESP and bag filters to control fly ash.
- Wastewater generated from sintering process is cooling water and is recycled after cooling tower. No production wastewater will be discharged.
- Pelletizing machines are installed with bag filters to control fly ash in ring cooling machine, rotary kiln, grate rotatory kiln and batching room.
- Wastewater generated from pelletizing process is collected and treated by existing WWTP at Bayuquan Steel combined with domestic instate. Cooling water is recycled after treated by cooling tower.
- Industrial waste like collected fly ash is recycled and used in batching system.
- Blast furnaces, weighing room, transfer station system, coal pulverizing system and storage facilities are installed with bag filters to control fly ash.
- Blast furnace gas is stored in gas tank after collection and purification
- Production wastewater is collected and treated by existing WWTP at Bayuquan Steel combined with domestic instate. Cooling water is recycled after treated by cooling tower.
- Domestic waste is collected by the local sanitation department for final disposal at an approved landfill.
- Iron slag is recycled as building material and ash collected by bag filters is send to sintering for batching.
- Hazardous waste is collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Bayuquan Steel.
- Low-noise equipment is used as far as possible, and noise reduction measures such as noise elimination, shock absorption and insulated enclosures are implemented.

39. Emission control measures of steel plant are listed below:
- Converters, feeding system, continuous casting machine, vacuum treatment equipment and storage facilities are installed with bag filters to control fly ash.

- Wastewater generated from converter system is collected and treated by existing WWTP at Bayuquan Steel combined with domestic waste. Cooling water is recycled after treated by cooling tower.
- Domestic waste is collected by the local sanitation department for final disposal at an approved landfill.
- Steel slag is recycled as building material and ash collected by bag filters is send to sintering for batching.
- Industrial waste like collected fly ash is recycled and used in batching system.
- Hazardous waste is collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Bayuquan Steel.
- Low-noise equipment is used as far as possible, and noise reduction measures such as noise elimination, shock absorption and insulated enclosures are implemented.

5. Fuel

12. Coal is primarily sourced from Liaoning province and transported to Chaoyang by train and truck. Total annual coal consumption in 2016 was not available because the Bayuquan Steel Plant was put into operation in November 2016. Coal is stored onsite both in a storage building and outside. Coal stored outside is chemically treated to prevent fugitive dust emissions using non-hazardous biodegradable wetting agents to control fly ash.

6. Water Supply and Wastewater

13. The Bayuquan Steel sources production and domestic water from the municipal water system. Production water is treated by reverse osmosis and mixed bed ion exchange. Cooling water is treated by cooling tower.

14. Domestic wastewater is discharged to the sewer and treated at the existing WWTP at Bayuquan Steel. All cooling water is recycled by cooling tower. Production wastewater are discharged to sewer and treated at the existing WWTP.

7. Solid Wastes

15. The Bayuquan Steel produces combustion waste, FGD slag, fly ash and hazardous waste like waste oil. All combustion waste products and FGD slag are recycled and are sold to construction companies for construction materials production. Fly ash collected by bag filters is recycled or reused.

16. Hazardous waste is collected, transported and treated by a Liaoning EPB certificated 3rd hazardous waste treatment company hired by Bayuquan Steel.

D. Environmental Management

8. Environmental Impact Assessment

17. The Bayuquan Steel is in compliance with all relevant PRC EIA requirements. The environmental acceptance was approved by Yingkou EPB on 18 November, 2016. Copies of the EIA Approval and Environmental Acceptance documents were provided to the audit team for review.

9. Relevant Environmental Standards

18. **Table 44** and **Table 45** present a summary of relevant emission standards for Bayuquan Steel.

Table 44: Summary of Environmental Pollution Standards

Pollutant	Standards
Stack Emissions of sintering and pelletizing	Emission standard of air pollutants for sintering and pelletizing of iron and steel industry (GB28662-2012)
Stack Emissions of coke plant	Discharge standard of pollutants for coke chemical (GB16171-2012)
Stack Emissions of iron plant	Emission standard of air pollutants for iron smelt industry (GB28663-2012)
Stack Emissions of steel plant	Emission standard of air pollutants for steel smelt industry (GB 28664—2012)
Fugitive PM	Integrated Emission Standard of Air Pollutants (GB 16297-1996)
Noise	Emission Standard for Industrial Enterprises at Site Boundary (GB 12348-2008)
Wastewater	Class A of *Wastewater Quality Standards for Discharge to Municipal Sewers* (CJ 343—2010)

Table 45: PRC *Wastewater Quality Standards for Discharge to Municipal Sewers* (Class A, CJ 343-2010)

No	Pollutant	Maximum acceptable concentration mg/L (except pH)
1	pH	6.5-9.5
2	SS	400
3	COD	500
4	Ammonia nitrogen	45
5	BOD	300
6	Total nitrogen	70
7	Total phosphorus	8

19. **Table 35** presents the relevant ambient air quality standards for the Bayuquan Steel surrounding urban area, while Table 36 presents ambient noise standards. There is no applicable surface water quality standard as all wastewater from the Bayuquan Steel is discharged to the sewer and treated in existing WWTP.

Table 46: Applicable ambient air quality standards – *Class II*, *Ambient Air Quality Standards* (GB 3095—2012)

Pollutants	Annual mean (class 2) mg/m^3	24-hr mean (class 2) mg/m^3	1-hr mean (class 2) mg/m^3
TSP	0.200	0.300	--
PM_{10}	0.070	0.150	--
$PM_{2.5}$	0.035	0.075	--
SO_2	0.060	0.150	0.500
NO_2	0.040	0.080	0.200

Table 47: Applicable ambient environment noise standard – *Class III, Environmental Quality Standards for Noise* (GB3096-2008)

Item	Class III
Daytime Noise (06:00-22:00 h)	65 dB(A)
Nighttime noise (22:00-06:00 h)	55 dB(A)

10. Environmental Monitoring and compliance

20. The Bayuquan Steel is equipped with a continuous emissions monitoring systems (CEMS) that monitors in real time SO_2, NOx, PM and air flow of each stacks. Data is sent electronically to the Yingkou EPB Data Center. The Yingkou EPB monitors daily average concentrations, and staff indicates that the EPB can be on site within as little as 1 hour if the CEMS indicates serious noncompliance. Third party stack monitoring is also undertaken. Noise and fugitive dust is also monitored on a quarterly basis, as is wastewater quality.

21. The environmental monitoring results are disclosed on websites of Yingkou EPB. The link is http://www.ykepb.gov.cn/info.aspx?CId=3003.

22. The consultant reviewed all the environmental monitoring results on the website and found that all the results are compliance with relevant standards.

23. It is understood from Bayuquan Steel staff that when it became operational the Bayuquan Steel was in compliance with relevant emission standards.

11. ISO Certification, Staffing and Environmental Management

24. The Bayuquan Steel Group has been third-party certified for ISO 9001 (Quality Management Systems), ISO 14001 (Environmental Management Systems) and ISO 18001 (Occupational Health and Safety).

25. The Bayuquan Steel has around 5258 staff. Environmental, health and safety (EHS) responsibilities are assigned to the Environment and Safety Department, which has a staff of 35 and includes several environment engineers and safety engineers.

26. The Bayuquan Steel has established an Environment Management System (EMS). A copy of the EMS manual was shown to the audit team. The EMS system includes:

Environment Targets:

- Reduce consumption of water, power and coal;
- Comply with relevant pollutant emission standards;

- Comply with relevant boundary noise standard;
- Eliminate dust pollution to surrounding urban area and no dust related public complaints;
- Collect and dispose solid waste; and
- Implement environment indicators for all departments.

Responsibility

- The Bayuquan Steel has primary responsibility for environmental management, capacity building, operation and control, emergency preparation and response, monitoring, compliance assessment, prevention and corrective measures, and communication and outreach.

Procedural Documentation

The EMS manual refers to a series of procedural control documents for environmental management that the TPP must comply with, including:

- Identification and assessment of environmental factors;
- Acquisition and update of laws, regulations and other requirements;
- Environment policies, targets, indicators and environment management programs;
- Human resources;
- Information communication;
- Documentation;
- Operation;
- Wastewater emission management;
- Energy and resources;
- Environmental monitoring and monitoring equipment;
- Compliance assessment;
- Emergency preparation and response;
- Occupational health and safety; and
- Prevention and corrective measures.

40. The EMS is annually reviewed by a qualified third party and updated as required.

12. Health and Safety

41. Safety at the Bayuquan Steel is implemented and controlled through a series of safety management regulations (SMRs), prepared according to relevant national, provincial and local laws and regulations, and assembled into a SMR manual. During the site visit the current SMR manual was provided to the audit team for review. The main contents of the SMR manual are listed in **Table 48**.

42. According to information from Bayuquan Steel, the SMR manual is reviewed and updated periodically. Bayuquan Steel also reports that there have been no safety related accidents in the past three years.

13. Occupational Health Management Regulation

43. Occupational health at the Bayuquan Steel is implemented and controlled through 12 occupational health management regulations (OHMRs), prepared according to relevant national, provincial and local laws and regulations, and assembled into a OHMR manual. During the site visit the current OHMR manual was provided to the audit team for review. The main contents of

the OHMR manual are listed in **Table 49**. The OHMR is reviewed and updated periodically. Bayuquan Steel reports that there have been no occupational health related accidents in the past three years.

Table 48: Bayuquan Steel SMR Manual Contents

No	Name
1	Management assessment standard
2	Safety production responsibility system
3	Safety production management system
4	Work permit management system
5	Operation permit management system
6	Equipment periodical test and rotation system
7	Operation shift change system
8	Operation patrol inspection system
9	Management system for potential safety hazard check and rectification
10	Fire safety management system
11	Flame operation management system and implementation rules
12	Management system for safety technology measures, labor protection measures and anti-accident measures
13	Management system for accident, barrier and anomaly division
14	Management system for special operators safety training assessment
15	Hazardous chemical safety management system
16	Hoisting machinery and equipment safety management system
17	Scaffold installation, demolition and utilization safety management system
18	Safety production education and training management system
19	Safety production meeting system
20	Maintenance safety management system
21	Project outsourcing management system
22	Electrical safety equipment management system
23	Hydrochloric acid management system
24	Safety management system for heat supply network maintenance and operation
25	Personal protection equipment management system

Source: Bayuquan Steel

Table 49: Bayuquan Steel OHMR Manual Contents

No	Name
1	Responsibility system for prevention and control of occupational hazards
2	Caution and notification system for occupational hazards
3	Application system for occupational hazards project
4	Promotion, education and training system for prevention and control of occupational hazards
5	Maintenance and overhaul system for occupational hazards prevention and control facilities
6	Management system for occupational hazards prevention and control equipment
7	Occupational hazards monitoring and assessment management system
8	Occupational health supervision and record management system for workers
9	Report and treatment system for occupational hazardous accidents

10	Emergency response and management system for occupational hazardous accidents
11	Occupational health operation regulation
12	Management system for prevention and control of occupational hazards

Source: Bayuquan Steel

27. The Bayuquan Steel follows emergency management system of Ansteel and has an emergency response procedure. Regular emergency response training and drills are undertaken. A copy of emergency response procedure was provided to the audit team.

28. Overall, the Bayuquan Steel has an adequate environmental, health and safety management system which involves a lot of regulations and policies. The system and regulations are updated regularly. The Bayuquan Steel also has an emergency response procedure and working properly.

E. Conclusion

29. Based on this environmental due diligence audit, the Bayuquan Steel has an adequate environmental, health and safety management system and obtained all the necessary approvals for the plant operation. Proper environmental mitigation measures and control devices are up to date to keep pace with more stringent emission standards and the Bayuquan Steel Plant meets all the necessary environmental standards. Till now, no public complaint has been received. It is concluded that the Bayuquan Steel Plant is well managed and performs good environmental, health and safety performance.