Report and Recommendation of the President to the Board of Directors

Project Number: 48003-002
November 2015

Proposed Loan
People's Republic of China: Qingdao Smart Low-Carbon District Energy Project

Asian Development Bank

CURRENCY EQUIVALENTS

(as of 20 October 2015)

Currency unit	–	yuan (CNY)
CNY1.00	=	$0.157
$1.00	=	CNY6.359

ABBREVIATIONS

ADB	–	Asian Development Bank
IEE	–	initial environmental examination
PAM	–	project administration manual
PRC	–	People's Republic of China
QEG	–	Qingdao Energy Group
QMG	–	Qingdao municipal government

WEIGHTS AND MEASURES

^{o}C	–	degree Celsius
$\mu g/m^3$	–	microgram per cubic meter
m^2	–	square meter
MWth	–	megawatt-thermal equivalent

NOTE

In this report, "$" refers to US dollars.

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PROJECT AT A GLANCE

1. Basic Data — **Project Number:** 48003-002

Project Name	Qingdao Smart Low-Carbon District Energy Project	**Department /Division**	EARD/EAEN
Country	China, People's Republic of	**Executing Agency**	Qingdao Municipal Government
Borrower	Government of the People's Republic of China		

2. Sector	**Subsector(s)**	**ADB Financing ($ million)**
✓ **Energy**	Energy utility services	130.00
	Total	**130.00**

3. Strategic Agenda	**Subcomponents**	**Climate Change Information**	
Inclusive economic growth (IEG)	Pillar 1: Economic opportunities, including jobs, created and expanded	Mitigation ($ million)	34.67
Environmentally sustainable growth (ESG)	Eco-efficiency	CO_2 reduction (tons per annum)	1,398,456
	Global and regional transboundary environmental concerns	Climate Change impact on the Project	Medium

4. Drivers of Change	**Components**	**Gender Equity and Mainstreaming**	
Knowledge solutions (KNS)	Pilot-testing innovation and learning	Some gender elements (SGE)	✓

5. Poverty Targeting		**Location Impact**	
Project directly targets poverty	No	Rural	Low
		Urban	High

6. Risk Categorization: Low

7. Safeguard Categorization **Environment:** B **Involuntary Resettlement:** C **Indigenous Peoples:** C

8. Financing

Modality and Sources	**Amount ($ million)**
ADB	**130.00**
Sovereign Project loan: Ordinary capital resources	130.00
Cofinancing	**0.00**
None	0.00
Counterpart	**133.60**
Government	133.60
Total	**263.60**

9. Effective Development Cooperation

Use of country procurement systems	Yes
Use of country public financial management systems	Yes

Source: Asian Development Bank

I. THE PROPOSAL

1. I submit for your approval the following report and recommendation on a proposed loan to the People's Republic of China (PRC) for the Qingdao Smart Low-Carbon District Energy Project.[1]

2. The project will develop and demonstrate a low-carbon, energy-efficient district heating, cooling, and power production and distribution system in eight locations in Qingdao City. Instead of coal, the system will use natural gas, solar thermal, shallow-ground geothermal, and waste heat recovered from industrial plants as its energy sources.[2] The project will also demonstrate a low-temperature district energy distribution network and combine it with a smart energy management system.[3] The project system is expected to lower energy intensity by 40% and carbon intensity by 64% from the averages achieved by comparable standard systems now in use in the northern PRC.[4]

II. THE PROJECT

A. Rationale

3. Qingdao is in Shandong Province in the northeast of the PRC where winter temperatures drop to as low as –17 degrees Celsius (^{o}C) and are typically below zero for 5 months a year. Heating is therefore an essential service for public health and well-being and sustaining people's livelihoods. Demand for heating grew along with urbanization at an average rate of 11% a year during 2011–2014 in Qingdao. The city air has become hazy and polluted in the winter, a problem common in the PRC's urban regions. According to the local air quality monitoring system, the average annual fine particulate matter concentration in 2014 was 84 micrograms per cubic meter (μg/m^3), more than 8 times the level recommended by the World Health Organization.[5] It is estimated that on winter days 40% of this particulate matter comes from burning coal.

4. Coal-based heating is a major cause of rising levels of outdoor and indoor air pollution during the winter months and the growing risk of respiratory and heart diseases that results. The sick, children, the elderly, and the poor are affected the most. In June 2013, the Government of the PRC issued a policy on 10 air pollution prevention and control measures, which included the reduction of coal use and greater use of natural gas and renewable energy. In July 2013, the Qingdao municipal government (QMG) developed a comprehensive policy for urban air pollution reduction, which included a ban on the use of coal in district energy systems for new and

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[1] The design and monitoring framework is in Appendix 1.

[2] Shallow-ground geothermal technology uses the earth as a heat source in the winter and a heat sink in the summer for heating and cooling systems. The project will use waste heat recovered from both industrial plants and municipal sewage plants.

[3] Instead of keeping the prevailing flow temperature of water at 75 degree Celsius (^{o}C) and return temperature of water at 55^{o}C in the distribution network for heat, the project will employ current best practice of flow temperature of water at 50^{o}C and return temperature of water at 40^{o}C in the network, which is extensively used in many European countries. The smart energy management system will optimize energy supply by responding to real-time demand.

[4] Compared with the average energy intensity of 0.56 gigajoules per square meter (m^2) in the PRC, the project will achieve 0.35 gigajoules per m^2. Compared with the 70 kilograms of carbon emissions per m^2 produced by coal-based systems, the project system will produce 20 kilograms per m^2.

[5] In 2014, the average concentration of fine particles (of less than 2.5 micrometers) in some large PRC cities, which have drawn much national and international attention, was 95 μg/m^3 in Hebei, 86 μg/m^3 in Beijing, and 83 μg/m^3 in Tianjin. Air pollution in Qingdao is equally severe. In contrast, the average concentration is 22 μg/m^3 in Metro Manila in the Philippines and 10 μg/m^3 in Yokohama in Japan.

additional heating areas, and a plan to eliminate the use of coal over time in urban areas. In January 2014, the PRC set new targets for provinces to reduce air pollution by 5%–25% during 2015–2020. The United Kingdom, where smog rose to serious levels in London in 1952, showed that a rapid switch from the use of coal to gas as a basic energy fuel can greatly reduce air pollution.[6]

5. Qingdao was selected as pilot city for low-carbon development by the government's National Development and Reform Commission in December 2012. One-third of carbon dioxide emissions in the city come from residences and the heating industry, many of which still use coal-based systems and high-loss heating networks.[7] This makes the replacement of boilers and centralized district heating networks using coal with decentralized systems using natural gas and renewable sources a high priority of Qingdao in the effort to reduce carbon dioxide emissions.[8]

6. The district heating systems in the PRC also tend to overheat buildings, which leads to significant energy loss through the building envelope. This happens because heat suppliers do not know and cannot react to the customer demand for heat in real time. Use of a smart energy management system will prevent overheating, save energy, and improve the quality of heating service. These systems provide interactive communications and energy control between heat suppliers and customers to indicate and meet household demand.

7. The project design (para. 2) responds directly to the urgent national, provincial, and municipal government priorities to develop low-carbon cities and reduce urban air pollution (paras. 4–6). When the project is completed, the design can be replicated in other major cities to bring their systems in line with current international best practices for achieving energy efficiency.[9] By providing cleaner district energy services and improving air quality, the project will directly benefit about half a million people in the project area, or about 15% of the city's urban population, as well as commercial enterprises and public agencies. It will indirectly benefit the residents of the other parts of Qingdao by removing some of the sources of pollution now emanating from the project area.

8. While preparing the project, the Asian Development Bank (ADB) established a platform for an exchange and dissemination of knowledge between the Qingdao District Heating Association and the Swedish Council for District Heating and District Cooling, an international leader in the development of low-carbon and energy-efficient district heating and cooling systems. This will help Qingdao gain knowledge of (i) district energy policies and regulations, (ii) district energy technologies and new applications, and (iii) lessons learned in other relevant projects beyond the PRC.[10] In addition, to disseminate knowledge and experience gained from

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[6] The World Bank recommends that natural gas be used for heating rather than coal. World Bank. 2007. *Environmental Health and Safety Guidelines*. Washington, DC. This is because it emits 50% less carbon dioxide, 82% less nitrogen oxide, negligible particulate matters, and 98% less sulfur dioxide. A heating source using natural gas can be operated independently and located within the building being heated (distributed energy).

[7] ADB. 2012. *Technical Assistance to the People's Republic of China for Enabling the Protection of Jiaozhou Bay Water Quality.* Manila.

[8] A decentralized or distributed energy system can reduce the amount of energy lost in transmitting heat and/or power from where they are generated to where they are to be used because the source is within the same building or nearby. In addition, upgrading and/or expanding current heating pipelines to meet demand is difficult when the underground space for service infrastructure is already congested.

[9] It can be replicated in 180 cities in 14 provinces and 2 autonomous regions and in the municipalities of Beijing and Tianjin where heating is provided by a district system.

[10] ADB facilitated the signing of the memorandum of understanding between the Swedish Council for District Heating and District Cooling and the Qingdao District Heating Association on 29 May 2015.

the Qingdao project, ADB will support district energy conference in the PRC and publish knowledge products and policy notes.

9. The project is closely aligned with (i) the Midterm Review of Strategy 2020,[11] which identifies environmentally sustainable growth as a priority for helping developing member countries move to a low-carbon growth path by improving energy efficiency and introducing renewable energy; (ii) ADB's country partnership strategy, 2011–2015 for the PRC,[12] which identifies environmental sustainability as one of the three pillars of ADB assistance; and (iii) ADB's Energy Policy,[13] which prioritizes energy efficiency, renewable energy development, and access to energy for all.

B. Impacts and Outcome

10. The impacts will be (i) greater energy efficiency in district energy systems, and (ii) a decline in cases of respiratory and heart diseases. The outcome will be the avoidance of emissions of carbon and pollutants by district energy systems in Qingdao.

C. Output

11. The output will be the construction of a smart, distributed district energy system in Qingdao. The key activities will be the (i) installation of small, distributed natural gas boilers, a waste heat recovery system from sewage plants and industries, heat pump systems, a solar heating system, a heat storage system, and low-temperature pipelines in eight locations; (ii) installation of a smart energy management system in eight locations; and (iii) supervision of project implementation.[14] The project's components and key features are summarized in Table 1.

Table 1: Key Features of the Project by Location

District Name and System Type	Heating Area (million m^2)	Cooling Area (million m^2)	Power Supply (MWh)	Length of Pipeline (km)	Heat Source and Technology[b]
Binhai energy system (N)	6.7	0.8	25.6	0.0 [a]	Waste heat recovery from industry, gas, and sewage source heat pump
Houhai energy system (N)	0.7	0.3	59.8	14.0	Gas
Licang unit-based heating and cooling system (N)	0.1	0.2	0.0	0.0[a]	Gas
Shibei heat exchange stations (N)	5.0	0.0	0.0	47.2	Gas
Jidong energy system	2.1	0.4	22.5	27.4	Gas
East Licang heating system (N)	3.1	0.0	0.0	28.2	Gas
Shinan unit-based heating and cooling system (N)	0.4	0.0	0.0	0.0 [a]	Gas and absorption heat pump
Shibei geothermal and solar heating system (N)	0.1	0.1	0.0	0.0 [a]	Underground source heat pump and solar thermal
Total	**18.2**	**1.8**	**107.9**	**116.8**	

[11] ADB. 2014. *Midterm Review of Strategy 2020: Meeting the Challenges of a Transforming Asia and Pacific.* Manila.
[12] ADB. 2012. *Country Partnership Strategy: People's Republic of China, 2011–2015.* Manila.
[13] ADB. 2009. *Energy Policy*. Manila.
[14] The integrated functions of energy management systems include (i) acquisition and monitoring of data on heating values, temperatures, humidity, and flow rates; (ii) real-time demand response and controls; and (iii) provision of situational awareness for faster user recognition in real time. These functions help optimize the performance of the heating network.

km = kilometer, MWh = megawatt-hour, m^2 = square meter, N = new supply area.
[a] Due to a building-based heating and/or cooling system at these locations, a heating distribution network is not required.
[b] Renewable energy will contribute about 5.5% to the total heat output.
Source: Asian Development Bank estimates.

D. Investment and Financing Plans

12. The project is estimated to cost $263.6 million (Table 2).

Table 2: Project Investment Plan
($ million)

Item		Amount[a]
A.	**Base Cost**[b]	
	1. Binhai energy system	87.0
	2. Houhai energy system	43.1
	3. Licang unit-based heating and cooling system	8.6
	4. Shibei heat exchange stations	25.6
	5. Jidong energy system	27.1
	6. East Licang heating system	10.7
	7. Shinan unit-based heating and cooling system	5.5
	8. Shibei geothermal and solar heating system	3.3
	9. Smart energy management system	18.3
	10. Project implementation consulting services	1.0
	Subtotal (A)	**230.3**
B.	**Contingencies**[c]	**25.4**
C.	**Financial Charges During Implementation**[d]	**7.9**
	Total (A+B+C)	**263.6**

Note: Numbers may not sum precisely because of rounding.
[a] Includes taxes and duties of $22.7 million to be financed from government resources and Asian Development Bank (ADB) loan resources. The amount of taxes and duties ($11 million) to be financed by ADB is based on the principles that (i) the amount will be within the reasonable threshold identified during the country partnership strategy preparation process, (ii) the amount of taxes and duties financed by the ADB loan does not represent an excessive share of the project, (iii) the taxes and duties apply only to ADB-financed expenditures, and (iv) the financing of taxes and duties is material and relevant to the success of the project. Government financing of taxes and duties will be provided through a cash contribution.
[b] In September 2015 prices.
[c] Physical contingencies computed at 5.0% of base cost. Price contingencies computed at an average 1.4% on foreign exchange costs and 3.0% on local currency costs; includes provision for potential exchange rate fluctuation under the assumption of a purchasing power parity exchange rate.
[d] Includes interest and commitment charges. Interest during construction for an ordinary capital resources loan has been computed at the 5-year US dollar fixed swap rate plus an effective contractual spread of 0.5% and maturity premium of 0.1%. Commitment charges for an ordinary capital resources loan are 0.15% per year to be charged on the undisbursed loan amount.
Sources: Asian Development Bank and Qingdao municipal government estimates.

13. The government has requested a loan of $130 million from ADB's ordinary capital resources to help finance the project. The loan will have a 25-year term, including (i) a grace period of 5 years, (ii) a straight-line repayment method, (iii) an annual interest rate determined in accordance with ADB's London interbank offered rate (LIBOR)-based lending facility, (iv) a commitment charge of 0.15% per year to be charged on the undisbursed loan amount, and (v) such other terms and conditions set forth in the draft loan and project agreements. The average loan maturity is 15.25 years, and the maturity premium payable to ADB is 0.1% per year. The Qingdao Energy Group (QEG) will finance $133.6 million through equity contributions.[15]

[15] Qingdao Energy Group is a state-owned enterprise 100% owned by QMG. Its core business is investment, construction, operation, and service provision in fuel (compressed natural gas for vehicles) and natural gas supply,

14. The government of the PRC will be the borrower. The government will make the loan available to QEG through QMG on the same terms and conditions as those of the ADB loan. QEG will assume the foreign exchange and interest variation risks of the ADB loan. The government, QMG, and QEG have assured ADB that counterpart funding will be provided in a timely manner, including any additional counterpart funding required for any shortfall of funds or cost overruns. No withdrawals will be made from the loan account until QMG and QEG have entered into an agreement, duly executed and delivered between QMG and QEG.

15. The financing plan is in Table 3.

Table 3: Financing Plan

Source	**Amount** ($ million)	**Share of Total** (%)
Asian Development Bank		
Ordinary capital resources (loan)	130.0	49.0
Government		
Qingdao Energy Group	133.6	51.0
Total	**263.6**	**100.0**

Sources: Asian Development Bank and Qingdao municipal government estimates.

E. Implementation Arrangements

16. QMG will be the executing agency and will be responsible for overall project guidance during implementation. It has set up a project leading group comprising representatives of its municipal development and reform commission, finance bureau, utility bureau, planning bureau, housing and urban–rural development commission, land and resources bureau, and environment protection bureau. QEG will be the project implementing agency. QEG will sign onlending agreements with QMG and be responsible for day-to-day management during project preparation and implementation.

17. QEG will recruit project management consultants to train and support QMG and QEG staff in project implementation and (i) help optimize technical design, (ii) help monitor the project's environmental impact, and (iii) share their knowledge of advanced district energy applications to reduce implementation risks and improve project sustainability.

18. The implementation arrangements are summarized in Table 4 and described in detail in the project administration manual (PAM).[16]

Table 4: Implementation Arrangements

Aspects	**Arrangements**
Implementation period	January 2016–December 2020
Estimated completion date	Physical completion: 31 December 2020 Loan closing: 30 June 2021
Management	
(i) Oversight body	Project leading group Chair: vice-governor of the Qingdao municipal government Members: representatives from the Qingdao municipal government's municipal development and reform commission, finance bureau, utility bureau, planning bureau, housing and urban–rural development commission, land and resources bureau, and environment protection bureau
(ii) Executing agency	Qingdao municipal government

heat and electricity supply, and applications of new and renewable energies. It has about 6,000 staff. In 2014, its total assets were CNY11 billion.

[16] Project Administration Manual (accessible from the list of linked documents in Appendix 2).

Aspects	Arrangements		
(iii) Implementing agency	Qingdao Energy Group		
(iv) Implementation unit	Project management office at the Qingdao Energy Group, four staff members		
Procurement	International competitive bidding	2 contracts	$27.3 million
	National competitive bidding	15 contracts	$101.7 million
Consulting services	Quality- and cost-based selection (90:10)	39 person-months	$1.0 million
Retroactive financing and/or advance contracting	The Qingdao municipal government has requested advance contracting and retroactive financing. This will include the recruitment of consulting services and the procurement of goods. The amount to be retroactively financed will not exceed $26 million (equivalent to 20% of the ADB loan) and may finance costs incurred prior to loan effectiveness, but not earlier than 12 months before the signing date of the loan agreement.		
Disbursement	The loan proceeds will be disbursed in accordance with ADB's *Loan Disbursement Handbook* (2015, as amended from time to time) and detailed arrangements agreed between the government and ADB.		

ADB = Asian Development Bank.
Sources: Asian Development Bank and Qingdao municipal government estimates.

III. DUE DILIGENCE

A. Technical

19. **Heat source assessment.** An assessment of the heat sources available for the project established the following:

(i) **Natural gas.** The project will consume an estimated 155 million cubic meters of natural gas annually, equivalent to less than 2% of the gas consumed in 2014 in Qingdao. A gas supply agreement has been concluded with the Qingdao Taineng Gas Company, a 100% subsidiary of QEG.
(ii) **Solar energy.** Qingdao has good solar irradiation of 4,200–5,400 megajoules per square meter annually, which is suitable for solar heating.
(iii) **Wastewater heat.** The temperature of wastewater is 12°C–14°C in winter, which is within the range of ideal heat source temperatures (above 10°C in winter).
(iv) **Ground heat.** The ground temperature is stable year-round at about 15°C and is within the range of ideal heat source temperatures.
(v) **Waste heat recovery from industrial plants.** Available waste heat from industrial plants is estimated at 240 megawatt-thermal equivalent, and a heat supply agreement has been concluded with the source industries. In the event that heat supply from industrial plants is interrupted, natural gas boilers to be installed under the project will provide backup.

20. The technical due diligence confirmed that the use of these diverse heat sources is viable and that the envisioned project methods have been applied successfully in Germany and Scandinavian countries.[17] However, QEG's limited experience in this technology poses performance risks. To mitigate these risks, technical consultants engaged under the project and a local design institute with experience in the technical design of an advanced district energy

[17] The applications include (i) combined, natural gas-based cooling, heating, and power; (ii) waste heat recovery from industrial and municipal sewage plants; (iii) underground heat pumps; (iv) absorption heat pumps; and (v) solar thermal.

system will help QEG in reviewing and optimizing the systems' technical design and in supervising project implementation (para. 19).

B. Economic and Financial

21. The economic benefits of the project will include those provided by a more efficient heating system and environmental improvements. An economic analysis considered all the project-related costs, benefits from cost savings from the use of alternative fuels and system efficiency improvements, and local and global environmental benefits. The project's estimated economic internal rate of return was 16.81% without the environmental benefits and 16.98% with them, making the project economically viable since both figures exceed the 12.00% economic cost of capital. Sensitivity testing indicated that the project would likely remain sustainable under a variety of adverse economic impacts.

22. The project will generate revenue from the sale of heat, cooling, electricity, and the collection of the service connection fees from new customers in the project areas. Financial analysis of the project indicated a financial internal rate of return of 10.35%, well above the weighted average cost of capital of 2.92%. Sensitivity analysis showed the project to be likely sustainable under several potential adverse scenarios. A financial performance analysis and financial projections indicated that QEG has the financial capacity needed to provide counterpart funding, service the project debt, and cover operation and maintenance costs.

C. Governance

23. ADB has assessed the financial management risk of QEG as moderate. This is based on its limited direct experience in following ADB disbursement procedures, which could delay disbursements.[18] To address the risk, QEG and QMG were given disbursement training during project preparation. More training will follow during implementation, and the financial management arrangements are deemed adequate with these mitigation measures. QMG has established a good track record in financial management while implementing several other ADB-financed projects.[19]

24. An assessment of QEG procurement capacity showed it to have the skilled and experienced staff and well-established procedures and systems needed to manage procurement in a manner consistent with ADB requirements.[20] Staff received procurement training three times during the project preparation period, and QEG has conducted international competitive bidding for other projects financed by foreign development partners. QEG engaged a tendering agency with good experience on 15 June 2015 specifically for this project, and ADB

[18] The financial management assessment was conducted under project preparatory technical assistance in May 2015. Financial Management Assessment of the Implementing Agency (accessible from the list of linked documents in Appendix 2).

[19] The executing agency has administered two ADB projects: ADB. 1988. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Qingdao Tire Development Project.* Manila; and ADB. 1992. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Qingdao Environmental Improvement Project.* Manila. It is administering one ADB project: ADB. 2008. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Qingdao Water Resources and Wetland Protection Project.* Manila.

[20] Project Procurement Risk Assessment Report (accessible from the list of linked documents in Appendix 2.)

conducted extensive discussions with this agency to familiarize it fully with the 10-point procurement reforms undertaken by ADB in 2015.[21]

25. ADB's Anticorruption Policy (1998, as amended to date) was explained to and discussed with the government and the QMG. The specific policy requirements and supplementary measures are described in the PAM (footnote 16).

D. Poverty and Social

26. **Social benefits.** The project will directly benefit 420,000 people in the project area, of whom about 210,000 are female and 7,495 are from poor households. It will provide direct benefits to 22,000 children in 15 schools and an additional 7,000 in 55 kindergartens, as well as patients and medical staff in 7 hospitals. The project will (i) reduce cases of respiratory diseases by improving indoor and outdoor air quality, (ii) reduce carbon monoxide poisoning by providing safer district heating services, (iii) provide a better medical environment by providing cleaner and more reliable heating services, (iv) improve living conditions by providing adequate and reliable heating services, (v) reduce household spending on heating by shifting consumers from the use of stoves and decentralized heating systems to centralized energy-efficient heating systems, (vi) provide a better learning environment for students during the winter by providing schools with cleaner and more reliable heating services, and (vii) increase income through the creation of 350 temporary jobs during construction.

27. **Gender impact.** The project's gender category is some gender elements. Its benefits for women will include (i) access to a reliable, cleaner, and safer heating system; (ii) an easing of the domestic chores related to space heating (1 hour per day); (iii) a reduced incidence of respiratory diseases related to indoor air pollution; and (iv) a lowering of the current rate of carbon monoxide poisoning and accidental fires.

28. The project will (i) organize energy conservation-awareness campaigns in partnership with a women's federation at least twice during implementation, targeting all 100,000 women in the project area (including 11,000 female students); (ii) aim to fill 50% of the 310 permanent positions to be created during operation with women employees; (iii) ensure that QMG provides a 100% subsidy for heating tariffs to poor households headed by women and that heating companies waive their connection fees for these households; and (iv) conduct customer satisfaction surveys in a gender-responsive manner to improve service delivery.

E. Safeguards

29. **Environment.** The project is classified as category B for environment. The initial environmental examination (IEE) complied with ADB's policies and requirements, including those under ADB's Safeguard Policy Statement (2009). The risks during project construction identified by the IEE included those related to (i) noise and dust, (ii) construction waste, (iii) community disturbance and public safety, and (iv) occupational health and safety. It found potential adverse environmental impacts during system operation to be related to (i) the emission of nitrogen oxides, (ii) noise, (iii) the disposal of wastewater from the heat source plants, and (iv) occupational health and safety. The IEE concluded that all the construction and operational risks it pinpointed could be mitigated by implementing measures specified by the

[21] The tendering agency has a grade A certificate as an international tendering agent from the government and experience from five ADB projects and five World Bank projects currently being implemented.

environmental management plan, monitoring implementation, and assigning institutional responsibility for ensuring proper environmental management.

30. QMG and QEG carried out meaningful consultations with the public in accordance with ADB's Safeguard Policy Statement. QMG and QEG are committed to managing the environmental risks cited by the IEE and have agreed on a comprehensive set of environment-related loan covenants and to participate in a training program that will strongly emphasize environmental safeguards. The IEE was posted on ADB's website on 3 August 2015. Environmental safeguard documents were disclosed to the affected people. Potential environmental complaints or disputes will be handled in accordance with the grievance redress mechanism established for the project. An assessment of the climate change risks posed to the project considered them to be moderate. The most significant threat comes from rising sea levels, and no specific design modifications were required or justified since this will not affect the project during its life span.[22]

31. **Involuntary resettlement and indigenous peoples.** The project is classified as category C for involuntary resettlement and indigenous peoples. The project does not entail permanent land acquisition, restrictions on land use, the demolition of any structure, or involuntary resettlement. Installing underground heating pipelines will affect only publicly owned roads and sidewalks for a maximum of 6 months. The project is not expected to have adverse impacts on ethnic minorities. It will be implemented in a large urban area where a vast percentage of people are members of the Han ethnic majority, and where no significant differences exist between the lifestyles and socioeconomic status of the Han majority and ethnic minorities. The project site is not close to any ethnic minority towns or villages.

32. **Environmental benefits.** The project's completion will allow QMG to shut down coal-fired heating systems. The project system's natural gas use will generate an estimated annual carbon dioxide emission of 490,000 tons. This will be offset by emission reductions expected from QMG's low-carbon and air pollution control program.[23] By using natural gas and renewable energy sources, the project system will eliminate the consumption of the 537,867 tons of coal that would occur each year under a business-as-usual scenario. This will prevent the emission of 1,398,456 tons of carbon dioxide, 12,909 tons of sulfur dioxide, 3,765 tons of nitrogen oxide, and 5,379 tons of particulate matter. Compared with a traditional heating system, the project system will emit 53% less carbon dioxide, and less than 5% of nitrogen oxide, sulfur dioxide, and particulate matter.

F. Risks and Mitigating Measures

33. Major risks and mitigating measures are summarized in Table 5 and described in detail in the risk assessment and risk management plan.[24]

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[22] The assessment found that the project's critical structures are roughly 2–4 meters above the current sea level. An average sea level rise of even 1 centimeter a year would result in a sea level only 25 centimeters higher than today's by the end of the project design's estimated 25-year life span. Slow-onset sea level risks can be addressed through adaptive incremental interventions.

[23] QMG has been implementing other low-carbon and air pollution control measures that include the (i) elimination of old vehicles and construction of 10 metro lines to reduce the emissions from road traffic; (ii) development of renewable energy (wind, solar, and hydropower); (iii) enforced installation of desulphurization, denitrification, and dust removal facilities in coal-fired power plants and boilers; (iv) elimination of small coal-fired boilers; and (v) shutdowns of polluting industries. The progress made through these measures will be monitored during the project implementation.

[24] Risk Assessment and Risk Management Plan (accessible from the list of linked documents in Appendix 2).

Table 5: Summary of Risks and Mitigating Measures

Risks	Mitigating Measures
The contract award may be delayed.	ADB provided procurement training to QEG during project preparation and will give additional training to both QEG and the tendering company during implementation.
Disbursement could be slow.	ADB will provide disbursement training to QEG and QMG during project preparation and implementation.
The project's district energy system achieves less than anticipated energy efficiency.	Technical consultants under the project will assist QEG in reviewing and optimizing the technical design and the specifications for the detailed design, selecting quality contractors and suppliers, and supervising project implementation to ensure high probability of achieving design efficiency levels.

Asian Development Bank = ADB, QEG = Qingdao Energy Group, QMG = Qingdao municipal government.
Source: Asian Development Bank.

34. Overall, the risks associated with the project have been adequately addressed. The integrated benefits and impacts are expected to outweigh the costs.

IV. ASSURANCES AND CONDITIONS

35. The government and QMG have assured ADB that implementation of the project shall conform to all applicable ADB policies, including those concerning anticorruption measures, safeguards, gender, procurement, consulting services, and disbursement as described in detail in the PAM and loan documents.

36. The government and QMG have agreed with ADB on certain covenants for the project, which are set forth in the loan agreement and project agreement.

V. RECOMMENDATION

37. I am satisfied that the proposed loan would comply with the Articles of Agreement of the Asian Development Bank (ADB) and recommend that the Board approve the loan of $130,000,000 to the People's Republic of China for the Qingdao Smart Low-Carbon District Energy Project, from ADB's ordinary capital resources, with interest to be determined in accordance with ADB's London interbank offered rate (LIBOR)-based lending facility; for a term of 25 years, including a grace period of 5 years; and such other terms and conditions as are substantially in accordance with those set forth in the draft loan and project agreements presented to the Board.

Takehiko Nakao
President

16 November 2015

DESIGN AND MONITORING FRAMEWORK

Impacts the Project is Aligned with
Energy efficiency in district energy systems improved.[a]
Cases of respiratory and heart diseases decreased.[a]

Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting Mechanisms	Risks
Outcome Carbon and pollutant emission from district energy system in Qingdao avoided	By 2022 Annual standard coal consumption of more than 537,867 tons avoided. As a result, annual emissions of 1,398,456 tons of carbon dioxide, 12,909 tons of sulfur dioxide, 5,379 tons of particulate matter, and 3,765 tons of nitrogen oxide also avoided (2015 baseline: 0)	Data from the project's annual environmental compliance report	The project system achieves lower than anticipated energy efficiency and environmental performance levels
Output A smart, distributed district energy system constructed in Qingdao	By 2020 a. Capacity to supply 1,003 MWth of heating (55 MWth from renewables), 176 MWth of cooling, and 79 MWe of electricity constructed, along with 116 km of pipelines (2015 baseline: 0 MWth, MWe, and 0 km) b. Automated information and communication technology to gather and act on information about the behaviors of suppliers and consumers installed (2015 baseline: 0) c. District energy system in eight locations installed (2015 baseline: 0)	Loan review missions and project performance reports	Technical specifications change due to a change in energy demand

Key Activities with Milestones
1. A smart, distributed district energy system constructed in Qingdao
1.1 Install small, distributed natural gas boilers, waste heat recovery system from sewage plants and industries, heat pump systems, a solar heating system, a heat storage system, and low-temperature pipelines in eight locations in Qingdao (Q2 2016–Q4 2020)
1.2 Install a smart energy management system (Q2 2016–Q4 2020)
1.3 Supervise project implementation (Q2 2016–Q4 2020)

Inputs

Asian Development Bank: $130,000,000
Counterpart funds: $133,600,000

Assumptions for Partner Financing
Not applicable.

km = kilometer, MWe = megawatt-electricity equivalent, MWh = megawatt-hour, MWth = megawatt-thermal equivalent, Q = quarter.
[a] Qingdao municipal government. 2004. *Qingdao City Low Carbon Development Plan.* Qingdao.
Source: Asian Development Bank.

LIST OF LINKED DOCUMENTS

http://www.adb.org/Documents/RRPs/?id=48003-002-3

1. Loan Agreement
2. Project Agreement
3. Sector Assessment (Summary): Energy
4. Project Administration Manual
5. Contribution to the ADB Results Framework
6. Development Coordination
7. Financial Analysis
8. Economic Analysis
9. Country Economic Indicators
10. Summary Poverty Reduction and Social Strategy
11. Initial Environmental Examination
12. Risk Assessment and Risk Management Plan

Supplementary Documents

13. Financial Management Assessment of the Implementing Agency
14. Project Procurement Risk Assessment Report
15. Key System Configuration