

PROJECT PREPARATORY TECHNICAL ASSISTANCE

A. Justification

1. The proposed project for additional financing involves implementing a carbon capture, utilization, and storage (CCUS) pilot project at the Tianjin integrated gasification combined cycle (IGCC) power plant to test pre-combustion capture of up to 100,000 tons per year of carbon dioxide (CO₂), its utilization for enhanced oil recovery (EOR) and geological sequestration. This CCUS pilot project will be the first complete one at an IGCC power plant in a developing country.¹ The unique lessons learned and important knowledge shall be shared with the national and international stakeholders. Based on the consensus reached with the Government of the People's Republic of China (PRC), the China Huaneng Group (CHNG), and the Huaneng Clean Energy Research Institute (HNCERI) regarding the medium-term operation of the proposed project, appropriate financial support arrangements for the pilot project need to be finalized. The pilot project to be funded under the proposed grant would be subject to technical, financial, economic, and environmental due diligence prior to the approval of the grant. A regional project preparatory technical assistance (R-PPTA) of \$800,000 is required to undertake the above mentioned tasks. The government has been advised that the approval of the PPTA does not commit Asian Development Bank (ADB) to finance the ensuing grant.

B. Major Outputs and Activities

2. The major outputs and activities are summarized in Table A4.1.

Table A4.1: Summary of Major Outputs and Activities

Major Activities	Major Outputs	Expected Completion Date
R-PPTA Part A		
<ul style="list-style-type: none"> • Establishment of procurement plan and support contract management 	<ul style="list-style-type: none"> • Procurement plan and procurement of equipment in accordance with ADB guidelines 	15 January 2014
<ul style="list-style-type: none"> • Financial management and procurement capacity assessment 	<ul style="list-style-type: none"> • Financial Management and procurement capacity assessment report in accordance with ADB guidelines 	31 March 2014
<ul style="list-style-type: none"> • Detailed technical, financial and economic due diligence of pilot project 	<ul style="list-style-type: none"> • Detailed due diligence report for pilot project 	30 April 2014
<ul style="list-style-type: none"> • EOR and storage site due diligence 	<ul style="list-style-type: none"> • EOR and storage site assessment report 	30 April 2014
<ul style="list-style-type: none"> • EIA of carbon capture pilot plant 	<ul style="list-style-type: none"> • EIA uploaded to ADB website 	30 April 2014

¹ The company ELCOGAS from Spain built the world's first IGCC power plant with a carbon capture pilot plant demonstrating the technical feasibility of pre-combustion technology. A flagship commercial scale integrated commercial-scale project demonstrating the pre-combustion carbon capture technology at a 582 megawatt IGCC plant with an annual capture capacity of 3.5 million tons of CO₂ is under construction in the United States.

Major Activities	Major Outputs	Expected Completion Date
<ul style="list-style-type: none"> Environmental and Social Impact Assessment of EOR and storage sites 	<ul style="list-style-type: none"> Environmental and Social Impact Assessment Report uploaded to ADB website 	15 June 2014
<ul style="list-style-type: none"> Environmental audit of oilfield 	<ul style="list-style-type: none"> Environmental audit report 	30 April 2014
<ul style="list-style-type: none"> Develop best practice guidelines 	<ul style="list-style-type: none"> CCUS best practice guidelines developed for (i) EIA approval, (ii) business and support model, and (iii) monitoring and verification by June 2015 	31 December 2014
R-PPTA Part B		
<ul style="list-style-type: none"> Share knowledge and lessons learned 	<ul style="list-style-type: none"> Knowledge products and lessons learned presented at international conferences 	30 June 2015
<ul style="list-style-type: none"> Organize inter-regional workshop to share knowledge and lessons learned 	<ul style="list-style-type: none"> Regional workshop to share knowledge and lessons learned held by December 2015 	31 December 2015

ADB = Asian Development Bank, CO₂ = carbon dioxide, EIA = environmental impact assessment, EOR = enhanced oil recovery.
Source: Asian Development Bank.

C. Cost Estimate and Proposed Financing Arrangement

3. The R-PPTA is estimated to cost \$800,000 equivalent, of which \$800,000 equivalent will be financed on a grant basis by ADB's Carbon Capture and Storage Fund² under the Clean Energy Financing Partnership Facility. The implementing agency will also provide in-kind contribution in the form of office accommodation and support facilities, local transportation, counterpart staff, studies, reports, geological surveys, data, relevant rules and regulations, and other information and support needed for the TA. The detailed cost estimate is presented in Table A4.2.

Table A4.2: Cost Estimates and Financing Plan
(\$'000)

Item	Total Cost
A. Carbon Capture and Storage Funds^a under the Clean Energy Financing Partnership Facility (Due diligence of pilot project)	
a. Carbon capture plant, economic and financial due diligence	
1. Consultants	
a. Remuneration and per diem	

² Contributors: Global Carbon Capture and Storage Institute and the Government of the United Kingdom.

i. International consultants (11 person-months)	253.00
ii. National consultants (13 person-months) ^b	78.00
b. International and local travel	50.00
c. Reports and communications	15.00
2. EOR and CO ₂ Storage Site Due diligence ^c	75.00
3. Contingencies	44.00

Subtotal (A) 515.00

B. Carbon Capture and Storage Fund^a under the Clean Energy Financing Partnership Facility (Developed and disseminated knowledge products)

1. Training, seminars, workshops, and conferences	
a. Reports and communications ^d	30.00
b. International training, seminars, workshops, and conferences ^e	225.00
2. Miscellaneous administration and support costs ^f	5.00
3. Contingencies	25.00

Subtotal (B) 285.00

Total 800.00

^a Contributors: Global Carbon Capture and Storage Institute and the Government of the United Kingdom.

^b Number excludes person-months for EOR and CO₂ storage experts who will be engaged through single source selection (note c below).

^c The due diligence will be undertaken during the R-PPTA implementation and submitted to ADB for prior approval. Due to exclusive access to information and access to the oilfield this component will be single sourced from the Chinese University of Petroleum.

^d Includes the production of knowledge products.

^e An international knowledge sharing workshop and seminars will be organized inviting international and national experts as resource persons, representatives from other Includes international and national experts as resource persons. It will further include the invitation and payment of travel expenses of representatives from relevant government agencies, power generation and oil sectors of focus developing member countries including India, Indonesia, Kazakhstan, Malaysia, Pakistan, Thailand, and Vietnam.

Workshops: Translation services are included. Detailed activities in part B and estimated cost will be reviewed and approved by ADB.

Purpose	Venue
R-PPTA part B knowledge sharing workshop	Beijing and/or Tianjin

Trainings: Detailed activities and estimated costs will be reviewed and approved by ADB. An advance payment facility will be provided.

Purpose	Venue
Intensive training, also overseas	ADB member country

Conferences: It will include participation in relevant international high-level carbon dioxide capture and storage conferences and Carbon Sequestration Leadership Forum meetings by ADB staff as well as key consultants acting as resource persons.

^f Including costs for a national coordinator to support the organization of the knowledge sharing workshop.

Note: Funds will be expended in ADB member countries. The implementing agency will also provide in-kind contribution in the form of office accommodation and support facilities, local transportation, counterpart staff, studies, reports, geological surveys, data, relevant rules and regulations, and other information and support needed for the TA.

Source: Asian Development Bank.

C. Consulting Services

4. The R-PPTA is proposed to be implemented in two parts. Part A will require approximately 11 person-months of international consultants and 21 person-months of national consultants input in the following critical areas (i) technical due diligence of the CCUS pilot, (ii) environmental impact assessment (EIA), (iii) EOR and carbon sequestration, (iv) institutional set-up for CCUS operation and monitoring and verification structure, and (v) economic and

financial due diligence. Specifically, the following international experts shall be engaged (i) pre-combustion carbon capture expert (3.0 person-months), (ii) environment expert (6.0 person-months), and (iii) environmental auditor (2.0 person-months). In addition, the following national CCUS experts shall be engaged (i) pre-combustion carbon capture expert (3.0 person-months), (ii) expert for EOR (4.0 person-months), (iii) expert for carbon sequestration (4.0 person-months), (iv) environment expert (4.0 person-months), (v) economist (2.0 person-months), and (vi) procurement specialist (2.0 person-months).

5. For the technical due diligence of the carbon capture, compression, and liquefaction plant, the financial, economic, and the environmental and social safeguards due diligence of the CCUS project, including the environmental audit of the oilfield, ADB will select and engage consultants through a consulting firm in accordance with ADB's Guidelines on the Use of Consultants (2013, as amended from time to time) using the quality- and cost-based selection method (with a quality-cost ratio of 90:10). The consulting firm will be required to submit a simplified technical proposal covering all aspects of the terms of reference. For the due diligence of the EOR and the carbon sequestration plan ADB will engage the Petroleum University of China through the single source selection method in accordance with ADB's Guidelines on the Use of Consultants (2013, as amended from time to time) as the university and has exclusive access to the data. The form of engagement of the University, either through a sub-contract with the competitively chosen consulting firm or through a contract with ADB, will still be firmed up.

6. For Part B of the R-PPTA resource persons will be engaged to support the knowledge dissemination workshop. They will present lessons learned and good practice guidelines based on the experiences gained from the CCUS pilot project implementation.³

Table A4.3: Summary of Consulting Services Requirement

Positions	Person-Months Required
Part A	
International	
Pre-combustion carbon capture expert	3.00
Environment expert	6.00
Environmental Auditor	2.00
National	
Pre-combustion carbon capture expert	3.00
Expert for EOR	4.00
Expert for geological sequestration of CO ₂	4.00
Environment expert	4.00
Economist	2.00
Financial and institutional analyst	2.00
Procurement specialist	2.00
Part B	
Resource persons	tbd.

CCUS = carbon capture, utilization and storage, EOR = enhanced oil recovery, tbd = to be determined.
Source: Asian Development Bank.

7. The outline terms of reference for the R-PPTA consultants are described in paras. 8. to 18.

³ Resource persons will be engaged under ADB resource person contracts.

1. Part A of Regional Project Preparatory Technical Assistance

8. **Pre-combustion carbon capture expert and team leader** (international, 3.0 person-months, intermittent). The CCUS expert should have a postgraduate degree in chemical or electrical engineering, or any other relevant field of expertise. The expert should have at least 5 years of working expertise in the field of CCUS, ideally in the field of design, construction, and operation and maintenance (O&M) of pre-combustion CCUS attached to IGCC power plants. The expert will coordinate the production of the due diligence report and be responsible for the following specific tasks:

- (i) Visit the site for the CCUS pilot project, the route for CO₂ transportation, and the site for CO₂ sequestration.
- (ii) Review CCUS pilot design report and other relevant documents done by HNCERI.
- (iii) Assess the reliability of the proposed design with regards to the carbon capture, compression and liquefaction of CO₂.
- (iv) Validate the projected amount of CO₂ captured.
- (v) Review the construction and project implementation, O&M plans and provide recommendations, if necessary.
- (vi) Review and appraise cost estimate for the pilot project's implementation.
- (vii) Review and verify energy penalty assessment for operating the CCUS pilot project.
- (viii) Assess whether the proposed project design will have an adverse impact on the IGCC power plant's performance.
- (ix) Conduct risk assessment related to the CCUS pilot project by HNCERI, including the identification of major technical, cost overrun, and delay risks.
- (x) Review and provide recommendations, if any, for the institutional set-up for the O&M of the CCUS pilot, the relationship with (a) the operators of the Tianjin IGCC power plant, and (b) oil company for EOR.
- (xi) Provide recommendations on mechanism for remunerating the CCUS pilot project based on actual CO₂ geologically sequestered in collaboration with the carbon storage and the financial analyst.
- (xii) Formulate section on technical due diligence for due diligence report covering relevant assessments and recommendations.
- (xiii) Support the environment expert and the environmental auditor in their work.
- (xiv) Prepare a 10 page knowledge product on pre-combustion carbon capture based on lessons learned.
- (xv) Support the environment expert in the preparation of guidelines for EIAs for CCUS pilot and demonstration projects.

9. **Environment expert** (international, 6 person-months, intermittent). The proposed expert will have a postgraduate degree in environmental science, engineering, or relevant field. The expert should have at least 10 years of working experience in EIA, including at least 5 years of undertaking EIA experiences in relation to carbon capture, compression, liquefaction, transport, utilization and storage, large scale chemical, oil or gas operations. The knowledge and practical experience of ADB environmental safeguards will be an advantage. The expert will undertake environmental due diligence for the proposed additional financing of CCUS pilot project. The expert will undertake the following tasks:

- (i) Visit the project sites, including the Tianjin IGCC plant where a capture, compression, and liquefaction plant will be constructed, and Dagang oil field where EOR and geologic sequestration will be performed.

- (ii) Confirm a domestic approval procedure for the proposed carbon capture, utilization, and storage project; and assess the project readiness.
- (iii) Review all the relevant project documents, including domestic environmental impact assessment (EIA) report(s) and feasibility study report(s).
- (iv) Identify the extent and quality of available data and information; identify the information gaps; collect additional project information and relevant data through primary and secondary data collection; and ensure all the sufficient information to be collected to prepare an English EIA that can meet all the requirements of the ADB's Safeguard Policy Statement (2009).
- (v) Review and indicate all relevant environmental laws, regulations in the PRC. If no sufficient regulatory frameworks exist in the PRC, collect internationally available CCUS relevant environmental laws, standards, and regulations and propose best applicable ones to be applied for the proposed project.
- (vi) Review internationally available EIA guidelines and practices for CCUS projects; develop and propose the most appropriate EIA guideline for the CCUS projects in the PRC, which also can meet all the requirements of the ADB's Safeguard Policy Statement (2009).
- (vii) Perform environmental assessment using the proposed EIA guideline (see (vi)) for the entire project components of the proposed CCUS pilot project, including pre-combustion CO₂ capture, compression, liquefaction, transportation, utilization for oil recovery, and storage. a) assess cross-media trade-offs in the power plant's pollution emissions stemming from the CO₂ capture and from higher water and energy needs; b) assess proposed projects areas for seismicity and propose appropriate measures; c) assess the extent of emissions from extended oil recover using CO₂; d) Suggest appropriate solutions in the absence of validated CO₂ release and dispersion model; e) re-evaluate the impact and benefits of the original project.
- (viii) Conduct alternative analysis for each process and its employed technologies, including pre-combustion CO₂ capture, compression, liquefaction, transportation, utilization for oil recovery, and storage. The alternative analysis should consider layout and routing for the project elements as well as technologies to be adopted. Prepare "no project analysis". Prepare a comprehensive analysis to compare a range of technologies employed in existing CCUS projects worldwide by each CCUS process by process and to compare and assess different geologic storage options for the pilot CCUS project. The conclusion of the alternative analysis shall include the evaluation of the proposed project design and project components with technology choices, reflecting associated technical, economic, and environmental benefits and impacts.
- (ix) Evaluate potential environmental and social impacts and risks of the proposed project, including positive and negative direct and indirect impacts to physical, biological, socioeconomic – including occupational health and safety, community health and safety, broader community impacts caused by environmental media, physical cultural resources in the project's area of influence, in quantitative terms to the extent possible. Also examine global, transboundary, and cumulative impacts of the project. The assessment shall be based on accurate project description, appropriate environmental baseline data. If no baseline data exists, develop environmental baseline data set. Impacts will be assessed in respect of both normal operations and in the event of an emergency incident, particular consideration being given to the health, safety and environmental impact of gas leakages and any increased risks posed by natural disaster.

- (x) Based on the international best practices on CCUS, develop and propose a comprehensive set of mitigation measures to avoid, prevent, and/or reduce potential environmental impacts and risks throughout the entire chain of CCUS in a phase manner: (a) design and pre-construction; (b) construction; (c) operation; and (d) if necessary, closure and post-closure phases.
- (xi) Based on the international best practices on CCUS, determine, specify, and propose a comprehensive set of monitoring plan, including monitoring scope, parameters, equipment, frequencies, and all other necessary requirements for each step of CCUS process in a phase manner: (a) design and pre-construction; (b) construction; (c) operation; and (d) if necessary, closure and post-closure phases. Monitoring requirements should be robust enough to draw further conclusions about site-specific risks and long-term monitoring will be needed to fully demonstrate the competence of the oilfield to hold the carbon dioxide after injection has ceased. Develop clauses for the environmental monitoring plan requiring that detection of a leak through regular monitoring should initiate an emergency plan to stop the leak and manage any damage caused.
- (xii) Develop selection criteria for external experts to verify monitoring information for the project during project implementation; and develop a terms of reference of the external experts for monitoring verification.
- (xiii) Ensure the implementing agency to plan, organize, and perform meaningful consultation that meets the ADB requirement on “meaningful consultation” with local communities and record details of meaningful consultation. Facilitate the meaningful consultation by providing all the necessary project information, including environmental risks, impacts, and benefits of the project.
- (xiv) Plan and design a grievance redress mechanism (GRM) that meets the ADB requirements and ensure the implementing agency to set the project GRM. Identify and collect any information on any grievance that occurred relevant to the existing associated facilities of the project, the project areas, and the impact of CO₂ transport as well. If there is any record on complaints or incidents and how they have been handled, ensure the ADB project leader and safeguards specialists to be informed and such information to be documented in the English EIA.
- (xv) Assess the capacity of the implementing agency on environmental assessment, management, and monitoring; identify areas for improvement and training needs with respect to the environmental safeguards under the project; recommend required measures for capacity building; and prepare training materials and conduct the training workshops for the executing agency and the implementing agency and other stakeholders.
- (xvi) Ensure sufficient budgets to be allocated for the proposed mitigation measures; environmental monitoring- including external verification of the project’s environmental monitoring; training; GRM set up and operation; and all other environmental safeguards activities of the project. Work closely with the procurement specialist and ensure those budgets to be allocated as a part of the ADB financing procurement package.
- (xvii) Assess and quantify the environmental cost-benefits of the proposed project in terms of energy consumption, water consumption, greenhouse gas emission, air pollution, and other associated environmental benefits in consultation with the proposed CCUS experts. The assessment should include a holistic analysis, including environmental cost and benefits of the Tianjin IGCC plant.
- (xviii) Prepare and submit the English EIA of the project that can meet all the requirements of the ADB’s Safeguard Policy Statement (2009); prepare a

presentation on the project EUA and make presentation at ADB; update and the EIA incorporating ADB comments, and prepare a comment matrix with responses.

- (xix) Prepare a template of environmental monitoring report to meet the ADB's SPS (2009) and assist the implementing agency in preparing the first environmental monitoring report.
- (xx) Identify (a) the number of employment opportunities created under the project and (b) relevant civil society organization in the project area.
- (xxi) Prepare a 10 page knowledge product on key lessons learned and guidance on EIA for CCUS projects.

10. **Environmental Auditor** (international, 2 person-months, intermittent). The expert should have a postgraduate degree in environmental science, management, engineering or other relevant field and at least 10 years of relevant working experience. The expert must have at least 5 year experience in environmental auditing of oil and gas fields. The knowledge and practical experience of ADB environmental safeguards will be an advantage. A certified environmental auditor is desirable. The expert will organize the work and in conjunction with the national technical expert will be responsible for the following activities:

- (i) Visit Dagang oil field where the EOR and geologic sequestration will be held; review the overall operations of the facilities at Dagang oil field and their environment and safety management systems.
- (ii) Gather information and data and identify the extent and quality of information; collect data using questionnaires on-site inspections, relevant document reviews and interviews.
- (iii) Examine the records for appropriate government permits, requirements, environment and safety standards, and maintenance and inventory control measures.
- (iv) Assess the status of environment and social compliance status of Dagang oil field, including any safeguards concerns related to the impacts on the environment, involuntary resettlement and indigenous peoples.
- (v) Review environment, health and safety management systems, emergency preparedness and response procedures, employee training, environmental monitoring programs, chemicals and hazardous chemicals management, and waste management efforts.
- (vi) If non-compliance and any other environmental and safety concerns are raised, propose corrective actions.
- (vii) Prepare an English environmental audit report for Dagang oil field, which can meet all the ADB safeguard requirements in accordance with ADB's Safeguard Policy Statement (SPS) (2009); and update and refine the environmental audit report incorporating ADB comments, and prepare a comment matrix with responses.
- (viii) Prepare a 10 page knowledge product on key lessons learned and guidance on EIA for CCUS projects.

11. **Pre-combustion carbon capture expert** (national, 3.0 person-months, intermittent). The expert should have a postgraduate degree in chemical or electrical engineering, or any other relevant field of expertise. The expert should have at least 5 years of working expertise in the field of CCUS, ideally in the field of design, construction, and O&M of pre-combustion CCUS attached to IGCC power plants. The expert must be fluent in English and Chinese. The expert will support the international CCUS expert in performing the technical due diligence for the

proposed CCUS pilot project at Tianjin IGCC plant. The expert will be responsible for the following specific tasks:

- (i) Visit the carbon capture, compression, and liquefaction plant project site.
- (ii) Assist the international CCUS expert in (a) reviewing the plans for CO₂ capture, compression, liquefaction and transport; (b) data collection by reviewing relevant documents, preparing questionnaires in Chinese, and conducting interviews; (c) performing all relevant work to perform the technical due diligence; (d) identifying information gaps, collecting sufficient information through primary and secondary data collection; and (e) elaborating the technical due diligence report and guidelines for the monitoring and verification during the operation of the CCUS project.
- (iii) Review domestic technical due diligence and other relevant documents identified by the international CCUS expert and translate them into English.
- (iv) Provide communication facilitation among ADB, CHNG the implementing agency, and other local government officers, and other relevant people engaged in the project, who needs English-Chinese translations.
- (v) Support international CCUS expert in formulating the technical due diligence section for the due diligence report.
- (vi) Support the environment expert and the environmental auditor in their work.
- (vii) Prepare best practice guidelines in conjunction with the international carbon capture expert and facilitate knowledge sharing events as required by ADB.

12. **Expert for enhanced oil recovery** (national, 4 person-months, intermittent). The expert for EOR should have a doctor degree or higher in geophysics, geology, or any other relevant field. The expert should have at least 15 years of professional experiences in the oil and the gas industry, including at least 5 years of relevant experiences with EOR. The expert must be fluent in English and Chinese. The expert will work in close cooperation with the carbon storage expert in performing the storage site risk assessment for the proposed CCUS pilot project at Tianjin IGCC plant and will support the environment experts and the environmental auditor in their work as required. The expert will undertake the following tasks:

- (i) Visit the site for EOR.
- (ii) Collect all necessary data to perform the task and identify information gaps.
- (iii) Review all relevant data to be provided to the expert by the HNCERI and the oil company, respectively.
- (iv) Assess the suitability of the chosen oilfield for EOR taking specific reservoir and oil characteristics into consideration.
- (v) Project –a) how much of the injected CO₂ per year will dissolve in and recovered with the oil, recycled and re-injected; -b) how much of the injected CO₂ per year will be stored in the well; -c) quantity of CO₂ which can be injected in the oil-bearing stratum that can be stored there safely.
- (vi) Assess how much the CO₂ EOR can increase the normal recovery rate from the well at the proposed oilfield and calculate how much additional oil can be recovered from CO₂-EOR per year assuming that for five years 40,000 tons of CO₂ will be injected in the oil well. Project additional revenues at current oil price projections for the PRC.
- (vii) Review and assess the EOR plan. Comment on the compliance with other internationally proposed guidelines for site selection and risk assessment.
- (viii) Identify, describe and quantify risks related to EOR, in particular with regards to (a) CO₂ leakage, its adverse impacts on occupational health and safety of workers, nearby communities; (b) assess risks of ground water and surface water pollution and support environment expert and environment auditor; (c) risks as a

- consequence of natural disasters such as earthquakes or tsunamis; and (d) any other relevant risk.
- (ix) Discuss risks with local communities.
 - (x) Review and assess investment plan, procurement plan, and operating cost estimates for CO₂ storage and EOR, and assess as much as possible cost overrun, and delay risks.
 - (xi) Review, assess, and provide recommendations on the proposed monitoring and verification plan, in particular in view of long-term storage. Propose emergency intervention plan for cases of CO₂ leakage.
 - (xii) Prepare EOR due diligence assessment report.
 - (xiii) Formulate guidelines for monitoring and verification for EOR and geological sequestration of CO₂ in conjunction with the storage expert.
 - (xiv) Support preparation and facilitate knowledge sharing events as required by ADB.
 - (xv) Provide communication facilitation among ADB, CHNG and implementing agencies, other local government officers, and other relevant people engaged in the project, who needs English-Chinese translations.
 - (xvi) Support the environment expert and the environmental auditor in their work environmental and social safeguards due diligence by providing required data, projections, risk assessments and other information required by the experts .
 - (xvii) Support the environment expert in the preparation of guidelines for EIAs for CCUS pilot and demonstration projects.

13. **Expert for carbon sequestration** (national, 4 person-months, intermittent). The expert for EOR and sequestration of CO₂ in geological sequestration sites should have a postgraduate degree in geophysics, or any other relevant field. The expert should have at least 15 years of professional experiences in the oil and the gas industry, including at least 5 years of relevant experiences with EOR and carbon sequestration related work. The expert must be fluent in English and Chinese. The expert will closely cooperate with the EOR expert and support the environment expert in his work. The expert will undertake the following tasks:

- (i) Visit the site for geological sequestration of CO₂.
- (ii) Collect all necessary data to perform the task and identify information gaps.
- (iii) Review all relevant data to be provided to the expert by the HNCERI and the oil company, respectively.
- (iv) Review and comment on CO₂ geological sequestration plans at the proposed sites over the estimated operation period of the CCUS pilot project.
- (v) Review, assess, and comment on the potential geological sequestration of CO₂ at the proposed site.
- (vi) Identify and quantify risks related to the geological sequestration of CO₂. Comment on the compliance with other internationally proposed guidelines for site selection and risk assessment.
- (vii) Analyze and project the CO₂ leakage at the geological sequestration site.
- (viii) Discuss risks with local communities supporting the national and the international environment specialists and auditor and support these experts in their work by providing required data, projections, risk assessments and other information required by the experts.
- (ix) Review and assess investment plan, procurement plan, and operating cost estimates for CO₂ storage, and assess as much as possible cost overrun, and delay risks.
- (x) Review, assess, and comment on the proposed monitoring and verification plan. If needed, propose improvements, especially for the closure and post-closure phase. Design an emergency plan in case of CO₂ leakage detection.

- (xi) Prepare storage site assessment due diligence report.
- (xii) Formulate guidelines for monitoring and verification for EOR and geological sequestration of CO₂ in conjunction with the EOR expert.
- (xiii) Support preparation and facilitate knowledge sharing events as required by ADB.
- (xiv) Provide communication facilitation among ADB, CHNG and implementing agencies, other local government officers, and other relevant people engaged in the project, who needs English-Chinese translations.

14. **Environment expert** (national, 4 person-months, intermittent). The proposed national environment specialist will have a postgraduate degree in environment science, engineering, management, or relevant field. The expert should have at least 5 years of working experience in environmental assessment, including at least 2 years of EIA experiences in CCUS. The expert must be fluent in English and Chinese. The expert will support the international CCUS environmental expert and the international environmental auditor in undertaking environmental due diligence for the proposed CCUS pilot project in accordance with the ADB's SPS (2009). The expert will undertake the following tasks:

- (i) Assist two international environmental experts indicated above in reviewing all the project documents, including both technical and environmental documents for the CCUS project and associated facilities, including Dagang oil field.
- (ii) Translate all the documents, which are requested by two international environmental experts and ADB, from Chinese to English and from English to Chinese.
- (iii) Support both international environmental experts in identifying information gaps; collecting sufficient information through primary and secondary data collection – including preparing questionnaires in Chinese, and conducting interviews; performing a preliminary assessment of the environmental benefits. in data collection by reviewing relevant documents,
- (iv) Assist both international environmental experts and ADB in all tasks related to the environmental due diligence of the project and its associated facilities.
- (v) Provide communication facilitation among ADB, international environmental experts, the executing and implementing agencies, other local government officers, and other relevant stakeholders engaged in the project, who might need English-Chinese translations.
- (vi) Support preparation and facilitate knowledge sharing events as required by ADB.

15. **Economist** (national, 2 person-months, intermittent). The expert should have a postgraduate degree in economics, finance, or other relevant field, and at least five years of relevant working experiences. The expert will undertake the following relevant tasks:

- (i) Perform the economic analysis for the proposed project in coordination with the international financial specialist, guided by the Guidelines for the Economic Analysis of Projects (1997).
- (ii) Propose methodologies to quantify the economic value of environmental benefits to be included in the economic analysis following ADB's Economic Evaluation of Environmental Impacts: A Workbook (1996, and Environmental Assessment Guidelines (2003).
- (iii) Prepare the economic analysis sections of the due diligence report.

16. **Financial and institutional analyst** (national, 2 person-months, intermittent). The expert should have a postgraduate degree in finance, economics, business administration, or any other relevant field. The expert should have at least 5 years of relevant working experiences in financial analysis and ideally has conducted financial analysis of CCUS projects before. It

would further be desirable for the financial and institutional analyst to have a recognized professional accountancy qualification. The expert will be responsible for the following tasks:

- (i) Assess the financial management capabilities and internal controls of the implementing agency.⁴
- (ii) Collect all necessary data and support the financial viability analysis by ADB of the proposed CCUS pilot project during its operation.
- (iii) Support the calculation of potential revenues from carbon prices in the Tianjin emission trading system.
- (iv) Support ADB in financial viability gap analysis based on the finalized project scope, cost estimate, investment plan, and implementation schedule
- (v) Support ADB in calculating cost of the energy penalty and CO₂ reservation price at which CO₂ may be sold for EOR.
- (vi) Support ADB in elaborating report on the financial viability of the CCUS pilot project discussing all assumptions in detail.
- (vii) Support the CCUS pilot project getting registered in the Tianjin emission trading system and claiming compensation for CO₂.
- (viii) Provide recommendations on mechanism for remunerating the CCUS pilot project based on actual CO₂ geologically sequestered in collaboration with the expert for EOR and carbon sequestration and the ADB financial analyst.
- (ix) Support the structuring of the business model for collaboration between power plant and oil field for EOR.
- (x) Support formulation section on financial due diligence for due diligence report covering relevant assessments and recommendations.
- (xi) Support preparation and facilitate knowledge sharing events as required by ADB.

17. **Procurement specialist** (national, 2 person-months, intermittent). The expert should have a postgraduate degree in engineering, business administration, or any other relevant field. The expert should have at least 5 years of relevant working experiences in procurement and should be familiar with both the procurement rules and regulations of the PRC and ADB's procurement procedures. The expert will undertake the following relevant tasks:

- (i) Prepare procurement plan.
- (ii) Assist the implementing agency in the preparation of the bidding packages.
- (iii) Assist the implementing agency in preparing the package of equipment procurement which is expected to be funded from ADB grant proceeds in accordance with ADB Procurement Guidelines (2013, as amended from time to time).
- (iv) Undertake a thorough review of the contract packages identified for advance contracting to ensure that they are procured in accordance with ADB Procurement Guidelines and submit a report to ADB on compliance of the contract packages with ADB Procurement Guidelines.
- (v) Provide guidance to ensure that the bid documents and bid evaluation reports for the international competitive bidding packages as well as the national competitive bidding packages for civil works and equipment, subject to ADB prior review, are prepared based on ADB's standard bid documents, guidelines, and the Ministry of Finance published national competitive bidding documents.
- (vi) Conduct a procurement capacity assessment of the Huaneng
- (vii) Update the procurement plan of the project as necessary during the initial phase of project implementation.

⁴ Financial Management Questionnaire: <http://www.adb.org/Documents/Others/FM-toolkit/fmaq.doc>

D. Reporting Requirements

18. The individual consultants under the leadership of the international consultant team leader for part A will prepare the technical, economic and financial due diligence report and EIA, each consisting of two copies in English for ADB and two copies in Chinese for the government. The expected deliverables of the consulting services include but are not limited to the following:

- (i) **Inception Report.** The selected firm as well as the Chinese University of Petroleum will be responsible to formulate an inception report within 1 month after the R-PPTA starts.
- (ii) **Monthly progress report.** The selected firm as well as the Chinese University of Petroleum will be responsible to formulate a monthly progress report commenting the status of implementation, any changes needed, difficulties faced during implementation and any other issue arising.
- (iii) **Draft final due diligence report.** The draft will be submitted within 6 months after the TA starts. The draft final report will include all components required in the study and it will cover all aspects of the TA implementation.
- (iv) **Final report.** This will be submitted within 1 month after the receipt of comments by ADB and the implementing agency. The consultants will incorporate comments in the final report. An executive summary will also be submitted.

E. Implementation Arrangements

19. ADB will be the executing agency. HNCERI will be the implementing agency. The implementing agency will work with the consultants in part A for the conducting the due diligence. (i) It will particularly help and support consultants in obtaining all necessary information to timely conduct their work, and (ii) provide strategic advice during the R-PPTA and the implementation period of ensuing grant. During part B, the implementing agency will provide resource persons from CHNG, its own organization, and from Huaneng Tianjin IGCC Co. Ltd. to facilitate the organization of knowledge sharing workshops. It will also support the consultants preparing the knowledge products. The implementing agency will provide in-kind contribution in the form of office accommodation and support facilities, local transportation, counterpart staff, studies, reports, geological surveys, data, relevant rules and regulations, and other information and support needed for the TA.

20. The TA will be implemented over 28 months from 1 November 2013, with an expected completion date of 31 December 2015. The proposed TA processing and implementation schedule is listed in Table A4.4.

Table A4.4: Technical Assistance Processing and Implementation Schedule

Major Milestones	Expected Completion Date
Approval of R-PPTA	IV October 2013
Inception mission for R-PPTA part A	II December 2013
Midterm review of R-PPTA part A	IV April 2014
Final review for R-PPTA part A	II July 2014
Completion of R-PPTA	IV Quarter 2015

R-PPTA = Regional Project preparatory technical assistance.

Source: Asian Development Bank.