



Technical Assistance Report

Project Number: 48114-001
Capacity Development Technical Assistance (CDTA)
July 2015

People's Republic of China: Accelerating Investment in Distributed Energy in Rural Qingdao

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Asian Development Bank

CURRENCY EQUIVALENTS

(as of 26 May 2015)

Currency unit	–	yuan (CNY)
CNY1.00	=	\$0.1612
\$1.00	=	CNY6.203

ABBREVIATIONS

ADB	–	Asian Development Bank
PRC	–	People's Republic of China
TA	–	technical assistance

NOTE

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

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CONTENTS

	Page
CAPACITY DEVELOPMENT TECHNICAL ASSISTANCE AT A GLANCE	
I. INTRODUCTION	1
II. ISSUES	1
III. THE CAPACITY DEVELOPMENT TECHNICAL ASSISTANCE	2
A. Impact and Outcome	2
B. Methodology and Key Activities	2
C. Cost and Financing	3
D. Implementation Arrangements	3
IV. THE PRESIDENT'S DECISION	4
APPENDIXES	
1. Design and Monitoring Framework	5
2. Cost Estimates and Financing Plan	7
3. Outline Terms of Reference for Consultants	8

CAPACITY DEVELOPMENT TECHNICAL ASSISTANCE AT A GLANCE

1. Basic Data		Project Number: 48114-001	
Project Name	Accelerating Investment in Distributed Energy in Rural Qingdao	Department /Division	EARD/EAEN
Country Borrower	China, People's Republic of Qingdao Municipal Government	Executing Agency	Qingdao Municipal Development & Reform Commission
2. Sector	Subsector(s)	ADB Financing (\$ million)	
✓ Energy	Renewable energy generation - biomass and waste		0.10
	Renewable energy generation - geothermal		0.05
	Renewable energy generation - solar		0.10
	Renewable energy generation - wind		0.10
	Total		0.35
3. Strategic Agenda	Subcomponents	Climate Change Information	
Inclusive economic growth (IEG)	Pillar 2: Access to economic opportunities, including jobs, made more inclusive	Mitigation (\$ million)	0.35
Environmentally sustainable growth (ESG)	Global and regional transboundary environmental concerns	CO ₂ reduction (tons per annum)	50
		Climate Change impact on the Project	High
4. Drivers of Change	Components	Gender Equity and Mainstreaming	
Governance and capacity development (GCD)	Institutional development	No gender elements (NGE)	✓
Knowledge solutions (KNS)	Application and use of new knowledge solutions in key operational areas Knowledge sharing activities Pilot-testing innovation and learning		
Private sector development (PSD)	Promotion of private sector investment		
5. Poverty Targeting		Location Impact	
Project directly targets poverty	No	Rural	High
		Urban	Low
6. TA Category:	B		
7. Safeguard Categorization	Not Applicable		
8. Financing			
Modality and Sources		Amount (\$ million)	
ADB		0.35	
Capacity development technical assistance: Technical Assistance Special Fund		0.35	
Cofinancing		0.00	
None		0.00	
Counterpart		0.00	
None		0.00	
Total		0.35	
9. Effective Development Cooperation			
Use of country procurement systems		No	
Use of country public financial management systems		Yes	

I. INTRODUCTION

1. During the 2014 country programming mission, the Government of the People's Republic of China (PRC) requested that the Asian Development Bank (ADB) provide technical assistance (TA) to the Qingdao Municipal Development and Reform Commission for Accelerating Investment in Distributed Energy in Rural Qingdao.¹ The TA was included in the country operations business plan, 2015–2017 for the PRC.² During the fact-finding mission in May 2015, an agreement was reached with the government on the impact, outcome, outputs, terms of reference for consultants, cost estimates, financing plan, and implementation arrangements. The design and monitoring framework is in Appendix 1.

II. ISSUES

2. The PRC is undergoing rapid urbanization. From 1978 to 2013, the PRC's urban population rose from 172 million to 731 million. About 53.7% of the total population now lives in urban areas.³ Rapid urbanization is making it challenging to provide adequate services to urban communities such as, housing, water, power, heating, sanitation, education, and health care. Substantial investment in infrastructure is needed to accommodate the increasing number of urban residents. In addition, Qingdao city faces challenges of high energy consumption per capita, and heavy reliance on fossil fuels.⁴

3. Following the National New Type Urbanization Plan, 2014–2020 issued by the State Council in 2014, Qingdao government is planning to develop compact sustainable cluster communities located in rural areas, far from cities and towns. Typically, about 3,000–5,000 persons live within a radius of 1.5 kilometers in such cluster communities. Basic services and municipal infrastructure must be provided to these communities, including a heating supply.⁵ Traditionally, heating is provided to cluster communities by small-scale district heating systems that use a coal-fired boiler, which is a primary source of air pollution in winter. Qingdao is one of the national low-carbon development pilot cities selected by the National Development and Reform Commission in December 2012, and adopted a policy banning the use of coal for heating systems. Therefore, the application of a traditional district heating supply for cluster communities is not acceptable. It is costly and difficult to convert to a natural gas-based district heating system and to extend the heating pipelines from existing centralized district heating networks (located in the cities) to rural cluster communities; the small population makes it technically and economically unviable to connect to the central system.

4. To meet the Qingdao government's target of green, livable, and sustainable community development in rural Qingdao, non-coal based district heating solutions are needed. The application of distributed energy for heating supply using locally available renewable resources—such as biomass, shallow-ground geothermal, wind, solar, and waste-to-energy—will be a key part of the solution.⁶ Distributed energy for heating supply has been successfully

¹ The TA first appeared in the business opportunities section of ADB's website on 29 April 2015.

² ADB. 2014. *Country Operations Business Plan: People's Republic of China, 2015–2017*. Manila.

³ Government of the People's Republic of China, National Bureau of Statistics of China. 2014. *Statistical Communique of the People's Republic of China on the 2013 National Economic and Social Development*. Beijing.

⁴ The average energy consumption of urban residents in the PRC is 3.5 times higher than that of rural residents; in Qingdao urban residents consume 9 times more energy than do rural residents.

⁵ Adequate heating services are essential in Qingdao, because sub-zero temperatures typically last for 5 months per year.

⁶ Distributed energy is a decentralized small system for heating and power generation that is located close to the load center, and typically uses locally available renewable sources.

applied in Northern Europe (e.g., in Denmark, Germany, and Norway). However, there is limited knowledge and experience with respect to applying international best practice, and there are some key barriers to implementing distributed energy-based heating supplies in rural Qingdao, including the (i) absence of a comprehensive assessment of locally exploitable renewable energy resources in rural areas that can be used for heating; (ii) weak technical capacity to design a least-cost district heating system using locally available renewable resources; (iii) lack of financial and nonfinancial government incentives promoting a distributed energy-based heating supply in rural areas; and (iv) absence of an institutional arrangement for the construction, operation, and maintenance of a distributed energy-based heating supply system.

5. The TA will help the Qingdao municipal government increase its readiness for investment in a distributed energy project in rural Qingdao. It will (i) select a pilot area in rural Qingdao for deployment of distributed energy; (ii) undertake cost–benefit analyses; (iii) propose a cost-effective solution to providing reliable energy for pilot cluster communities; (iv) identify investment needs; (v) review and assess existing policies and standards, and identify gaps; and (vi) recommend an appropriate business model to promote a distributed energy-based heating supply.

6. The TA is well aligned with the ADB Midterm Review of Strategy 2020 of achieving environmentally sustainable growth. Moving developing member countries onto low-carbon growth paths by improving energy efficiency and expanding the use of clean energy sources has been identified as one of the key means of addressing climate change.⁷ The PRC country partnership strategy, 2011–2015 identified environmentally sustainable growth as one of the three pillars of ADB assistance to the PRC.⁸ The TA will promote the use of low carbon technologies, thus addressing air pollution.

III. THE CAPACITY DEVELOPMENT TECHNICAL ASSISTANCE

A. Impact and Outcome

7. The impact will be cleaner, reliable energy services provided in rural Qingdao. The outcome will be enhanced readiness for investment in distributed energy projects in rural Qingdao. The draft project proposal of distributed energy for rural Qingdao will be submitted for approval by 2017.

B. Methodology and Key Activities

8. The key activities under the TA include the following:
- (i) **Select a pilot area in rural Qingdao.** Locally available renewable resources, energy supply condition, and projected heat load will be assessed, and a pilot area for deployment of distributed energy will be selected in rural Qingdao.
 - (ii) **Undertake cost–benefit analyses and propose a cost-effective solution.** Case studies of similar communities in Europe and the PRC that use distributed energy—examining the supporting policy, development plan, available renewable resources, energy demand, adopted technology, financing arrangements, and environmental and social impacts—will be conducted for the pilot area. Suitable, innovative technical solutions will be proposed, with a focus on the most exploitable renewable sources based on local conditions, including wind, solar,

⁷ ADB. 2014. *Midterm Review of Strategy 2020: Meeting the Challenges of a Transforming Asia and Pacific*. Manila.

⁸ ADB. 2012. *Country Partnership Strategy: People's Republic of China, 2011–2015*. Manila.

biomass, geothermal, waste-to-energy, and wastewater treatment. Cost–benefit analyses will be undertaken and the most cost-effective technical solution for the pilot area in rural Qingdao will be selected.

- (iii) **Identify investment need.** Investment needs in the short, mid-, and long term will be prioritized and possible financing sources identified.
- (iv) **Assess existing policies and standards.** Existing national and local policies and standards for implementing distributed energy projects in rural Qingdao will be assessed, policy gaps identified, and recommendations made for changes.
- (v) **Recommend an appropriate business model.** The most appropriate business model for sustainable implementation of distributed energy in rural Qingdao will be developed. Recommendations for private sector engagement will be made.
- (vi) **Disseminate technical assistance findings and recommendations.** Capacity development training, including an overseas study tour and workshops, will be conducted. Consultation meetings will be held to disseminate TA findings and best practices (international and from other provinces in the PRC).

9. Major risks are that the (i) identified policy changes are not adopted, (ii) government's lengthy internal process to approve the proposed business model and technical solutions delays readiness, and (iii) local counterpart has limited capacity. To mitigate those risks, capacity development training and workshops will be organized, a suitable business model will be proposed, and close coordination and monitoring among ADB, the executing agency, and implementing agency will be established.

C. Cost and Financing

10. The TA is estimated to cost \$389,000, of which \$350,000 will be financed on a grant basis by ADB's Technical Assistance Special Fund (TASF-other sources). The government will provide counterpart support in the form of counterpart staff, office accommodation, office supplies, and other in-kind contributions.

D. Implementation Arrangements

11. The executing agency will be the Qingdao Development and Reform Commission. The implementing agency will be Qingdao Energy Group.⁹ The TA will be implemented over a period of 18 months, from 1 July 2015 to 31 December 2016. The TA will require 3 person-months of inputs from international consultants, and 24 person-months of inputs from national consultants. To reduce the administrative burden and improve economy, efficiency, and value for money, the consulting services under the TA will be engaged on an output-based (lump-sum) contract. The outline consultant terms of reference are in Appendix 3.

12. A firm with a team of international and national consultants will be engaged by ADB in accordance with ADB's Guidelines on the Use of Consultants (2013, as amended from time to time), to conduct the study using ADB's quality- and cost-based selection method (with a quality–cost ratio of 90:10), following the submission of a simplified technical proposal. ADB's Procurement Guidelines (2015, as amended from time to time) will be followed and the shopping method to be used to procure equipment under the TA. Equipment will be used by the consultants during implementation and turned over to the executing agency upon TA completion.

⁹ ADB. 2014. *Technical Assistance to the People's Republic of China for Qingdao Smart Low-Carbon District Energy*. Manila (TA 8625-PRC, implemented by the Qingdao Municipal Development and Reform Commission and Qingdao Energy Group).

TA proceeds will be disbursed in accordance with ADB's *Technical Assistance Disbursement Handbook* (2010, as amended from time to time).

13. The TA will be monitored through the (i) consultant's progress report, and (ii) TA review missions. Two workshops will be organized for the consultation regarding the interim and draft final reports, with relevant government officials, district heating companies, potential investors, and donors invited. One overseas study tour (Denmark, Germany, or Norway with similar rural distributed energy development) will be organized for relevant government officials and district heating companies. The overall results of the TA and lessons from European countries and other provinces in the PRC are expected to be disseminated through workshops, training, and the study tour.

IV. THE PRESIDENT'S DECISION

14. The President, acting under the authority delegated by the Board, has approved the provision of technical assistance not exceeding the equivalent of \$350,000 on a grant basis to the Government of the People's Republic of China for Accelerating Investment in Distributed Energy in Rural Qingdao, and hereby reports this action to the Board.

DESIGN AND MONITORING FRAMEWORK

Impacts the Project is aligned with:

Cleaner and reliable energy services provided in rural Qingdao by 2025 (Statistics of Qingdao, annually)

Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting	Risks
<p>Outcome Readiness for investment in distributed energy project in rural Qingdao enhanced</p>	<p>By 2017 Draft project proposal of distributed energy for rural Qingdao submitted for approval (2015 baseline: 0)</p>	<p>Information from the Qingdao DRC and other relevant government authorities</p>	<p>Identified policy changes are not adopted. The government's lengthy internal process to approve the proposed business model and technical solutions delays readiness.</p>
<p>Outputs</p> <ol style="list-style-type: none"> 1. A pilot area is selected in rural Qingdao for deployment of distributed energy 2. Cost-effective solution for reliable energy supply proposed 3. Investment needs identified 4. Existing policies and standards assessed 5. An appropriate business model for development of distributed energy established 6. Capacity of relevant government agencies to implement distributed energy project improved 	<p>By 2016</p> <ol style="list-style-type: none"> 1a. Research study undertaken (2015 baseline: 0) 2a. Cost–benefit analyses undertaken (2015 baseline: 0) 3a. Investment plan prepared (2015 baseline: 0) 4a. Policy changes for improvement recommended (2015 baseline: 0) 5a. Business model recommended (2015 baseline: 0) 6a. At least 20 people from relevant government agencies trained 6b. Findings of the TA and lessons from international best practice and other provinces disseminated 	<p>1–5. Consultant's final report</p> <p>6a. Workshop and training materials 6b. Workshop and training records</p>	<p>Limited capacities of local counterparts</p>

Key Activities with Milestones**Output 1. A pilot area in rural Qingdao for deployment of distributed energy is selected**

- 1.1 Assess locally available renewable resources, energy supply condition, and projected heat load in Qingdao rural area (January to February 2016)
- 1.2 Select pilot communities for future deployment of distributed energy resources (January to February 2016)

Output 2. Cost–benefit analyses undertaken and a cost-effective solution to provide reliable energy for compact communities in the pilot area proposed

- 2.1 Conduct case studies of similar communities that use distributed energy in Europe and the PRC in terms of supporting policy, development plan, available renewable resources, energy demand, adopted technology, financing arrangements, and environmental and social impacts (February to March 2016)
- 2.2 Propose suitable and innovative technical solutions, with a focus on the most exploitable renewable sources based on local conditions, including wind, solar, biomass, geothermal, waste-to-energy and wastewater treatment (March to April 2016)
- 2.3 Undertake a cost–benefit analysis for each solution (April to May 2016)
- 2.4 Assess and select the most cost-effective technical solution for rural Qingdao based on the cost–benefit analyses (May to June 2016)

Output 3. Investment needs identified

Prioritize investment needs in the short, mid-, and long term, and identify possible financing sources (June to July 2016)

Output 4. Existing policies and standard assessed

- 4.1 Assess existing national and local policies and standards for implementing distributed energy projects in rural Qingdao (July to August 2016)
- 4.2 Identify policy gaps and recommend changes (July to August 2016)

Output 5. An appropriate business model to promote the development of distributed energy recommended

- 5.1 Develop the most appropriate business model for sustainable implementation of distributed energy in rural Qingdao (August to September 2016)
- 5.2 Suggest actions needed to increase private sector participation (August to September 2016)

Output 6. Disseminate technical assistance findings and recommendations

- 6.1 Conduct capacity-building training, including an overseas study tour and workshops (October to December 2016)
- 6.2 Hold interim and final consultation meetings to disseminate findings and lessons (June to December 2016)

Inputs

ADB: \$350,000

Note: The government will provide counterpart support in the form of counterpart staff, office accommodation, office supplies, and other in-kind contributions.

Assumptions for Partner Financing

Not Applicable.

ADB = Asian Development Bank, DRC = development and reform commission, PRC = People's Republic of China, TA = technical assistance.

Source: Asian Development Bank.

COST ESTIMATES AND FINANCING PLAN
(\$'000)

Item	Amount
Asian Development Bank^a	
1. Consultants ^b	
a. Remuneration and per diem	
i. International consultants (3 person-months)	77.3
ii. National consultants (24 person-months)	135.0
b. International and local travel	27.6
c. Reports and communications ^c	10.0
2. Equipment ^d	2.0
3. Workshop, training and, study tour ^e	55.0
4. Survey	10.0
5. Contingencies	33.1
Total	350.0

Note: The technical assistance (TA) is estimated to cost \$389,000, of which contributions from ADB are presented in the table above. The government will provide counterpart support in the form of counterpart staff, office accommodation, office supplies, and other in-kind contributions. The value of government contribution is estimated to account for 10% of the total TA cost.

^a Financed by the Asian Development Bank (ADB) Technical Assistance Special Fund (TASF-other sources).

^b A consulting firm will be recruited to undertake the studies.

^c To include translation cost.

^d Includes the cost of two laptop computers. These assets will be turned over to the executing agency upon completion of the project.

^e Includes the cost of supporting the travel expenses of three to five staff members from relevant agencies to participate in an overseas study tour of similar rural energy developments in Denmark, Germany, or Norway. The interim and draft final workshops will be held in Qingdao.

Source: Asian Development Bank estimates.

OUTLINE TERMS OF REFERENCE FOR CONSULTANTS

1. For the proposed capacity development technical assistance (TA), a consulting firm will provide a team of international and national consultants. The firm will be engaged by ADB using ADB's quality- and cost-based selection method (with quality–cost ratio of 90:10), following the submission of a simplified technical proposal. The government will also provide counterpart support to the consultants, including (i) adequately heated office space (with basic furniture, an international telephone line, and internet access); (ii) bilingual counterpart personnel available to work full time, if required; (iii) assistance with visas and other permits required by the consultants to enter and work in the country; and (iv) access to all data, including documents, reports, accounts, drawings and maps; and permission to enter offices, as appropriate and necessary, to undertake the work. The consulting services terms of reference will include, but not be limited to, the following.

A. International Consultants (3 person-months total)

2. **District heating specialist and team leader** (3 person-months, intermittent). The consultant must have (i) at least a master's degree in distributed energy, renewable energy or a relevant field; (ii) a minimum of 10 years of experience in district heating; (iii) excellent written and oral English; (iv) experience in international cooperation and management. The proposed consultant will also be the team leader, and will

- (i) analyze local data from an international perspective to ensure its reliability, compare it with the data collected in other countries, and provide an analysis report;
- (ii) offer technical solutions to local problems from an international perspective: (a) compare distributed energy technologies (e.g., biomass, solar energy, heat pump, and sewage treatment); and (b) develop a proposed solution that specifies what technologies should be used and under what conditions they should be applied;
- (iii) identify the infrastructure needs based on the most cost-effective solution;
- (iv) cooperate with the financial expert to (a) compare energy usage scenarios, while taking local conditions into consideration; and (b) propose a solution regarding energy usage that is consistent with the local economy;
- (v) analyze the policies of the municipal government and those of other countries, and then make policy recommendations to the project based on those policies;
- (vi) propose an action plan to implement the proposal;
- (vii) provide training and workshops to relevant agencies; and
- (viii) strengthen contacts between ADB and the team of experts for the project, and make sure the project will be carried out on time, and as requested.

B. National Consultants (24 person-months total)

3. **District heating specialist and deputy team leader** (6 person-months, intermittent) The consultant must have (i) at least a master's degree in distributed energy, renewable energy, district heating or a relevant field; (ii) a minimum of 10 years of experience in the renewable and district heating energy fields; (iii) a fair ability to communicate in English; and (iv) experience in international cooperation and management. The proposed consultant will serve as the deputy team leader and will

- (i) analyze local data to ensure reliability;
- (ii) review the feasibility study report and collect relevant information;
- (iii) assist the team leader in designing proposed solutions, including by (a) comparing energy technologies (such as solar, wind, and bio-energy); and (b)

- developing specific technical proposals that take into account local social and environmental conditions;
- (iv) assist the team leader in analyzing social impacts, including the economic influence on target customers, and impacts on lifestyles;
- (v) conduct the feasibility study;
- (vi) communicate with the local municipal government, and build policy support;
- (vii) assist the team leader in providing training and workshops to relevant agencies; and
- (viii) compose a specific execution plan for each step of the proposed solutions.

4. **Biomass energy specialist** (5 person-months, intermittent). The consultant must have (i) at least a master's degree in bio-energy or a relevant field, (ii) a minimum of 10 years experience in bio-energy, (iii) a fair ability to communicate in English, and (iv) experience in international cooperation. The consultant will

- (i) investigate local biomass data to ensure reliability;
- (ii) review the feasibility study report and collect relevant biomass energy information;
- (iii) assist the team leader and deputy team leader to design proposed solutions and determine which biomass gasifying technologies should be applied, while taking local social and environmental factors into consideration;
- (iv) assist the team leader and deputy team leader in writing the economic feasibility report sections on the biomass gas and biomass gas combined heat and power (CHP) project, including total project investment, investment payback time, and benefits to local staff;
- (v) conduct the feasibility study on biomass for the project report;
- (vi) assist the team leader and deputy team leader to analyze the social impact of the biomass gas and biomass gas CHP project, including the economic influence on target customers and lifestyle impacts;
- (vii) assist the team leader in providing training and workshops for relevant agencies; and
- (viii) compose a specific execution plan for proposed solutions that include biogas and biomass gas CHP.

5. **Renewable energy specialist** (5 person-months, intermittent). The consultant must have (i) at least a master's degree in renewable energy or a relevant field, (ii) a minimum of 10 years of experience in renewable energy, (iii) a fair ability to communicate in English, (iv) experience in dealing with ground- and water-source heat pumps, and (v) experience in international cooperation. The consultant will

- (i) analyze data about the distribution of local renewable energy and ground- and water-source heat to ensure its reliability, including wind, solar, and geothermal, based on the local exploitable potential;
- (ii) select a pilot area for future deployment of distributed energy resources;
- (iii) study similar communities that use distributed energy in Europe and the People's Republic of China (PRC), addressing applicable policies, development plans, local resources, energy demand, the technology used, economic and social impacts, and culture;
- (iv) review the feasibility study report and collect relevant information and parameters about solar, and ground- and water-source pump energy;
- (v) assist the team leader and deputy team leader to design proposed solutions and decide what renewable energy and heat pump technologies should be applied, while taking local social and environmental factors into consideration;
- (vi) conduct the feasibility study;

- (vii) assist the team leader and deputy team leader in writing the economic feasibility report sections about renewable energy and heat pump technologies, including total project investment, payback time, and benefits to local staff;
- (viii) identify investment needs and possible financing sources;
- (ix) propose and compare applicable business models;
- (x) suggest the most appropriate business model to develop distributed energy in rural Qingdao;
- (xi) recommend actions to engage the private sector;
- (xii) assist the team leader and deputy team leader to analyze the social impacts associated with renewable energy and heat pump technologies, including the economic influence on target customers, and lifestyle impacts;
- (xiii) assist the team leader to provide training and workshops for relevant agencies; and
- (xiv) compose a specific execution plan for the proposed renewable energy and heat pump solutions.

6. **Environmental specialist** (3 person-months, intermittent). The consultant must have (i) at least a master's degree in environmental engineering or a relevant field, (ii) a minimum of 10 years of experience conducting environmental impact assessments, (iii) experience in solid waste treatment and sewage treatment, and (vi) experience in international cooperation. The consultants will

- (i) analyze local pollutant emissions to ensure that there is no adverse impact on the environment by the proposed solutions;
- (ii) review the feasibility study report and collect information relevant to rural pollution solutions;
- (iii) assist the team leader and deputy team leader in designing proposed solutions to rural pollution and decide what sewage treatment and solid waste treatment technologies should be applied, taking local social and environmental factors into consideration;
- (iv) conduct an environmental risk assessment for all the alternatives to make sure there are no severe impacts on local residents and no severe environmental risks;
- (v) conduct the feasibility study;
- (vi) assist the team leader and deputy team leader in writing sections of the feasibility report addressing how a distributed energy system will solve pollution problems;
- (vii) assist the team leader and deputy team leader in writing the economic feasibility report sections on sewage and solid waste treatment, including regarding the total project investment, payback time, and benefits to local staff;
- (viii) assist the team leader and deputy team leader to analyze the social impacts associated with a sewage treatment and biogas project, including the economic influence on target customers, and impacts on lifestyles;
- (ix) assist the team leader to provide training and workshops to relevant agencies; and
- (x) compose an execution plan for the sewage treatment project.

7. **Economist and financial specialist** (5 person-months, intermittent). The consultant must have (i) certification as a public accountant; (ii) a minimum of 5 years of experience in financial and economic analysis; (iii) abundant knowledge about the PRC's financial and fiscal systems; (iv) experience in distributed energy and environmental investment, or financing and investing; and (v) experience in international cooperation. The consultant will

- (i) take charge of the overall analysis of relevant policies, regulations, and incentive plans to ascertain the obstacles in financing distributed energy, sewage treatment, and solid waste treatment projects;
- (ii) confirm available financing tools and loan measures, especially funds from banks for distributed energy and sewage treatment;
- (iii) assist the team leader in writing the economic feasibility report for the project, including portions addressing total project investment, payback time, and benefits to local communities;
- (iv) assist the team leader, deputy team leader, and environment expert in setting the selection criteria and benchmarks for the project investment and construction;
- (v) undertake cost–benefit analyses and select the most cost-effective solution for rural Qingdao based on the cost–benefit analyses, including comparison of the cost of using a natural gas system versus a renewable energy-based distributed energy heating system;
- (vi) conduct a financial analysis of project construction;
- (vii) conduct an affordability and willingness-to-pay analysis of beneficiaries;
- (viii) identify investment needs and possible financing sources;
- (ix) propose applicable business models and compare the proposed models;
- (x) suggest the most appropriate business model to develop distributed energy in rural Qingdao;
- (xi) make recommendations regarding how to engage the private sector;
- (xii) assist the team leader in providing training and workshops for relevant agencies; and
- (xiii) assist the team leader and deputy team leader in composing an information handbook, involving all aspects of distributed energy, and sewage and solid waste treatment.

C. Deliverables

8. The consultant shall submit the following reports to ADB (in both English and Chinese) and to the government (in Chinese):

- (i) **Inception report.** To be submitted within 1 month of commencement of services. The report will include a detailed work program and address any major inconsistencies in the terms of reference.
- (ii) **Interim report.** To be submitted within 5 months of commencement of services. The report will include interim results of activities, an updated work program, and address any issues and concerns.
- (iii) **Draft final report.** To be submitted within 10 months of the commencement of services. Upon submission of the draft final report, a final consultation will be held, attended by relevant stakeholders, to obtain feedback on the report.
- (iv) **Final report.** To be submitted within 1 month following receipt of comments from ADB and the government on the draft final report. The final report shall take into consideration comments by ADB and the government. An executive summary (with a maximum length of 10 pages) should be included in the final report.