Technical Assistance Report

Project Number: 51421-001
Knowledge and Support Technical Assistance (KSTA)
August 2018

People's Republic of China: Advanced Renewable Energy Technology Demonstration

Asian Development Bank

CURRENCY EQUIVALENTS
(as of 24 August 2018)

Currency unit	–	yuan (CNY)
CNY1.00	=	$0.145387
$1.00	=	CNY6.878200

ABBREVIATIONS

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

NOTE

In this report, "$" refers to United States dollars.

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KNOWLEDGE AND SUPPORT TECHNICAL ASSISTANCE AT A GLANCE

1. Basic Data — **Project Number:** 51421-001

Project Name	Advanced Renewable Energy Technology Demonstration	**Department/Division**	EARD/EAEN
Nature of Activity	Research and Development	**Executing Agency**	People's Government of Aba Tibetan and Qiang Autonomous Prefecture
Modality	Regular		
Country	China, People's Republic of		

2. Sector

	Sector	Subsector(s)	ADB Financing ($ million)
✓	Energy	Energy utility services	0.50
		Total	**0.50**

3. Strategic Agenda

Strategic Agenda	Subcomponents
Inclusive economic growth (IEG)	Pillar 1: Economic opportunities, including jobs, created and expanded
Environmentally sustainable growth (ESG)	Global and regional transboundary environmental concerns Urban environmental improvement

Climate Change Information

Climate Change impact on the Project	Low
ADB Financing	
Adaptation ($ million)	0.35
Mitigation ($ million)	0.15
Cofinancing	
Mitigation ($ million)	0.20

4. Drivers of Change

Drivers of Change	Components
Knowledge solutions (KNS)	Knowledge sharing activities
Partnerships (PAR)	Foundations Official cofinancing

Gender Equity and Mainstreaming

Some gender elements (SGE)	✓

5. Poverty and SDG Targeting

Geographic Targeting	No
Household Targeting	No
SDG Targeting	Yes
SDG Goals	SDG5, SDG7, SDG9, SDG13

Location Impact

Rural	Low
Urban	High

6. Risk Categorization Low

7. Safeguard Categorization Safeguard Policy Statement does not apply

8. Financing

Modality and Sources	Amount ($ million)
ADB	**0.50**
Knowledge and Support technical assistance: Climate Change Fund	0.20
Knowledge and Support technical assistance: Technical Assistance Special Fund	0.30
Cofinancing	**0.20**
Clean Energy Fund under the Clean Energy Financing Partnership Facility (Full ADB Administration)	0.20
Counterpart	**0.00**
None	0.00
Total	**0.70**

I. INTRODUCTION

1. The knowledge and support technical assistance (TA) will increase the readiness of the Government of Aba Prefecture for investments in climate-resilient distributed heating based on renewable energy in Barkam County in Sichuan Province. The TA will assist the local government in developing knowledge about and preparing a pre-feasibility study on renewable energy-based climate-resilient distributed heating systems.

2. The TA is in the country operations business plan, 2018–2020 of the Asian Development Bank (ADB) for the People's Republic of China (PRC).[1] It fully aligns with ADB's country partnership strategy, 2016–2020 for the PRC's priority on managing climate change and the environment for an ecological civilization.[2] It will support the strategic priorities of Strategy 2030[3] to build climate resilience and enhance environmental sustainability.[4]

II. ISSUES

3. Barkam County is the city seat of Aba Tibetan and Qiang Autonomous Prefecture in Sichuan Province, which lies in a cold, high-altitude region in southern PRC. Barkam has an average elevation of 2,650 meters and is an alpine-gorge city with a heating season that lasts more than 6 months. Its annual temperature ranges from 8°C to 9°C and its winter temperature often drops to –10°C. Heating services are therefore essential for public health and well-being and for the sustenance of people's livelihoods. However, the county does not have a central heating system as it lacks fossil fuels, faces high fuel transportation costs, and has low fuel combustion efficiency because of the low density of oxygen associated with high altitude.

4. As in other regions in southern PRC, space heating in Barkam relies on independent systems such as electric heaters, biomass burning, and coal-fired stoves. Such heating systems are generally energy inefficient and costly and present potential safety hazards and health concerns. Developing an energy-efficient and affordable space heating system is one of the highest development priorities in Barkam, which is facing rising heating demand from its growing population.

5. Aba has abundant renewable energy resources. Its electricity supply is fully dependent on renewable energy power plants, mainly from hydropower, which comprises 96.6% of installed capacity and generated 18.8 terawatt-hours of power in 2017.[5] The recoverable potential is 5.5 gigawatts for solar power and 2.3 gigawatts for wind power. Aba's electricity supply exceeds demand and surplus electricity is exported to neighboring regions. To meet rising heating demand, improve energy efficiency, and reduce air pollutant emissions from heating, the Government of Barkam County has been seeking sustainable heating systems that use rich renewable energy resources and targeting to develop a renewable energy-based distributed heating system, as reflected in its urban development plan approved in 2017. A renewable energy-based distributed heating system can meet space heating demand in commercial buildings and apartment complexes using heating technologies that supply carbon- and pollutant-free sustainable services. In general, renewable energy technologies for heating include ones

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1 ADB. 2018. *Country Operations Business Plan: People's Republic of China, 2018–2020.* Manila.
2 ADB. 2016. *Country Partnership Strategy: Transforming Partnership: People's Republic of China and Asian Development Bank, 2016–2020.* Manila.
3 ADB. 2018. *Strategy 2030: Achieving a Prosperous, Inclusive, Resilient, and Sustainable Asia and the Pacific*. Manila.
4 The TA first appeared in the business opportunities section of ADB's website on 28 June 2018.
5 The current installed hydropower capacity is 5.6 gigawatts.

that can directly convert renewable energy into heat, such as solar thermal energy storage; and ones that use power generated from renewable sources, such as electric thermal storage or shallow-ground thermal storage-coupled heat pump. The renewable energy-based distributed heating solution will be the first of its kind in a high-altitude region in the PRC, with large potential for scale-up and duplication in other regions in the country. It could particularly provide valuable experience to existing heating system renovations in northern PRC.

6. Heat loss from buildings in Barkam is high due to building vintage. In general, air leaks from doors and windows contribute 40%–50% of total building heat loss in rural housing in the PRC.[6] Improving building thermal efficiency is an efficient approach to reduce heat loss and save heating costs.

7. The city is vulnerable to climate change and has a fragile ecosystem because of high altitude. Developing a renewable energy-based distributed heating system requires finding technically feasible, commercially viable, affordable, and sustainable solutions with an adequate degree of flexibility and robustness that would allow adaptation to uncertainties related to climate change and socioeconomic development. Failure to consider the potential impact of climate change in the heating system's design could lead to inefficiency and underperformance of the underlying investment, compromising mitigation efforts. Among the uncertainties to consider are:

(i) **Renewable energy generation.** Long-term grid power supply could be affected by a possible change in available water resources because of climate change, given the dominant role of hydropower in the energy mix. If the security of hydropower is projected to be uncertain in the future, proposed technology options need to be less dependent on grid power supply.
(ii) **Technology operations.** Different technologies are exposed to specific climatic variables. For example, for underground thermal energy storage, climate change will influence its performance through changes in annual mean air temperature, permafrost melt, and aquifer availability.
(iii) **Heating demand.** Heating demand uncertainties can emerge from extreme weather conditions because of climate change and socioeconomic development. For example, a severe cold spell, elongated winter seasons, or unexpected rapid urbanization can increase heating demand. If those uncertainties were not factored into the project design, technological design would be locked and the investment's environmental and financial sustainability might be compromised.

8. There are valuable experiences and lessons from several activities on renewable energy-based heating systems that ADB has supported in the PRC.[7] The TA will draw from such experiences and lessons from existing activities to improve the design of the renewable energy-based heating system and cross-fertilizing the knowledge.

[6] Y. Wu and C. Liu. 2007. *Research on Economic Incentives and Policies to Promote Construction Energy Saving in China*. Beijing: China Architecture and Building Press.
[7] ADB. People's Republic of China: Geothermal District Heating Project. https://www.adb.org/projects/51186-001/main; ADB. People's Republic of China: Qingdao Smart Low-Carbon District Energy Project. https://www.adb.org/projects/48003-002/main; and ADB. 2015. *Technical Assistance to the People's Republic of China for Accelerating Investment in Distributed Energy in Rural Qingdao.* Manila.

III. THE TECHNICAL ASSISTANCE

A. Impact and Outcome

9. The TA is aligned with the following impact: renewable energy-based climate-resilient distributed heating in high-altitude regions in the PRC developed.[8] The TA will have the following outcome: readiness for investments in renewable energy-based climate-resilient distributed heating in Barkam increased.[9]

B. Outputs, Methods, and Activities

10. **Output 1: Pre-feasibility study on renewable energy-based climate-resilient distributed heating prepared.** The TA will achieve this output through the following activities:

(i) **Geo-referenced household survey.** Consulting firm will conduct a geo-referenced and gender-focused household survey to understand heating methods, heating consumption and expenses, building types and heating areas, household income, willingness to pay for heating, household composition, time consumption of existing heating methods, options that enhance household energy efficiency, and other factors influencing heating consumption and consumer behavior on heating.

(ii) **Electricity supply and pricing analysis.** The consulting firm will assess the diurnal and seasonal patterns of the power supply and associated power pricing mechanism.

(iii) **Building thermal energy audit.** The consulting firm will conduct an energy audit of the buildings to identify potential areas for thermal efficiency improvement, propose recommendations to local authorities, and evaluate heating demand with improved building thermal efficiency.

(iv) **Heat load analysis.** The consulting firm will conduct analyses on medium- and long-term space heating demand, which will consider the potential change in outside temperature during winter, continuous population influx, and thermal insulation of existing buildings.

(v) **Technology options identification.** The consulting firm will lay out the available renewable energy-based distributed heating technologies that can accommodate consumers' heating demand cost-effectively. It will take local conditions into consideration, such as adequate sunshine, underground temperature, thermal capacity, and heat demand density, to avoid major reconstruction or resettlement issues or any negative environmental impact.

(vi) **Climate-resilient solutions development.** The consulting firm will identify potential uncertainties brought by climate change and socioeconomic development (para. 7) in the project area and recommend adaptation interventions to rectify these uncertainties to ensure climate-resilient design, construction, and operation and maintenance of the project. In consultation with all stakeholders and within their acceptable level of risk tolerance, technical designs should be developed in a flexible and robust manner so that (a) a cost-effective course of action can be implemented to ensure that investments are ready for adaptation in the future and (b) the performance of investments will not be compromised across

[8] Government of the PRC, National Development and Reform Commission. 2016. *13th Renewable Energy Development Five-Year Plan (2016–2020).* Beijing.

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

the range of future plausible scenarios within an acceptable level of risk tolerance.[10]

(vii) **Environmental impact assessment.** The consulting firm will conduct a preliminary environmental impact assessment, including the carbon and pollutant mitigation impact of the proposed heating system, following ADB's Safeguard Policy Statement (2009).

(viii) **Financial and economic assessment.** The consulting firm will calculate indicative cost estimates, develop a financing plan, conduct a financial analysis of the project, perform a cost–benefit analysis on the developed technical design, estimate the adaptation costs and benefits, and explore the availability and cost of financial instruments for performance guarantees.

(ix) **Business model development.** The TA team will (a) lay out plausible heating service delivery options such as a state-owned enterprise model, a public–private partnership model, or a build–operate–transfer model; (b) assess the required financial support from the government based on the affordability analysis; and (c) design an indicative implementation period.

(x) **Submission schedule.** The consulting firm will submit the survey design as part of the inception report to ADB within 1 month of commencement of services and the survey report as part of the interim report to ADB within 6 months of commencement of services. Results of (ii) to (v) will be submitted as part of the interim report to ADB within 6 months of commencement of services. The pre-feasibility study will be submitted as part the draft final report to ADB within 14 months of commencement of services.

11. **Output 2: Knowledge of renewable energy-based climate-resilient distributed heating system disseminated.** The TA will achieve this output through workshops and overseas training. An international workshop will be organized by April 2020 to disseminate knowledge on renewable-based climate-resilient distributed heating systems. One overseas training in an ADB member in northern Europe will be organized by the consulting firm for two or three government officials from the executing and implementing agencies to acquire knowledge and operational experience in the application of renewable energy-based distributed heating systems.

C. Cost and Financing

12. The TA is estimated to cost $700,000, of which (i) $300,000 will be financed on a grant basis by ADB's Technical Assistance Special Fund (TASF-other sources), (ii) $200,000 will be financed on a grant basis by ADB's Climate Change Fund,[11] and (iii) $200,000 will be financed on a grant basis by the Clean Energy Fund[12] under the Clean Energy Financing Partnership Facility and administered by ADB. The government will provide counterpart support in the form of counterpart staff, office accommodation, office supplies, information and documents relevant for TA preparation, and other in-kind contributions. Key expenditure items are in Appendix 2.

[10] N. Kalra et. al. 2014. Agreeing on Robust Decisions: New Processes for Decision Making Under Deep Uncertainty. *Policy Research Working Paper*. No. 6906. Washington, DC: World Bank; and ADB. 2015. *Economic Analysis of Climate-Proofing Investment Projects.* Manila.

[11] Established by ADB.

[12] Financing partners: the governments of Australia, Norway, Spain, Sweden, and the United Kingdom.

D. Implementation Arrangements

13. ADB will administer the TA. The Energy Division of ADB's East Asia Department will select, administer, supervise the consulting firm's outputs for the TA, and evaluate the consulting firm. The implementation arrangements are summarized in the table.

Implementation Arrangements

Aspects	Arrangements		
Indicative implementation period	October 2018–May 2020		
Executing agency	People's Government of Aba Tibetan and Qiang Autonomous Prefecture		
Implementing agency	Aba Tibetan and Qiang Autonomous Prefecture Development and Reform Commission		
Consultants	To be selected and engaged by ADB		
	Firm: QCBS (90:10)	Advanced Renewable Energy Technology Demonstration	$700,000
Procurement	To be procured by consultants		
	Shopping	2 contracts	$13,000
Disbursement	The TA resources will be disbursed following ADB's *Technical Assistance Disbursement Handbook* (2010, as amended from time to time). Disbursement arrangements for all funding sources will be on a pro rata basis.		
Disposal arrangement upon TA completion	The purchased goods will be turned over to the executing agency at TA completion.		

ADB = Asian Development Bank, QCBS = quality- and cost-based selection, TA = technical assistance.
Source: ADB estimates.

14. **Consulting services.** ADB will engage the consultants following the ADB Procurement Policy (2017, as amended from time to time) and its associated project administration instructions and/or staff instructions.[13] The consultants will handle procurement for the two contracts. The consulting firm will organize and conduct the workshops and will organize and administer the overseas training under output 2 of the TA.

IV. THE PRESIDENT'S DECISION

15. The President, acting under the authority delegated by the Board, has approved (i) the Asian Development Bank (ADB) administering a portion of technical assistance not exceeding the equivalent of $200,000 to be financed on a grant basis by the Clean Energy Fund under the Clean Energy Financing Partnership Facility and (ii) ADB providing the balance not exceeding the equivalent of $500,000 on a grant basis to the Government of the People's Republic of China for Advanced Renewable Energy Technology Demonstration, and hereby reports this action to the Board.

[13] Terms of Reference for Consultants (accessible from the list of linked documents in Appendix 3).

DESIGN AND MONITORING FRAMEWORK

Impact the TA is Aligned with
Renewable energy-based climate-resilient distributed heating in high-altitude regions in the PRC developed[a]

Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting Mechanisms	Risks
Outcome Readiness for investments in renewable energy-based climate-resilient distributed heating in Barkam increased	By 2021: Potential for renewable energy-based climate-resilient distributed heating system established by Aba Tibetan and Qiang Autonomous Prefecture Development and Reform Commission (2018 baseline: not applicable)	Government report of Aba Tibetan and Qiang Autonomous Prefecture	Local government's limited capacity to finance distributed heating projects Lending to local government from ADB not supported by the MOF
Outputs 1. Pre-feasibility study on renewable energy-based climate-resilient distributed heating prepared	1. One pre-feasibility study prepared by 2020 (2018 baseline: not applicable)	1. TA final report prepared by consultants	Diminished capacity of local counterparts
2. Knowledge of renewable energy-based climate-resilient distributed heating system disseminated	2. 50% of workshop and/or training participants reported enhanced understanding of renewable energy-based climate-resilient distributed heating by 2020 (2018 baseline: not applicable)	2. Feedback questionnaire administered after workshops and/or training	

Key Activities with Milestones

1. Pre-feasibility study on renewable energy-based climate-resilient distributed heating prepared

1.1 Conduct geo-referenced household survey and gender analysis (October 2018–January 2019)
1.2 Analyze electricity supply and pricing mechanism (December 2018–January 2019)
1.3 Conduct building thermal energy audit (December 2018–January 2019)
1.4 Analyze heat load (December 2018–February 2019)
1.5 Identify technology options (December 2018–March 2019)
1.6 Identify and manage climate uncertainties and develop climate-resilient solutions (March–June 2019)
1.7 Assess environmental impact (March–June 2019)
1.8 Conduct financial and economic assessment (July 2019)
1.9 Develop business models (September–November 2019)

2. Knowledge of renewable energy-based climate-resilient distributed heating system disseminated

2.1 Organize workshops and overseas training (November 2019–May 2020)

Inputs
ADB: $300,000 (TASF-other sources)
Climate Change Fund[b]: $200,000
Clean Energy Fund under the Clean Energy Financing Partnership Facility: $200,000
Note: The government will provide counterpart support in the form of counterpart staff, office accommodation, office supplies, information and documents relevant for TA preparation, and other in-kind contributions.

Assumptions for Partner Financing
Not Applicable

ADB = Asian Development Bank, MOF = Ministry of Finance, PRC = People's Republic of China, TASF = Technical Assistance Special Fund.

[a] Government of the PRC, National Development and Reform Commission. 2016. *13th Renewable Energy Development Five-Year Plan (2016–2020).* Beijing.

[b] Established by ADB.

Source: Asian Development Bank.

COST ESTIMATES AND FINANCING PLAN
($'000)

Item	Amount		
	Technical Assistance Special Fund (TASF-other sources)	**Climate Change Fund[a]**	**Clean Energy Fund[b] under the Clean Energy Financing Partnership Facility**
A. Consultants			
1. Remuneration and per diem			
a. International consultants	87.0	75.0	60.0
b. National consultants	96.0	21.0	66.0
2. Out-of-pocket expenditures			
a. International and local travel	37.0	25.0	23.0
b. Reports and communications	2.0	2.0	1.0
c. Survey[c]	30.0	20.0	20.0
d. Goods (purchase)[d]	7.0	2.0	4.0
B. Workshop, seminars, and conferences	5.0	27.0	8.0
C. Overseas training[e]	12.0	7.0	7.0
D. Contingencies	24.0	21.0	11.0
Total	**300.0**	**200.0**	**200.0**

ADB = Asian Development Bank, TA = technical assistance.

Note: The TA is estimated to cost $700,000, of which contributions from ADB, the Climate Change Fund, and the Clean Energy Fund under the Clean Energy Financing Partnership Facility are presented in the table above. The government will provide counterpart support in the form of counterpart staff, office accommodation, office supplies, information and documents relevant for TA preparation, and other in-kind contributions. The value of government contribution is estimated to account for 10% of the total TA cost.

[a] Established by ADB.

[b] Financing partners: the governments of Australia, Norway, Spain, Sweden, and the United Kingdom. Administered by ADB.

[c] The cost for the geo-referenced survey of about 1,000 households on customers' heating consumption and behaviors covers costs associated with conducting the survey.

[d] Goods will include tablets for conducting the survey and software design costs for recording survey results. Consulting firm will procure the goods following the ADB Procurement Policy (2017, as amended from time to time). The purchased goods will be turned over to the executing agency at TA completion.

[e] The objective of the overseas training is to provide local authorities (government officials from the executing and implementing agencies) with opportunities to acquire knowledge and operational experience in the application of renewable energy-based distributed heating systems. The training will be in an ADB member country in northern Europe and will be scheduled during the heating season, tentatively in November 2019. The training will be organized and administered by the consulting firm and will be subject to ADB's approval.

Source: Asian Development Bank estimates.

LIST OF LINKED DOCUMENTS

http://www.adb.org/Documents/LinkedDocs/?id=51421-001-TAReport

1. Terms of Reference for Consultants