



Completion Report

Project Number: 40634-013
Loan Number: 2658
August 2020

People's Republic of China: Inner Mongolia Autonomous Region Environment Improvement Project (Phase II)

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Asian Development Bank

CURRENCY EQUIVALENTS

Currency unit – yuan (CNY)

		At Appraisal (21 June 2010)	At Project Completion (31 December 2018)
CNY1.00	=	\$0.146	\$0.145
\$1.00	=	CNY6.828	CNY6.878

ABBREVIATIONS

ADB	–	Asian Development Bank
CO ₂	–	carbon dioxide
DHS	–	district heating supply
DMF	–	design and monitoring framework
EIA	–	environmental impact assessment
EIRR	–	economic internal rate of return
EMP	–	environmental monitoring plan
EPB	–	environmental protection bureau
FIRR	–	financial internal rate of return
GDP	–	gross domestic product
GIMAR	–	Government of the Inner Mongolia Autonomous Region
IMAR	–	Inner Mongolia Autonomous Region
IMARFD	–	Inner Mongolia Autonomous Region Finance Department
NGS	–	natural gas supply
NO _x	–	nitrogen oxides
O&M	–	operation and maintenance
PIA	–	project implementing agency
PMO	–	project management office
PPMS	–	project performance management system
PRC	–	People's Republic of China
SIEE	–	summary initial environmental examination
SO ₂	–	sulfur dioxide
TA	–	technical assistance
TSP	–	total suspended particulates
WACC	–	weighted average cost of capital

WEIGHTS AND MEASURES

km	–	kilometer
m ²	–	square meter
m ³	–	cubic meter
MW	–	megawatt

NOTE

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

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BASIC DATA

A. Loan Identification

1.	Country	People's Republic of China
2.	Loan number and financing source	2658-PRC, ordinary capital resources (OCR)
3.	Project title	Inner Mongolia Autonomous Region Environment Improvement Project (Phase II)
4.	Borrower	People's Republic of China
5.	Executing agency	Government of Inner Mongolia Autonomous Region
6.	Amount of loan	\$150 million
7.	Financing modality	Project loan

B. Loan Data

1.	Appraisal	
	– Date started	15 September 2009
	– Date completed	18 September 2009
2.	Loan negotiations	
	– Date started	28 June 2010
	– Date completed	29 June 2010
3.	Date of Board approval	6 August 2010
4.	Date of loan agreement	20 September 2010
5.	Date of loan effectiveness	
	– In loan agreement	19 December 2010
	– Actual	21 February 2011
	– Number of extensions	1
6.	Project completion date	
	– Appraisal	30 June 2014
	– Actual	31 December 2018
7.	Loan closing date	
	– In loan agreement	31 December 2014
	– Actual	31 December 2018
	– Number of extensions	3
8.	Financial closing date	
	– Actual	22 August 2019
9.	Terms of loan	
	– Interest rate	London interbank offered rate (LIBOR) + 0.6% less credit of 0.4%
	– Maturity (number of years)	24
	– Grace period (number of years)	4
10.	Terms of relending (if any)	
	– Interest rate	LIBOR + 0.6% less credit of 0.4%
	– Maturity (number of years)	24
	– Grace period (number of years)	4
	– Second-step borrower	Government of Inner Mongolia Autonomous Region

11. Disbursements

a. Dates

Initial Disbursement 25 September 2012	Final Disbursement 15 February 2019	Time Interval 77 months
Effective Date 21 February 2011	Actual Closing Date 22 August 2019	Time Interval 103 months

b. Amount (\$ million)

Category	Original Allocation (1)	Increased during Implementation (2)	Canceled during Implementation (3)	Last Revised Allocation (4=1+2-3)	Amount Disbursed (5)	Undisbursed Balance (6=4-5)
1-Works	22.60	(17.90)	0.00	4.70	4.62	0.08
2-Equipment	119.60	20.17	0.00	139.77	126.60	13.17
3-Project Management	1.75	0.00	0.00	1.75	1.12	0.63
4-Interest and Commitment Charge during Construction	6.05	(2.27)	0.00	3.78	3.78	0.00
Total	150.00	0.00	0.00	150.00	136.12	13.88

Note: Amounts may not add up precisely due to rounding. Loan savings of \$13,871,113.62 were cancelled at loan closing.
Source: Asian Development Bank.

C. Project Data

1. Project cost (\$ million)

Cost	Appraisal Estimate	Last Revised	Actual
Foreign exchange cost	166.32	150.00	136.13
Local currency cost	166.70	265.35	176.23
Total	333.02	415.35	312.36

2. Financing plan (\$ million)

Cost	Appraisal Estimate	Last Revised	Actual
Implementation cost			
Borrower financed	179.06	245.98	176.23
ADB financed	143.95	159.77	132.35
Total implementation cost	323.01	405.75	308.58
Interest during construction costs			
Borrower financed	3.96	5.83	0
ADB financed	6.05	3.77	3.78
Total interest during construction cost	10.01	9.60	3.78

ADB = Asian Development Bank.

3. Cost breakdown by project component (\$ million)

Component	Appraisal Estimate	Last Revised	Actual
A. Base costs			
Output A: District Heating Systems	272.94	364.77	307.43
Output B: Natural Gas Transmission and Distribution	16.23	0	0
B. Project Management	1.75	3.96	1.15
C. Contingencies	32.11	37.02	0
D. Financing charges during implementation	9.99	9.60	3.78
Total (A+B+C+D)	333.02	415.35	312.36

4. Project schedule

Item	Appraisal Estimate	Actual
Date of contract with consultants	January 2011	June 2014
Completion of engineering designs	April 2011	January 2017
Civil works contract		
Date of award	January 2011	October 2012
Completion of work	April 2013	December 2018
Equipment and supplies		
First procurement	September 2010	May 2012
Last procurement	October 2013	October 2017
Completion of equipment installation	April 2014	December 2018
Start of operations		
Completion of tests and commissioning	April 2014	October 2018
Beginning of start-up	June 2014	December 2018

5. Project performance report ratings

Implementation Period	Ratings	
	Impact and Outcome	Implementation Progress
From 6 August 2010 to 31 December 2010	Satisfactory	Satisfactory
	Single Project Rating	
From 1 April 2011 to 31 December 2012	On-track	
From 1 January 2013 to 30 June 2013	Potential problem	
From 1 July 2013 to 31 December 2014	On-track	
From 1 January 2015 to 31 March 2015	Potential problem	
From 1 April 2015 to 30 September 2015	Actual problem	
From 1 October 2015 to 31 December 2015	Potential problem	
From 1 January 2016 to 22 August 2019	On-track	

Note: Rating for 1 January to 31 March 2011 not available in eOps.

D. Data on Asian Development Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-Days	Specialization of Members ^a
Loan fact-finding	5–19 May 2008	8	51	a, b, c, d, e, f, g, h
Pre-appraisal	15–18 September 2009	2	8	b, i
Loan Negotiation	28–29 June 2010	3	6	b, d, j
Loan Inception	14–18 October 2010	2	6	f, i
Loan Review 1	15 June 2011	1	1	f
Loan Review 2	23–26 September 2011	2	6	f, k
Special Loan Administration	3–4 November 2011	1	2	h
Loan Review 3	20–21 June 2012	1	2	h
Loan Review 4	3–14 December 2012	4	44	b, f, k, l
Loan Review 5	29 July–1 August 2013	6	15	b, f, g, h, k, l
Mid-term Review	26 July–2 August 2014	6	23	h, j, l, m, n, o
Loan Review 6	23–29 August 2015	2	9	h, m
Loan Review 7	4–8 July 2016	2	8	h, l
Loan Review 8	18–23 September 2017	2	10	h, p
Loan Review 9	13–18 May 2018	3	13	h, p, q
Project Completion Review	19–27 November 2018	6	38	h, i, l, p, r, s

^a a = sector director, b = senior financial specialist, c = senior energy specialist, d = legal counsel, e = social specialist, f = energy specialist, g = carbon fund officer, h = energy officer, i = environmental specialist, j = administrative assistant, k = economist, l = project analyst, m = national consultant, n = head, portfolio management unit, o = disbursement officer, p = procurement officer, q = environment officer, r = safeguards officer, s = financial management officer.

I. PROJECT DESCRIPTION

1. The Inner Mongolia Autonomous Region (IMAR) of the Peoples' Republic of China (PRC) depended on coal to meet more than 90% of its energy demand in 2008. IMAR has considerable coal reserves and generates electricity for export to other provinces. In 2008, its sulfur dioxide (SO₂) emissions were 1.43 million tons, which was 5% of national emissions, although IMAR had less than 2% of the PRC's population. Coal burning for district heating contributed 10% of IMAR's SO₂ emissions. Reliance on coal was having a high environmental cost for urban areas in IMAR, as only 6 out of 15 cities monitored for air quality reached grade II air quality standards in 2008.¹

2. District heating infrastructure consisted largely of inefficient neighborhood coal-fired boilers with low capacity and efficiency and an aging and poorly insulated pipe network that suffered high distribution losses. These coal-fired boilers were highly polluting and lacked emission-control devices. In many urban areas, district heating systems had been installed in the 1970s and had exceeded their design lives, resulting in unreliable service. The inadequacy of heating in remote areas disproportionately affected the poor. IMAR was a major producer of natural gas, which is widely considered to be the cleanest fossil fuel. But the consumption of natural gas as a proportion of total energy consumption was less than 2.5%, lower than the national average. This was primarily because natural gas transmission and distribution infrastructure was underdeveloped.

3. The Inner Mongolia Autonomous Region Environmental Improvement Project (Phase II)² built on the Inner Mongolia Autonomous Region Environment Improvement Project, which was approved by the Asian Development Bank (ADB) in December 2006 and targeted district heating and natural gas distribution in the Bayannur and Wuhai Districts of IMAR.³ Phase II (the project) aimed to extend the improved and diversified district heating and natural gas supply to other urban areas, including more remote and poorer municipalities and counties. The expected impact of the project was improved energy efficiency and environment in IMAR. The outcome of the project was improved air quality in targeted urban areas.

4. The project originally consisted of two outputs: (i) six district heating supply (DHS) subprojects, and (ii) a natural gas supply (NGS) subproject (para.7). Some revisions to IMAR's district heating and NGS development plan became unavoidable because of rapid urbanization. As a result, certain subprojects in the original project scope were implemented without using the ADB loan as the respective project implementing agency (PIA) decided to implement them expeditiously with funds from local governments. Minor changes in scope and implementation arrangements were approved by ADB during project implementation, with the project finally comprising seven DHS subprojects.

¹ As provided under the PRC's Ambient Air Quality Standards GB 3095-1996, grade I standards apply to specially protected areas (e.g., natural conservation areas, scenic areas, and historical sites); grade II standards to residential areas, mixed commercial-residential areas, and cultural, industrial, and rural areas; and grade III standards to special industrial areas. Annual daily average concentrations are: (i) grade I—total suspended particulates (TSP): 80 micrograms per cubic meter (µg/m³); SO₂: 20 µg/m³; nitrogen oxide (NO_x): 50 µg/m³; (ii) grade II—TSP: 200 µg/m³; SO₂: 60 µg/m³; and NO_x: 50 µg/m³; and (iii) grade III—TSP: 300 µg/m³; SO₂: 100 µg/m³; and NO_x: 100 µg/m³.

² ADB. 2010. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Inner Mongolia Autonomous Region Environment Improvement Project (Phase II)*. Manila.

³ ADB. 2006. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Inner Mongolia Autonomous Region Environment Improvement Project*. Manila.

II. DESIGN AND IMPLEMENTATION

A. Project Design and Formulation

5. The project design at appraisal was consistent with the development priorities of the PRC government. The project was aligned with the PRC's targeted energy efficiency improvements to lower carbon intensity by 45% by 2020, compared with 2005. During the Eleventh Five-Year Plan (2006–2010), the government emphasized resource conservation and environmental protection, and prioritized improving energy efficiency and developing cleaner energy sources. The targets were (i) a 20% reduction in energy consumption per unit of gross domestic product (GDP), and (ii) a 10% reduction in SO₂ emissions and chemical oxygen demand by 2010.⁴ During this period, the Government of Inner Mongolia Autonomous Region (GIMAR) prioritized developing a modern and efficient district heating system and expanding the use of natural gas. The project remained relevant to the Twelfth Five-Year Plan (2011–2015), which targeted (i) a 16% reduction in energy consumption per unit of GDP, and (ii) a 17% reduction in carbon dioxide (CO₂) emissions per unit of GDP by 2015;⁵ and to the Thirteenth Five-Year Plan (2016–2020), which targeted (i) a 15% reduction in energy consumption per unit of GDP, and (ii) an 18% reduction in CO₂ emissions per unit of GDP by 2020.⁶

6. The project was consistent with ADB's long-term strategic framework, 2008–2020 (Strategy 2020), which identified energy as a core operational sector and achieving environmental sustainability as a strategic priority.⁷ The project was also consistent with (i) ADB's country partnership strategy for the PRC, 2008–2010, in which resource efficiency and environmental sustainability formed a strategic pillar;⁸ and (ii) subsequent ADB country partnership strategies, in which urban energy efficiency and improvement of the urban environment were priorities.⁹ In line with ADB's Energy Policy 2009, the project adopted an integrated approach to improve energy efficiency.¹⁰ It also supported the ADB energy efficiency initiative to expand ADB's investments in clean energy projects, and built on continuing engagement with the GIMAR in the energy sector. Overall, the project fit well with ADB's operational strategy for the PRC.

7. ADB approved a loan of \$150 million from its ordinary capital resources on 6 August 2010 and the loan became effective on 21 February 2011. It was designed to help achieve development priorities (para. 5), and originally comprised two outputs: (i) DHS subprojects in Hohhot, Baotou, Chifeng, Zhalaite, Kalaqin, and Keyouqian; and (ii) an NGS subproject in Keyouqian Banner.¹¹

8. When local district heating and NGS development plans changed (para. 4), the DHS subprojects in Kalaqin and Keyouqian were integrated into the expanded DHS in Chifeng and Ulanhot cities, respectively; and Keyouqian Banner NGS was included in the expanded NGS project covering six banners in Xing An League.¹² The first minor change in scope and implementation arrangements was approved by ADB on 8 July 2013 to (i) remove these two DHS

⁴ Government of the PRC. 2006. *People's Republic of China Eleventh Five-Year Plan* (2006–2010). Beijing.

⁵ Government of the PRC. 2011. *People's Republic of China Twelfth Five-Year Plan* (2011–2015). Beijing.

⁶ Government of the PRC. 2016. *People's Republic of China Thirteenth Five-Year Plan* (2016–2020). Beijing.

⁷ ADB. 2008. *Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank, 2008-2020*. Manila.

⁸ ADB. 2008. *Country Partnership Strategy (2008–2010), People's Republic of China*. Manila.

⁹ ADB. 2012. *Country Partnership Strategy (2011-2015), People's Republic of China*. Manila. 2016. *Country Partnership Strategy-Transforming Partnership: People's Republic of China and Asian Development Bank (2016-2020)*. Manila.

¹⁰ ADB. 2009. *Energy Policy*. Manila.

¹¹ A banner is an administrative unit essentially equivalent to a county.

¹² These three subprojects in the original project scope were implemented with funds from local governments.

subprojects and the NGS subproject from the project scope; and (ii) accommodate an additional three DHS subprojects in Aershan, Tuquan, and Wengniute. Responding to subsequent changes, a second minor change in scope and implementation arrangements was approved by ADB on 21 December 2016 to (i) remove the Wengniute DHS subproject from the project scope, (ii) change the Hohhot DHS subproject scope to remove the new coal-fired heating boilers and include installation of desulfurization and dust removal facilities for the existing coal-fired heating boilers, and (iii) add the Zhalaite DHS expansion subproject.¹³

9. Project preparatory technical assistance (TA) helped formulate the project (para. 22).¹⁴ The project design adopted key lessons from the implementation of the Inner Mongolia Autonomous Region Environment Improvement Project. To strengthen project readiness, ADB reviewed the key factors that may delay startup, and provided training on ADB procedures during project preparation. The project design was generally appropriate to help achieve the outcome, and the formulation was generally adequate. However, for a project with multiple subprojects, a more flexible loan modality than a stand-alone project could have been considered to better accommodate potential changes (para. 53). During project implementation, two minor changes in project scope and implementation arrangements were made to respond to changes in local development plans (para. 8). These changes fit within the original design and monitoring framework (DMF), strengthened the project's relevance, and enhanced the project outcome of improved air quality in urban areas in IMAR. Loan reallocations and extensions maximized the use of ADB loan proceeds and accommodated the completion of the subprojects included at a later stage. The DMF at appraisal and updated during implementation, along with the achievement of project targets is in Appendix 1.

B. Project Outputs

10. The project originally consisted of two outputs: Output 1: DHS subprojects in Hohhot, Baotou, Chifeng, Zhalaite, Kalaqin, and Keyouqian; and (ii) Output 2: an NGS subproject in Keyouqian Banner. After two minor changes of project scope and implementation arrangements, two DHS subprojects in Kalaqin and Keyouqian in Output 1, and the only NGS subproject in Output 2 were cancelled. Three new DHS subprojects in Aershan, Tuquan, and Zhalaite were included; and the DHS subproject in Hohhot was revised under Output 1 (para. 8). The project finally comprised seven DHS subprojects in Hohhot, Baotou, Chifeng, Zhalaite (2 subprojects), Aershan, and Tuquan under Output 1.

11. **Output 1: District Heating Supply.** As designed at appraisal in 2010, output 1 consisted of six district heating subprojects, which would install 835 megawatts (MW) of large, efficient coal-fired boilers, 591 heat exchange stations, and 535 kilometers (km) of heating pipelines. This would facilitate the closure of 383 small, inefficient coal-fired boilers for 34.49 million square meters (m²) of heating area in Hohhot, Baotou, Chifeng, Zhalaite, Kalaqin, and Keyouqian and supply cleaner heating services for about 1.58 million urban residents.

¹³ The slow construction of the new urban zone in Wengniute resulted in insufficient heating demand for the timely implementation of the subproject. the reason for Wengniute DHS subproject being cancelled from the project scope. Because of Hohhot city's new air pollution control action plan, no new coal-fired boilers were allowed to be constructed in the city and so the 464 MW coal-fired boilers in the original subproject scope could not be implemented. Domestic funds were utilized to construct new gas-fired boilers instead. The subproject scope of the Hohhot DHS was adjusted to 94 heating exchange stations, 344.1 km of heating pipelines, and installation of desulfurization and dust removal facilities for the existing coal-fired heating boilers.

¹⁴ ADB. 2007. *Technical Assistance to the People's Republic of China for Preparing the Inner Mongolia Autonomous Region Environment Improvement Project (Phase II)*. Manila.

12. Based on the last minor change of project scope and implementation arrangements approved by ADB in 2016, output 1 consisted of seven district heating subprojects, which would install 494 MW of large, efficient coal-fired boilers, 597 heat exchange stations, and 576 km of heating pipelines. This would facilitate the closure of 453 small, inefficient coal-fired boilers for 36.61 million m² of heating area in Hohhot, Baotou, Chifeng, Zhalaite, Kalaqin, and Keyouqian and supply cleaner heating services for about 1.47 million urban residents.

13. At completion in 2018, the seven DHS subprojects involved the construction of 479 MW of heating capacity and 612 heat exchange stations; the installation and rehabilitation of 336 km of heating pipelines; the demolition of 482 small, inefficient inner-city coal-fired boilers; and the rehabilitation or construction of infrastructure for 50.95 million m² of heating area for about 1.49 million urban residents. Table 1 compares the scope of output 1 as approved and at completion.

Table 1: Output 1 Scope Comparison

DHS Subprojects	Heating Area (million m ²)		Heat Source ^a (MWt)		Pipeline ^b (kilometer)		Old Boiler Closure (No.)	
	Approved	Completion	Approved	Completion	Approved	Completion	Approved	Completion
Hohhot	5.89	10.37			344.10	110.37	144	144
Chifeng	13.04	13.13			91.35	54.16	37	37
Baotou	9.76	19.36			50.41	54.01	164	164
Zhalaite	2.00	2.22	116	116	18.50	24.10	27	37
Aershan	0.61	0.61	42	42	7.00	14.00	39	34
Tuquan	2.59	2.59	220	205	35.67	49.34	36	36
Zhalaite Expansion	2.72	2.67	116	116	29.20	29.90	6	30
Total	36.61	50.95	494	479	576.23	335.88	453	482

DHS = district heating supply, m² = square meter, MWt = megawatt thermal.

^a The heat sources were gas-fired boilers funded by local funds for the Hohhot subproject, and existing combined heat and power plants for the Chifeng and Baotou subprojects.

^b Excludes pipeline system inside buildings and households.

Sources: Asian Development Bank and Inner Mongolia Autonomous Region Project Management Office.

14. **Output 2: Natural Gas Supply.** As designed at appraisal in 2010, output 2 consisted of an NGS subproject, which would construct natural gas distribution infrastructure in Keyouqian Banner, including 37.23 km of natural gas pipelines and associated auxiliary and control plant and equipment. As a result of a minor change of project scope and implementation arrangements approved by ADB in 2013, output 2 was removed from the project scope and ADB financing was cancelled (para. 8).

C. Project Costs and Financing

15. At appraisal, the project cost was estimated at \$333.02 million equivalent, comprising \$166.32 million of foreign exchange costs (49.9%) and \$166.70 million equivalent of local currency costs (50.1%). As approved at change of project scope in 2016, project costs were revised to \$415.35 million, including \$150.00 million of foreign exchange costs (36.1%) and \$265.35 million equivalent of local currency costs (63.9%). At project completion, actual costs totaled \$312.36 million, including \$136.13 million of foreign exchange costs (43.6%) covered by the ADB loan, and \$176.23 million equivalent of local currency costs (56.4%). The project costs and financing plan were updated at each change of project scope for cancellation, revision, and inclusion of additional subprojects. The project costs and financing plans at appraisal, at the last change of project scope, and at completion are in Appendix 2. A detailed cost breakdown by financier is in Appendix 3.

16. Compared with the approved estimate, the costs for civil works, equipment and materials, project management and capacity development, and financing charges during implementation

decreased.¹⁵ Loan reallocations were made between loan categories to maximize utilization of ADB loan proceeds during implementation. As a whole, total project expenditures decreased by 6.2% compared with the appraisal estimate, and the project did not use the contingencies.

D. Disbursements

17. ADB disbursed \$136.13 million from September 2012 to February 2019 in accordance with the provisions in the loan agreement and ADB's *Loan Disbursement Handbook* (2012, as amended from time to time). The Inner Mongolia Autonomous Region Finance Department (IMARFD) adopted advance fund and direct payment procedures.¹⁶ The interval between the initial and final disbursements was 77 months against the 103 months between the actual effective date and the loan closing date. The project did not utilize retroactive financing. Of the amount disbursed, \$4.62 million was for civil works, \$126.60 million for equipment and materials, \$1.13 million for project management, and \$3.78 million for interest during construction and commitment charges.

18. IMARFD used the advance fund procedure for most withdrawals and withdrew \$35,917,562.76 through the direct payment procedure. IMARFD was responsible for setting up and maintaining the advance fund and reported no problems on the use of the advance fund procedure. It also observed regular replenishments to the advance fund during project implementation, although with varying frequency. The external auditors provided unqualified opinion on the project financial statements during project implementation and raised no significant issues on the management of the advance fund. Disbursements were behind the original schedule because of slow project implementation as a result of two changes in project scope and implementation arrangements approved by ADB in 2013 and 2016 (para. 8). The loan closing date was extended three times with a cumulative extension of 4 years. The last disbursement was made on 15 February 2019 for expenses incurred before the loan closing date of 22 August 2019, at which time loan savings of \$13,871,113.62 were cancelled. The projected and actual disbursements are in Appendix 4.

E. Project Schedule

19. The project was approved on 6 August 2010. The loan and project agreements were signed on 20 September 2010, and the loan became effective on 21 February 2011. The original loan closing date was 31 December 2014, while the actual loan closing date was 31 December 2018, which was a 48-month extension. Actual project implementation was slower than planned, with changes in project scope and rebidding in several subprojects.¹⁷ All subprojects were in operation by 2018.¹⁸ The planned and actual implementation schedules are in Appendix 5. A chronology of major events is in Appendix 6.

¹⁵ Costs of the Hohhot subproject were reduced because some costs of the pipelines, gas-fired boiler houses, and civil works for heating exchange stations were borne by other agencies including local government agencies and real estate developers in alignment with the evolving Hohhot government plan to implement a coal to gas program.

¹⁶ All references to advance funds and advance accounts refer to the former imprest funds and imprest accounts.

¹⁷ Rebidding occurred in Aershan, Tuquan, and Hohhot subprojects.

¹⁸ Baotou and Zhalaite subprojects started operation in 2015, and went into full operation in 2016; Chifeng and Zhalaite expansion subprojects started operation in 2017, and went into full operation in 2018; Tuquan and Hohhot subprojects started operation in 2018, and went into full operation in 2019; Aershan subproject started operation in 2018, and was scheduled to go into full operation by 2020.

F. Implementation Arrangements

20. GIMAR was the executing agency and responsible for overall project implementation and management. GIMAR was guided by the project leading group, which comprised the IMAR vice governor, Development and Reform Commission, Finance Bureau, Construction Bureau, and Environment Protection Bureau. The project management office (PMO) was established in 2006 under the Development and Reform Commission, which was directly responsible for overall project management, coordination, and supervision. The PMO had gained some experience through the implementation of the Inner Mongolia Autonomous Region Environment Improvement Project (para. 3). The subprojects were implemented by PIAs, with each PIA establishing a project implementation unit that was responsible for the design, construction, and operation of each subproject under GIMAR's guidance.

21. Changes in the implementation arrangements were required because some subprojects were removed from the project scope and new subprojects were added. Two changes in project scope and implementation arrangements were approved by ADB in 2013 and 2016. The project finally comprised seven DHS subprojects in Hohhot, Baotou, Chifeng, Zhalaite (2 subprojects), Aershan, and Tuquan, with one PIA in each of the six cities/counties. The PIA in Zhalaite implemented both the Zhalaite DHS and the Zhalaite DHS expansion subprojects. The implementation arrangements were generally satisfactory and effective, and consistent with the design envisaged at project appraisal.

G. Technical Assistance

22. The project preparatory TA helped formulate the project (para. 9). It helped finalize the project design and address technical due diligence, social and environment safeguards, financial and economic analyses, procurement package planning, and institutional and policy analyses. The TA services, which were carried out by a consulting firm selected through quality- and cost-based selection in 2007, included reviews of project feasibility study reports; reviews of environmental impact assessment reports; financial, institutional, and economic impact analyses; a resettlement and poverty reduction analysis; and a private sector participation analysis. The TA deliverables also included an inception, interim, draft final, and final reports. The consultants' final report was posted on the ADB website in June 2008. However, ADB did not approve the project until two years later, in August 2010. Appendix 1, footnote c provides further details.

23. As phase II, the project involved new PIAs, and so weaker capacity was recognized as a critical barrier that may potentially delay project implementation.¹⁹ To ensure smooth project implementation, ADB provided separate capacity-building TA for Energy Efficiency Improvements in Inner Mongolia Autonomous Region.²⁰ This TA supported (i) capacity building and knowledge dissemination for improved energy conservation in the district heating sector, and (ii) institutional capacity building in project management. The TA enhanced the project management and procurement capacity of the IMAR Finance Bureau and IMAR PMO; provided additional support to the local governments of the project's original subprojects in Baotou, Chifeng, Hohhot, Kalakin, Keyouqian, and Zhalaite cities and selected implementing agencies during the start-up process; and developed their capacity in planning and implementing energy efficiency projects.

¹⁹ During implementation of Inner Mongolia Autonomous Region Environment Improvement Project, which was approved in December 2006, unfamiliarity of most of the implementing agencies with ADB project implementation requirements resulted in a start-up delay and subsequent slower implementation.

²⁰ ADB. 2009. *Technical Assistance to the People's Republic of China for Energy Efficiency Improvements in Inner Mongolia Autonomous Region*. Manila. The TA facilitated capacity strengthening of EA and PIAs.

H. Consultant Recruitment and Procurement

24. The ADB-financed consulting services consisted of two contracts. One was for project implementation supervision and the other for PMO project management support. They were designed at appraisal to assist the GIMAR and PIAs with (i) project design and engineering, (ii) institutional enhancement, (iii) construction supervision related to equipment and materials procured under ADB financing, (iv) project management, (v) impact monitoring and assistance in preparing progress reports, and (vi) dissemination of lessons learnt. Consulting services were procured in accordance with ADB's Guidelines on the Use of Consultants by Asian Development Bank and Its Borrowers (2010, as amended from time to time). The contract for PMO project management support was signed on 26 August 2013 and the contract for project implementation supervision on 24 June 2014.²¹

25. The contract awards for ADB loan proceeds are shown in Appendix 7. The project awarded 36 goods or works contracts, comprising (i) 32 goods contracts through international competitive bidding for the supply and installation of boilers and auxiliary equipment, heating exchange station equipment, pipelines for districting heating systems; (ii) 2 goods contracts through national competitive bidding for the supply of a coal system, slag system, ash handling system, and steel pipes; and (iii) 2 civil works contracts through national competitive bidding for two district heating supply subprojects. All packages financed by ADB were procured in accordance with ADB's Procurement Guidelines (2010, as amended from time to time), without any major deviations or misprocurement. Appendix 8 shows the ADB-financed contract packages. PIAs incorporated relevant sections of ADB's Anticorruption Policy (1998, as amended to date) into bidding documents and contracts and implemented them. In addition, the project applied domestic anticorruption practices in civil works construction. The PMO and PIAs found no serious issues regarding the packaging of contracts, preparation of bidding documents, and evaluation of bids that significantly constrained project implementation. However, under the Hohhot DHS subproject, two awarded contracts were cancelled during implementation.²²

I. Safeguards

26. The project is classified as category B for the environment in accordance with the ADB Environmental Assessment Guidelines (2003) and Environment Policy (2002). Ten separate domestic environmental impact assessment (EIA) reports were prepared by five local EIA institutes in accordance with PRC regulations and approved by local environmental protection bureaus (EPBs) in 2008. The summary initial environmental examination (SIEE) was prepared based on these EIAs and disclosed on the ADB website in September 2008.²³ In response to two minor changes in scope in 2013 and 2016 to accommodate new subprojects and the cancellation of some original subprojects, the SIEE was updated twice in accordance with the ADB Safeguard Policy Statement (2009) and posted on the ADB website in April 2013 and July 2016.

²¹ Using the quality- and cost-based selection procedure, the recruitment of the consulting firm experienced substantial delays. The reasons were disagreements on some issues such as the appropriateness of the service fee payment for the procurement agent with ADB loan proceeds and insufficient provision of evaluation supporting documentation. There was a 2-year interval from the shortlisting to the issuance of Request for Proposal.

²² Contract HHHT-EP-03 for boilers and accessories was cancelled because of Hohhot's new air pollution control action plan that allowed no new coal-fired boilers to be constructed in the city. Contract HHHT-EP-09 for prefabricated insulation pipes, pipe fitting, and steel equipment was terminated because of contract disputes and rebidding was concluded in October 2017, which caused a further delay to the Hohhot DHS subproject.

²³ <https://www.adb.org/projects/documents/imar-environment-improvement-project-phase-ii-updated-iee>

27. The GIMAR had overall responsibility for ensuring the environmental management plan (EMP) was implemented in accordance with the EIAs and SIEE. The PMO was established in IMAR Development and Reform Commission and was responsible for managing, coordinating, and supervising EMP implementation. A grievance redress committee was established inside the PMO. Each PIA established an environmental management unit responsible for EMP implementation and monitoring during subproject construction and operation. The PMO designated environmental staff to coordinate with each environmental management unit, and oversaw EMP implementation and monitoring for all subprojects, with assistance from the consultant.

28. During the construction phase, all contractors kept regular construction records and prepared progress reports that were submitted to the PIAs. Qualified monitoring units were assigned by the owner of each subproject to monitor the external environment. Environmental monitoring was carried out with specific monitoring frequency, time, parameters, and monitoring procedures, in accordance with the EIA and EMP and in the designated location. During operation, the PIAs were responsible for implementing the mitigation measures contained in the EIA and SIEE and reporting to provincial and municipal EPBs and the PMO. As a result of the delay in mobilizing the external environment monitoring agency, the PMO only submitted five environmental monitoring reports to ADB—twice per year during construction and once per year for 2 years following completion of construction in 2016. Public opinion surveys in subproject areas at completion indicated that people were generally satisfied with project performance during construction and operation, and no formal complaint was received during project implementation. As required under the PRC's laws and regulations, all the subprojects were reviewed by the local EPBs through an environment protection completion audit in 2018-2019. The demolition of small boilers was carried out in accordance with the applicable environmental and safety standards of the PRC (Appendix 9).

29. The project was categorized as B for involuntary resettlement. The involuntary resettlement assessment and measures were prepared during project preparation. One of the seven subprojects, Zhalaite DHS, would affect 1,740 m² of the buildings of two private entities, a driving school, and a closed factory. The remaining subprojects had no resettlement impacts as they were implemented on government-reserved land or existing premises. During implementation, Zhalaite DHS was constructed within the scope of the original site without affecting the buildings of the two private entities. The project required a scope change in 2016 and a resettlement due diligence report was prepared for the Zhalaite DHS expansion, which indicated that 118.52 *mu* of state-owned land had been transferred from a state-owned farm via the local land bureau without affecting people.²⁴ The ADB project completion review mission visited all seven subprojects and noted that (i) the boilers were constructed on state-owned land or within the existing premises of heating plants, (ii) the heat-exchange substations were constructed on land or within buildings provided by developers or residential communities, and (iii) heating pipelines were buried under roads. The project has not induced land acquisition and resettlement impacts because it did not demolish the two private entities in Zhalaite DHS.

J. Monitoring and Reporting

30. The loan covenants were considered adequate, and the project complied with them, except for partial compliance with the financial performance indicators of the project entities. The implementation arrangements were adequate and the ADB loan was appropriately used and disbursed. The PMO submitted the necessary reports, audited project accounts and financial

²⁴ A *mu* is a Chinese unit of measurement, the equivalent of 666.67 m².

statements to ADB as required in the loan agreement. The reports were generally acceptable to ADB, albeit with some delays during the initial period of project implementation. In general, project financial management was satisfactory, with timely submissions of annual project financial statements audited by the IMAR Audit Office. The auditor issued an unqualified auditor's opinion every year with a separate audit opinion on the use of the loan proceeds until the loan closing date. The remaining issues of the final audit report have been adequately addressed by the PMO.

31. According to the project agreement, from the commencement of the project's commercial operations, the PIAs shall maintain (i) a debt service coverage ratio of at least 1.2 times, (ii) a current ratio of more than 1:1, and (iii) a debt-equity ratio of not more than 70:30. Except for Zhalaite Xingda Heating Company, the PIAs did not satisfy the covenanted ratios. The main reasons include high debt ratios, operating losses resulting from the low heating tariff, high coal costs, and low operational efficiency. The local governments have been providing subsidies to support these companies considering the nature of the project. However, the local governments should review the heating tariff taking into account the operating costs of the heating supply companies and make appropriate tariff adjustments to ensure cost recovery as well as debt payment. A summary of compliance with loan covenants is in Appendix 10.

32. The project design required the GIMAR, through the PMO, to ensure that the PIAs use a project performance management system (PPMS) to monitor and evaluate project outcomes and outputs. The project preparatory TA prepared the PPMS, including a set of measurable indicators based on the project design, impact, and risks. The consultants supervising implementation were required to help the provincial government monitor project impacts and prepare periodic reports. However, because of the delayed mobilization of the project implementation consultants, the GIMAR and PIAs received inadequate project management support during early project implementation. The PPMS was not established in time nor did it operate effectively. In addition, some project outcome and output indicator targets were not correctly established (paras. 35-36; Appendix 1, footnotes c-e). Finally, submission of the project progress and monitoring reports by the PMO was delayed during the early stage of project implementation.

III. EVALUATION OF PERFORMANCE

A. Relevance

33. With its expected impact of improved energy efficiency and environment in IMAR, the project is rated *relevant* at appraisal and completion. It was fully aligned with the Eleventh, Twelfth, and Thirteenth Five-Year plans of the Government of the PRC and GIMAR, which prioritized energy conservation, environmental improvement, and a shift from heavy reliance on coal to green development. It was also consistent with ADB's country strategy and sector priorities, which emphasized resource efficiency and environmental sustainability, and with ADB's energy policy, which prioritized energy efficiency (para. 6). The project was directly relevant to the PRC's targeted energy efficiency improvements to lower carbon intensity by 45% by 2020, compared with 2005. However, the project was significantly affected by changes in local government policies, such as the local development plans. These changes impacted the scope of the subprojects, caused project implementation delays, and resulted in two minor changes to the project scope to accommodate the changed circumstances of the subprojects. The project DMF was updated accordingly. The changes in project scope strengthened the project's relevance and facilitated achievement of the project outcome. The project built on ADB's continuing engagement with the GIMAR in the energy sector. Following the project, ADB supported the development of

advanced, cleaner district heating systems using wind power, natural gas, and waste heat recovery in Huhhot, the capital of IMAR.²⁵

B. Effectiveness

34. The project substantially achieved its outcome of improved air quality in urban areas in IMAR, and its output of improved district heating in Huhhot, Chifeng, Baotou, Zhalaite, Aershan and Tuquan, as updated during changes in project scope. However, some project outcome and output indicator targets were not appropriately established (para. 32). Overall, the project was *effective* in achieving the intended project outcome and outputs.

35. The air quality in project areas improved to grade II by 2018. At completion, the project fully achieved the outcome target for energy efficient district heating in urban areas with avoidance of coal consumption by 1.562 million tons, thereby avoiding annual emissions of CO₂ by 2.436 million tons, SO₂ by 29,707 tons, total suspended particulates (TSP) by 39,494 tons, and nitrogen oxides (NOx) by 6,563 tons (Appendix 1, footnote d).

36. By end-2018, the project heated a floor area of 50.96 million m², benefiting 1.489 million residents with adequate and reliable district heating. This exceeded the targets of 36.61 million m² DHS area and 1.469 million residents. In addition, 482 inefficient high-pollution, small coal-fired boilers were shut down compared to the closure target of 453. The project therefore avoided coal consumption of 0.851 million tons annually with reduced annual emissions of CO₂ by 1.365 million tons, SO₂ by 12,137 tons, NOx by 3,845 tons, and TSP by 17,947 tons. The project thus exceeded all output targets (Appendix 1, footnote e).

C. Efficiency

37. The project is rated *less than efficient* because of the delay in achieving the overall project outcome and outputs, and limited economic viability. The economic internal rates of return (EIRRs) of the individual subprojects at completion ranged from 1.9% to 22.8% with environmental benefits with the national carbon price. The consolidated EIRR for the whole project was 15.7%, based on an aggregation of the economic benefits and economic costs of the seven subprojects. The Chifeng, Baotou, Zhalaite, and Zhalaite expansion subprojects, as well as the overall project, are economically viable as their EIRRs were higher than the threshold rate of 12%. The other subprojects are not viable. With the international carbon price, the EIRR results ranged from 11.4% to 31.1%. The sensitivity analysis tested the robustness of the economic viability of the subprojects and whole project, using three scenarios: (i) a 10% benefit decline, (ii) a 10% operation and maintenance (O&M) cost increase, and (iii) a combination of both. The analysis shows that Chifeng and Zhalaite DHS expansion subprojects will remain viable under a 10% benefit decline or O&M cost increase of 10%. The whole project and other subprojects are very sensitive to any negative changes, indicating limited robustness in their economic viability. The detailed economic reevaluation is in Appendix 11. Project implementation is *less than efficient* because of slow progress and two changes in project scope with a cumulative extension of 4 years.

²⁵ ADB. 2014. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for Low Carbon District Heating Project in Huhhot in Inner Mongolia Autonomous Region* (Loan 3218-PRC). Manila.

D. Sustainability

38. District heating supply is an essential public service, and the demand in urban areas is expected to multiply as the public becomes increasingly aware of the need for a cleaner environment. The operating facilities were designed and installed properly, and function well. The PIAs, which are the agencies responsible for O&M of the district heating systems, possess the institutional capability and expertise required to manage and operate the facilities effectively and efficiently, and are fairly stable in their human resources, finance, organizational arrangements, and governance.

39. The financial viability of the seven subprojects was reevaluated at completion (Appendix 12). The financial internal rates of return (FIRRs) for the seven subprojects ranged from -7.83% to 9.74%, while the FIRR for the overall project was 2.31%. The FIRRs for Baotou and Tuquan subprojects exceeded the weighted average cost of capital (WACC), indicating their financial viability. Other subprojects and the whole project registered an FIRR that was lower than their respective WACC, indicating lack of financial viability. This was mainly due to the higher O&M costs, longer construction period, and lower tariff prevailing at completion than those anticipated at appraisal. A sensitivity analysis tested three scenarios: (i) revenues decrease by 10%, (ii) O&M costs increase by 10%, and (iii) a combination of (i) and (ii). The resulting FIRRs indicated that, except for the Baotou subproject, the subprojects and the project as a whole would not be viable under most scenarios.

40. The financial performance of the six PIAs was assessed at completion based on their entity's financial statements for fiscal year 2018. According to the project agreement, from the commencement of the commercial operations of the project, PIAs shall maintain (i) a debt service coverage ratio of at least 1.2 times; (ii) a current ratio of more than 1:1; and (iii) a debt-equity ratio of not more than 70:30. Except for Zhalaite Xingda Heating Company, the PIAs did not satisfy the covenanted ratios. The main reasons include high debt ratios, operating losses resulting from the low heating tariff, high coal costs, and low operational efficiency. The local governments should review and adjust the heating tariff to ensure cost recovery as well as debt payment (para. 31).

41. The project operations will have no adverse environmental or social impacts, and will continue to service people in the project areas, including vulnerable people.

42. Overall, the project is rated *less than likely sustainable* considering its limited financial sustainability.

E. Development Impact

43. The project's development impact is considered *satisfactory*. By 2018, energy efficiency of the district heating sector improved 32.5% compared to 2010, and all IMAR cities and urban areas met improved air quality standards of at least grade II. The project's intended impact of improved energy efficiency and environment in IMAR has been achieved. The project created significant social and environmental benefits and contributed to poverty reduction by creating job opportunities, improving health and welfare, and driving economic growth while reducing pollution. Adverse environmental impacts during construction were minor and adequately mitigated. The project effectively implemented safeguard measures for land acquisition and resettlement and generated positive social development impacts.

44. **Environment impact.** The project's environmental impact is rated successful. It has improved the energy efficiency of the district heating systems, resulting in an estimated energy

savings of 0.851 million tons of coal per year. It is delivering substantial environmental benefits by avoiding annual net emissions of CO₂ by 1.365 million tons, SO₂ by 12,137 tons, NO_x by 3,845 tons, and TSP by 17,947 tons, exceeding the indicator targets (para. 36).

45. **Social impact.** The project's social impact is rated successful, as more than 1.489 million urban residents have benefited directly from the project through safe, reliable, and affordable district heating services, including 107,500 urban poor in six highly polluted urban areas where the winter temperatures can fall to -40°C and the heating season can last for 7 months. The expanded district heating systems have reduced the use of raw coal as fuel for indoor heating and replaced the old inefficient small coal-fired boilers, which were highly polluting and lacked emission-control devices. Women have benefited more from the project, as they take primary responsibility for household activities such as collecting fuel and operating household heating. The resulting time savings have benefited around 728,200 women. The poor also benefited through reduced health risk, since they had previously used indoor coal stoves for heating, which is a major cause of respiratory disease. The incidence of respiratory diseases and other air pollution related health risks are expected to decline further when the project is in full operation. The project contributed to an improved living environment for the local people and supported sustainable social and economic growth in the long term.

46. The project generated 4,130 jobs, including 3,290 during project construction and 840 during project operation. At completion in 2018, 482 inefficient high-polluting small boilers were shut down to improve urban air quality. The closure of inefficient small boilers affected 980 boiler workers. Each PIA arranged for the reemployment of the affected boiler workers upon subproject completion. No affected boiler worker lost their job because of the closure of the small boilers. Of the affected 980 workers, 324 were trained and retained in the heat exchange stations, 354 were reemployed in the power company without any changes in wages and benefits, and the rest remained with the original company in similar jobs. No complaints were received from the affected boiler workers.

F. Performance of the Borrower and the Executing Agency

47. The borrower, executing agency, and PIAs implemented the project in accordance with the loan and project agreements. The borrower, represented by the Ministry of Finance, signed the loan agreement on 20 September 2010, 1.5 months after ADB's approval, and completed the requirements for loan effectiveness on 21 February 2011. The performance of the Ministry of Finance as borrower was *satisfactory*. It provided timely guidance and approvals for relevant implementation issues to help smooth project implementation. The performance of the GIMAR as executing agency was also *satisfactory*, despite challenges resulting from (i) multiple project components with widely dispersed subprojects and PIAs; (ii) multi-layered project administration across county, city, and provincial governments; and (iii) the need for coordination among several provincial and local government agencies involved in project implementation. Notwithstanding the changes in project scope and implementation arrangements, lengthened implementation schedule, and revised outputs, the GIMAR adequately managed the project and guided the PIAs, including complying with the covenants and ADB guidelines, and mobilizing counterpart funding.

48. All contractors generally fulfilled their contractual responsibilities and organized construction activities well. They completed the assigned civil construction and mechanical and electrical installation works satisfactorily in accordance with the contract requirements, albeit with some delays. The project implementation units generally rated most of the contractors' performance as *satisfactory*. Similarly, the performance of the suppliers of equipment and materials was *satisfactory*; they generally delivered equipment and materials on time, installed

them properly, and provided the necessary technical training and services in accordance with the terms and conditions of their respective contracts. During implementation, a few minor disputes or contractual difficulties arose and were mostly resolved amicably.

49. The performance of the consultants was generally *satisfactory*. Engagement of the project implementation consulting firm was behind the original schedule because of the prolonged recruitment process (para. 24). The consultants provided assistance to the PMO and PIAs in project management and monitoring, and implemented the capacity building program, including domestic study tours to enhance corporate governance and improve project management. The performance of the domestic consultants involved in detailed engineering design, tendering, and construction supervision was also generally *satisfactory*.

G. Performance of the Asian Development Bank

50. ADB's performance is rated *satisfactory*. ADB conducted 12 review missions during implementation, including the midterm review mission. These missions addressed various requirements for project implementation such as procurement, disbursements, project management, monitoring of project progress, changes in project scope, loan reallocations, and loan extensions. The PMO assessed that the ADB mission provided strong support to the project and cooperated closely with the executing agency and the PIAs. ADB staff spent adequate time reviewing physical progress and resolving issues with the PMO and PIAs during implementation. ADB supported smooth implementation through timely approvals of bidding documents, bid evaluation reports, and contracts, and efficient disbursements. ADB's approvals of requests for changes in project scope and implementation arrangements, and extensions of the loan closing date were also timely. The GIMAR and PIAs expressed appreciation for ADB's timely actions in resolving project implementation issues.

H. Overall Assessment

51. The project is rated *less than successful* overall based on its ratings on the four core evaluation criteria following the methodology provided in the *Guidelines for the Evaluation of Public Sector Operations*.²⁶ It was *relevant*, *effective*, *less than efficient*, and *less than likely sustainable*. All seven DHS subprojects were implemented and are operating satisfactorily, albeit with some delay. The project was rated *relevant* because it was fully aligned with the Government of the PRC and IMAR's high priority on improving energy efficiency and with ADB's country partnership strategies for the PRC and energy policy. It was rated *effective* because it achieved the outcome and output targets; and *less than efficient* because of changes in scope, implementation delays, lower EIRRs for several subprojects, and an extended implementation period. The project's *less than likely sustainable* rating mainly resulted from a lower FIRR than WACC, with the local governments providing subsidies to support these companies considering the nature of the project. Local governments accorded adequate importance to the development of safeguards plans and ensured compliance with the ADB Safeguard Policy. The project has had a strong and positive environmental and social developmental impact. The overall ratings are in Table 2.

²⁶ ADB. 2016. *Guidelines for the Evaluation of Public Sector Operations*. Manila.

Table 2: Overall Ratings

Criteria	Rating
Relevance	Relevant
Effectiveness	Effective
Efficiency	Less than efficient
Sustainability	Less than likely sustainable
Overall Assessment	Less than successful
Development impact	Satisfactory
Borrower and executing agency	Satisfactory
Performance of Asian Development Bank	Satisfactory

Source: Asian Development Bank.

IV. ISSUES, LESSONS, AND RECOMMENDATIONS

A. Issues and Lessons

52. Changes in scope and implementation arrangements involved additional inputs and resources from both the government and ADB, as well as significant delays to project implementation. Reasons for these included changes in urban development plans and the urgency of local governments to move ahead with some subprojects using local funds. Prudent pre-screening of subprojects is imperative. ADB needs to conduct thorough due diligence during project appraisal to select subprojects that are realistic and consistent with the ADB loan implementation timeframe. Also, efforts should be made to reduce the time between the project preparatory TA final report and loan approval to minimize potential changes.

53. Choice of project modality, scope, and implementation arrangements should be carefully assessed and deliberately considered at project preparation. Further, project frameworks need to be improved to accommodate potential changes if such changes can be envisaged at project formulation and loan processing. A flexible approach that allowed individual subprojects to become effective when individual requirements were met would have avoided the situation created by a stand-alone project loan.

54. Delays in the recruitment and mobilization of the project implementation consultants meant that project management support could not keep pace with project implementation. During the early stage of project implementation, there were gaps in project implementation management compared to the requirements at appraisal. In particular, the PPMS was not established in time and did not operate effectively, and progress and monitoring reports were not submitted in a timely fashion. Advance contracting for consultant selection could have avoided such issues. In addition, some performance indicator targets were not appropriately established.

55. The local governments currently play a dominant role in determining the heating tariffs. DHS subprojects have not received approvals to increase heating tariffs based on the true cost of providing heating services. The increase in heating tariffs is lagging well behind the rise in the prices of the key materials. Because of the project's benefits to public welfare, local governments have committed to support these companies through debt restructuring and subsidies to help them meet debt service obligations and fill the gap between tariff collection and recurring operating costs. Local governments could periodically review the heating tariffs and initiate timely adjustments to ensure cost recovery as well as debt payment.

B. Recommendations

56. **Project design and modality.** The project performance indicator targets should be carefully checked for accuracy and consistency with the latest project design prior to ADB loan approval in case any changes have occurred between the project preparatory TA final report and loan approval. The project modality should be carefully considered during project preparation. The simple stand-alone project loan modality is less advantageous when implementing a multicomponent project that involves a wide range of subprojects, unless the executing agency has strong project management capacity. Given a sound development policy and firm medium-term investment plan, a more flexible project modality such as financial intermediation, sector loan, and results-based lending could be considered.

57. **Heating tariffs.** The GIMAR should continue to monitor the implementation status of heating reforms, and ensure local governments monitor the financial position of the project entities and take necessary measures to reduce the debt ratio for the DHS subprojects. Through regular reviews, the local governments should determine whether the tariffs can meet the normal full cost recovery criteria for sustainable heating services, and consider increasing the tariff as needed. Such measures will provide valuable lessons for other ADB-financed district heating projects in the PRC.

58. **Future monitoring.** To ensure the sustainability of project facilities, the GIMAR and local governments should ensure that the respective operators operate and maintain the completed district heating facilities in accordance with sound administrative, financial, engineering, environmental, and O&M practices at all times. Monitoring should ensure that the facilities are properly maintained and remain operational. The relevant covenants in the loan and project agreements should therefore remain in their existing form.

59. **Timing of the project performance evaluation report.** A project performance review should be conducted in 2022 or later. By that time, all subprojects should have been in operation for over 4 years, and this will allow proper evaluation of the project's impact on improved energy efficiency and environment in IMAR based on accumulated statistics.

DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets and Indicators with Baselines			Project Achievements
	Original	First Revision ^a	Last Revision ^b	
Impact Improved energy efficiency and environment in IMAR	<p>Compared to 2010, at least 15% improvement in energy efficiency of district heating sector by 2020</p> <p>Compared to 2010, all cities and urban areas of IMAR meet improved air quality standards of at least grade II by 2020</p>	<p>Compared to 2010, at least 15% improvement in energy efficiency of district heating sector by 2020</p> <p>Compared to 2010, all cities and urban areas of IMAR meet improved air quality standards of at least grade II by 2020</p>	<p>Compared to 2010, at least 15% improvement in energy efficiency of district heating sector by 2020</p> <p>Compared to 2010, all cities and urban areas of IMAR meet improved air quality standards of at least grade II by 2020</p>	<p>Compared to 2010, 32.5% improvement in energy efficiency of district heating sector achieved by 2018</p> <p>Compared to 2010, all cities and urban areas of IMAR met improved air quality standards of at least grade II by 2018</p>
Outcome Improved air quality in urban areas in IMAR	<p>By 2015, energy-efficient district heating and natural gas supplies in urban areas avoid coal consumption by at least 1.75 million tons, thereby avoiding annual emissions of CO₂ by more than 2.66 million tons, SO₂ by more than 31,640 tons, TSP by more than 36,967 tons of TSP, and NO_x by more than 9,218 tons^c</p> <p>The air quality in project areas improve to at least grade II by 2015.</p>	<p>By 2017, energy-efficient district heating and natural gas supplies in urban areas avoid coal consumption by at least 1.8 million tons, thereby avoiding annual emissions of CO₂ by more than 2.74 million tons, SO₂ by more than 32,605 tons, TSP by more than 38,044 tons of TSP, and NO_x by more than 9,560 tons.</p> <p>The air quality in project areas improve to at least grade II by 2017.</p>	<p>By 2018, energy efficient district heating in urban areas avoid coal consumption by at least 1.76 million tons thereby avoiding annual emissions of CO₂ by more than 2.66 million tons, SO₂ by more than 31,165 tons, TSP by more than 38,440 tons of TSP, and NO_x by more than 6,894 tons^d</p> <p>The air quality in project areas improves to at least grade II by 2018.</p>	<p>By 2018, energy efficient district heating in urban areas avoid annual coal consumption by 1.562 million tons, thereby avoiding annual emissions of CO₂ by more than 2.436 million tons, SO₂ by more than 29,707 tons, TSP by more than 39,494 tons, and NO_x more than 6,563 tons.</p> <p>The air quality in project areas improved to grade II by end 2018.</p>
Outputs 1. Improved district heating in project cities and towns	<p>Upgrading or extension of district heating services to 1.47 million urban residents, with a coverage of about 34.49 million m² in project cities and towns of Huhhot, Chifeng, Baotou, Zhalaite, Kalaqin and Keyouqian by 2014</p> <p>Energy-efficient district heating results in closure of 383 small, inefficient, and polluting coal-fired boilers by 2014</p>	<p>Upgrading or extension of district heating services to 1.46 million urban residents, with a coverage of about 36.89 million m² in project cities and towns of Huhhot, Chifeng, Baotou, Zhalaite, Aershan, Tuquan, and Wengniute by 2016</p> <p>Energy-efficient district heating results in closure of 447 small, inefficient, and polluting coal-fired boilers by 2016</p>	<p>Upgrading or extension of district heating services to 1.469 million urban residents, with coverage of about 36.61 million m² in project cities and towns of Huhhot, Chifeng, Baotou, Zhalaite, Aershan, and Tuquan by 2018</p> <p>Energy efficient district heating results in closure of 453 small, inefficient, and polluting coal-fired boilers by 2018</p>	<p>Upgrading or extension of district heating services to 1.486 million urban residents, with coverage of about 50.96 million m² by end 2018</p> <p>Energy efficient district heating results in closure of 482 small, inefficient, and polluting coal-fired boilers by 2018</p>

Design Summary	Performance Targets and Indicators with Baselines			Project Achievements
	Original	First Revision ^a	Last Revision ^b	
2. Provision of gas transmission and distribution systems in Keyouqian	Energy efficient district heating avoids 1.04 million tons of coal usage annually in these urban areas reducing the associated emissions of CO ₂ by 1.59 million tons, SO ₂ by 14,070 tons, NO _x by 6,500 tons, and TSP by 15,420 tons	Energy efficient district heating avoids 1.09 million tons of coal usage annually in these urban areas reducing the associated emissions of CO ₂ by 1.67 million tons, SO ₂ by 1,673 tons, NO _x by 6,842 tons, and TSP by 16,497 tons	Energy efficient district heating avoids 1.05 million tons of coal usage annually in these urban areas reducing the associated emissions of CO ₂ by 1.59 million tons, SO ₂ by 13,595 tons, NO _x by 4,175 tons, and TSP by 16,893 tons ^c	Energy efficient district heating avoids 0.851 million tons of coal usage annually in these urban areas reducing the associated emissions of CO ₂ by 1.365 million tons, SO ₂ by 12,137 tons, NO _x by 3,845 tons, and TSP by 17,947 tons
	Provision of reliable natural gas supplies of 20 million cubic meter annually in Keyouqian banner from 2014 to 108,000 urban residents and public transport system	Removed		
	Inputs ADB: \$150.0 million Implementing agencies: \$118.0 million Local banks: \$65.0 million Total project cost: \$333.0 million	Inputs ADB: \$150.0 million Implementing agencies: \$141.61 million Local banks: \$76.46 million Total project cost: \$368.07million	Inputs ADB: \$150.0 million Implementing agencies: \$145.3 million Local Bank: \$96.24 million Others: \$23.81 million Total project cost: \$415.35 million	Inputs ADB: \$136.13 million Implementing agencies: \$137.91 million Local Bank: \$3.36 million Total project cost: \$277.41 million

ADB = Asian Development Bank, CO₂=carbon dioxide, IMAR=Inner Mongolia Autonomous Region, m² =square meter, NO_x=nitrogen oxides, SO₂=sulfur dioxide, TSP=total suspended particulates

^a Revisions based on a minor change in project scope approved on 8 July 2013.

^b Revisions based on second minor change in project scope approved on 21 December 2016.

^c Last revised in December 2016.

^c The project preparatory technical assistance (PPTA) Consultants' *Final Report for Inner Mongolia Autonomous Region Environmental Improvement Project (Phase II)* was posted on ADB website in June 2008. However, due to issues of slow progress and pending changes of project scope of *Inner Mongolia Autonomous Region Environmental Improvement Project*, processing of *Inner Mongolia Autonomous Region Environment Improvement Project (Phase II)* was slowed down, while project issues of *Inner Mongolia Autonomous Region Environmental Improvement Project* were addressed with major change of project scope and implementation arrangements approved by ADB in 2010. ADB approved *Inner Mongolia Autonomous Region Environment Improvement Project (Phase II)* in August 2010, two years after PPTA final report. There were changes of Chifeng subproject during June 2006-August 2010. The heating area of Chifeng subproject changed from 28.40 million m² in PPTA final report to 13.04 million m² in the approved *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Inner Mongolia Autonomous Region Environment Improvement Project (Phase II)*. However, estimated environmental benefits of Chifeng subproject remained the same as in PPTA of annual coal consumption and associated emission to be avoided due to energy efficient district heating supply were 511,400 tons of coal, 654,700 tons of CO₂, 4,750 tons of SO₂, 1,260 tons of NO_x, and 1,090 tons of TSP; which should have been reduced in proportion to heating area reduction and corrected to: annual coal saving of 234,811 tons, and annual emission reduction of 300,608 tons of CO₂, 2,181 tons of SO₂, 578 tons of NO_x, and 500 tons of TSP. The estimated environmental benefits of annual coal consumption and associated emission to be avoided for the overall project should have been reduced accordingly.

^d Referring to footnote c, the outcome indicator targets for estimated environmental benefits are corrected to: by 2018, energy efficient district heating in urban areas avoid coal consumption by at least 1.483 million tons thereby avoiding annual emissions of CO₂ by more than 2.306 million tons, SO₂ by more than 28,596 tons, TSP by more than 37,850 tons, and NO_x by more than 6,212 tons, considering the erroneous emission reduction targets of Chifeng subproject set at approved *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Inner Mongolia Autonomous Region Environment Improvement Project (Phase II)*.

^e Referring to footnote c, the output indicator targets for estimated environmental benefits for the project are corrected to: energy efficient district heating avoids 0.774 million tons of coal usage annually in these urban areas reducing the associated emissions of CO₂ by 1.239 million tons, SO₂ by 11,026 tons, NO_x by 3,493 tons, and TSP by 16,303 tons, considering the erroneous emission reduction targets of Chifeng subproject set at approved *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Inner Mongolia Autonomous Region Environment Improvement Project (Phase II)*.

Sources: Asian Development Bank and Inner Mongolia Autonomous Region Project Management Office.

PROJECT COST AT APPRAISAL AND ACTUAL

Table A2.1: Project Cost by Financier at Appraisal and Actual
(\$ million)

Item	Appraisal Estimate				Last Revised				Actual			
	ADB Loan	Foreign Exchange	Local Currency	Total	ADB Loan	Foreign Exchange	Local Currency	Total	ADB Loan	Foreign Exchange	Local Currency	Total
A. Base Cost												
1. Output A: District Heating Systems												
a. Hohhot DHS	47.23	47.23	51.45	98.68	48.63	48.63	57.60	106.23	35.70	35.70	11.60	47.30
b. Chifeng DHS	37.10	37.10	43.40	80.50	37.35	37.35	42.15	79.50	36.27	36.27	61.10	97.37
c. Baotou DHS	17.08	17.08	17.12	34.20	16.85	16.85	56.83	73.68	16.97	16.97	55.90	72.87
d. Keyouqian DHS	15.35	15.35	14.02	29.37			Cancelled					
e. Kalaqin DHS	6.87	6.87	4.90	11.77			Cancelled					
f. Zhalaiteqi DHS	10.51	10.51	7.89	18.40	10.70	10.70	7.78	18.48	11.15	11.15	4.98	16.13
g. Zhalaiteqi expansion ^a					7.30	7.30	33.64	40.94	7.50	7.50	34.98	42.48
h. Tuquan DHS ^a					16.34	16.34	21.36	37.70	15.88	15.88	7.18	23.06
i. Aershan DHS ^a					7.30	7.30	0.94	8.24	7.75	7.75	0.47	8.22
2. Output B: Natural Gas Transmission and Distribution												
Keyouqianqi natural gas supply system	8.08	8.08	8.14	16.22			Cancelled					
B. Project management	1.75	1.75	0.00	1.75	1.75	1.75	2.21	3.96	1.13	1.13	0.02	1.15
C. Contingencies	0.00	16.32	15.80	32.12	0.00	0.00	37.02	37.02	0.00	0.00	0.00	0.00
D. Financing Charges During Implementation	6.03	6.03	3.98	10.01	3.78	3.78	5.83	9.60	3.78	3.78	0.00	3.78
Total	150.00	166.32	166.70	333.02	150.00	150.00	265.36	415.35	136.13	136.13	176.23	312.36

^a Added during scope change in 2013.

Sources: Asian Development Bank and Inner Mongolia Autonomous Region Project Management Office.

Table A2.2: Financing Plan
(\$ million)

Source	Appraisal Estimate		Last Revised		Actual	
	Amount	%	Amount	%	Amount	%
ADB	150.00	45.04	150.00	36.11	136.13	43.58
Enterprise Self Raised Fund	118.16	35.48	142.13	34.22	172.87	55.34
Commercial Bank Loans	64.86	19.48	96.24	23.17	0.00	0.00
Central financial funding	0	0	3.17	0.76	2.91	0.93
Local government funding	0	0	23.81	5.73	0.45	0.14
Total	333.02	100.00	415.35	100.00	312.36	100.00

Sources: Asian Development Bank and Inner Mongolia Autonomous Region Project Management Office.

PROJECT COST BY FINANCIER

	Item	Appraisal Amount (\$ million)	Last Revision (\$ million)	Actual Amount (\$ million)	% Increase (Decrease) ^a
A.	Hohhot District Heating Supply				
1	Base Cost				
	a. Civil Works	32.27	34.83	0	(100.00)
	b. Equipment and Materials	57.27	61.54	37.95	(33.73)
	c. Implementation Cost	9.14	9.86	9.35	2.30
	d. Project Management	0.58	0.58	0.38	(34.48)
2	Contingencies	11.97	14.15	0	(100.00)
3	Financial Charges during Implementation	4.06	2.67	1.36	(66.50)
	Subtotal	115.29	123.64	49.04	(57.46)
B.	Chifeng District Heating Supply				
1	Base Cost				
	a. Civil Works	27.58	29.77	26.75	(3.01)
	b. Equipment and Materials	45.37	44.04	62.14	36.96
	c. Implementation Cost	7.55	5.69	8.48	12.32
	d. Project Management	0.45	2.22	0.29	(35.56)
2	Contingencies	8.51	9.48	0	(100.00)
3	Financial Charges during Implementation	2.92	4.04	1.06	(63.70)
	Subtotal	92.38	95.24	98.72	6.86
C.	Baotou District Heating Supply				
1	Base Cost				
	a. Civil Works	6.38	29.42	31.25	389.81
	b. Equipment and Materials	24.75	42.65	36.11	45.90
	c. Implementation Cost	3.06	1.61	5.51	80.07
	d. Project Management	0.21	0.65	0.14	(33.33)
2	Contingencies	3.58	2.87	0	(100.00)
3	Financial Charges during Implementation	1.34	1.19	0.51	(61.94)
	Subtotal	39.35	78.39	73.51	86.81
D.	Tuquan District Heating Supply				
1	Base Cost				
	a. Civil Works		10.32	6.34	(38.57)
	b. Equipment and Materials		23.52	16.2	(31.12)
	c. Implementation Cost		3.86	0.52	(86.53)
	d. Project Management		0.20	0.13	(35.00)
2	Contingencies		4.16	0	(100.00)
3	Financial Charges during Implementation		0.46	0.48	4.35
	Subtotal		42.52	23.68	(44.31)
E.	Aershan District Heating Supply				
1	Base Cost				
	a. Civil Works		2.28	1.42	(37.72)
	b. Equipment and Materials		5.96	6.57	10.23
	c. Implementation Cost		0.00	0.24	0.00
	d. Project Management		0.09	0.06	(33.33)
2	Contingencies		1.85	0	(100.00)
3	Financial Charges during Implementation		0.11	0.2	81.82
	Subtotal		10.29	8.49	(17.49)
F.	Zhalaite District Heating Supply				
1	Base Cost				
	a. Civil Works	5.56	3.88	4.46	(19.78)
	b. Equipment and Materials	10.31	11.88	11.44	10.96
	c. Implementation Cost	2.52	2.72	0.22	(91.27)

	Item	Appraisal Amount (\$ million)	Last Revision (\$ million)	Actual Amount (\$ million)	% Increase (Decrease) ^a
	d. Project Management	0.13	0.13	0.08	(38.46)
2	Contingencies	2.02	1.60	0	(100.00)
3	Financial Charges during Implementation	0.36	0.17	0.1	(72.22)
	Subtotal	20.91	20.38	16.31	(22.00)
G.	Zhalaite District Heating Supply Expansion				
1	Base Cost				
	a. Civil Works		20.01	24.52	22.54
	b. Equipment and Materials		15.67	14.95	(4.59)
	c. Implementation Cost		5.26	3.01	(42.78)
	d. Project Management		0.09	0.07	(22.22)
2	Contingencies		2.91	0	(1.00)
3	Financial Charges during Implementation		0.96	0.07	(92.71)
	Subtotal		44.89	42.62	(5.06)
H.	Keyouqianqi District Heating Supply				
1	Base Cost				
	a. Civil Works	8.95	Cancelled		
	b. Equipment and Materials	16.49			
	c. Implementation Cost	3.93			
	d. Project Management	0.19			
2	Contingencies	2.95			
3	Financial Charges during Implementation	0.46			
	Subtotal	32.97			
I.	Kalaqin District Heating Supply				
1	Base Cost				
	a. Civil Works	2.79	Cancelled		
	b. Equipment and Materials	7.65			
	c. Implementation Cost	1.33			
	d. Project Management	0.09			
2	Contingencies	1.37			
3	Financial Charges during Implementation	0.54			
	Subtotal	13.76			
J.	Keyouqianqi Natural Gas				
1	Base Cost				
	a. Civil Works	5.29	Cancelled		
	b. Equipment and Materials	9.35			
	c. Implementation Cost	1.59			
	d. Project Management	0.1			
2	Contingencies	1.71			
3	Financial Charges during Implementation	0.31			
	Subtotal	18.36			
	Total Investment Cost				
1	Base Cost				
	a. Civil Works	88.82	130.51	94.75	6.68
	b. Equipment and Materials	171.19	205.26	185.35	8.27
	c. Implementation Cost	29.12	29.00	27.34	(6.11)
	d. Project Management	1.75	3.96	1.15	(34.29)
2	Contingencies	32.11	37.02	0	(100.00)
3	Financial Charges during Implementation	9.99	9.60	3.78	(62.16)
	Total	333.02	415.35	312.36	(6.20)

^a The base cost is the appraisal amount; in its absence the base cost is the revised amount.

Sources: Asian Development Bank and Inner Mongolia Autonomous Region Project Management Office.

DISBURSEMENT OF ADB LOAN PROCEEDS

Table A4.1: Annual and Cumulative Disbursements of ADB Loan Proceeds

Year	Annual Disbursements ^{a,b}		Cumulative Disbursements ^{a,b}	
	Amount (\$ million)	% of Total	Amount (\$ million)	% of Total
2011	0.19	0	0.19	0
2012	8.58	6	8.77	6
2013	17.25	13	26.02	19
2014	23.98	18	50.00	37
2015	19.68	14	69.68	51
2016	32.65	24	102.33	75
2017	19.62	14	121.95	90
2018	8.72	6	130.67	96
2019	5.46	4	136.13	100
Total	136.13	100	136.13	100

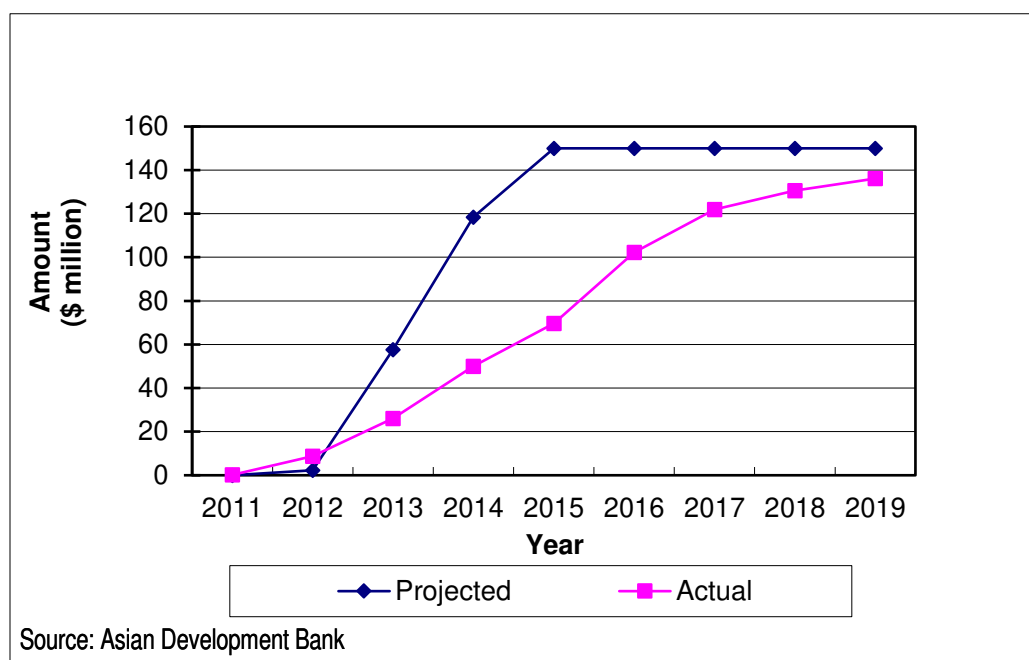
Note: Numbers may not sum up precisely because of rounding.

^a Classified by PCSS dates.

^b From eOps after actualization.

Source: Asian Development Bank.

Figure A4.1: Projection and Cumulative Disbursements of ADB Loan Proceeds (\$ million)



PROJECT IMPLEMENTATION SCHEDULE

[illegible]

[illegible]

[illegible]

DHS = district heating supply, HES = heat exchange station, SCADA = supervisory control and data acquisition system.

Source: Inner Mongolia Autonomous Region Project Management Office.

CHRONOLOGY OF MAJOR EVENTS

Date		Events
2008	15 Apr	Concept cleared
	5–19 May	Loan fact-finding mission conducted
	8 Jul	Management review meeting conducted
2009	15–18 Sep	Pre-appraisal mission conducted
	12 Nov	Staff review committee meeting conducted
2010	28–29 Jun	Loan negotiations conducted
	6 Aug	Loan approved
	20 Sep	Loan signed
	14–18 Oct	Loan inception mission fielded
2011	21 Feb	Loan effectiveness declared
2012	9 May	First ICB goods contract awarded
	30 May	First disbursement processed
	15 Oct	First NCB civil works contract awarded
2013	14 Mar	First NCB goods contract awarded
	8 Jul	Minor change in project scope and implementation arrangements, reallocation of loan proceeds, and the 1st loan closing extension approved
	24 Jul	Loan Agreement Amendment letter signed
	29 Jul–1 Aug	Loan handover/review mission conducted
	31 Oct	Loan administration delegated to PRCM
2014	24 Jun	Consulting services contract signed
	26 Jul–2 Aug	Loan mid-term review mission fielded
2016	21 Dec	Minor change in project scope and implementation arrangements, reallocation of loan proceeds, and the 2nd loan closing extension approved
2017	10 Feb	Loan Agreement Amendment letter signed
	27 Dec	The 3rd loan closing extension approved
2018	19–27 Nov	Loan completion review mission fielded
	31 Dec	Project completion/loan closing
2019	12 Aug	Final financial transaction
	22 Aug	Loan cancellation of \$13,871,113.62/Actual financial closing

ICB = international competitive bidding, NCB=national competitive bidding, PRCM=Asian Development Bank People's Republic of China Resident Mission.

Sources: Asian Development Bank and Inner Mongolia Autonomous Region Project Management Office.

CONTRACT AWARDS OF ADB LOAN PROCEEDS

Table A7.1: Annual and Cumulative Contract Awards of ADB Loan Proceeds

Year	Annual Contract Awards ^{a,b}		Cumulative Contract Awards ^{a,b}	
	Amount (\$ million)	% of Total	Amount (\$ million)	% of Total
2011	0.00	0	0.00	0
2012	33.00	25	33.00	25
2013	33.84	26	66.84	51
2014	8.12	6	74.96	57
2015	46.90	35	121.86	92
2016	5.45	4	127.31	96
2017	19.62	15	146.94	111
2018	0.00	0	146.94	111
2019	-14.59	-11	132.35	100
Total	132.35	100	132.35	100

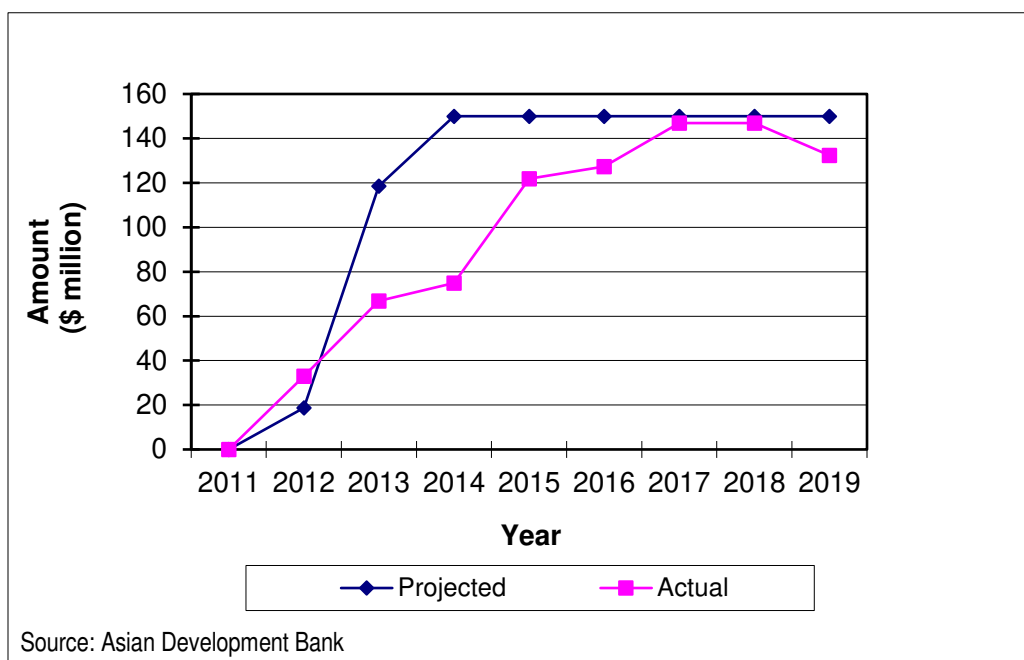
Note: Numbers may not sum up precisely because of rounding.

^a Classified by PCSS dates.

^b From eOps after actualization.

Source: Asian Development Bank.

Figure 7.1: Projection and Cumulative Contract Awards of ADB Loan Proceeds
(\$ million)



ADB-FINANCED CONTRACT PACKAGES

Contract No.	PCSS No.	Procurement Mode	Contract Description	Supplier Name	Contract Date	Contract Value (\$ Equivalent)	ADB Financing (\$ Equivalent)
BT-EP-01	0001	ICB	Pre-insulated Pipe and Fittings for New and Rehabilitated Pipeline	Beijing IST Machinery Engineer & Technology Co., Ltd.	09-May-12	\$7,991,635.30	\$5,300,973.37
ZLT-EP-01	0002	ICB	Boiler, Fan, Dust Removal Equipment	Beijing Brill Sanyou Technology Development Co., Ltd.	17-May-12	\$3,947,463.87	\$3,947,463.87
BT-EP-03	0003	ICB	Water Pumps, Heat Metering Device, SCADA and Distribution Frequency Converter	Beijing IST Machinery Engineering & Technology Co., Ltd.	15-Oct-12	\$5,124,049.11	\$5,124,049.11
BT-EP-04	0004	ICB	Water Pump, Frequency Converter Device Valves for The Existing Thermal Source	Beijing IST Machinery Engineering & Technology Co., Ltd.	16-Oct-12	\$2,759,469.40	\$2,759,469.40
BT-EP-02	0005	ICB	Automatic Heat Exchange Unit for New Thermal Power Station	CETC International Co., Ltd.	15-Sep-12	\$3,884,737.73	\$3,780,138.63
ZLT-EP-02	0006	ICB	DCS System and Electrical Equipment for Thermal Source Station	Beijing Brill Sanyou Technology Development Co., Ltd.	15-Oct-12	\$2,544,226.33	\$2,544,226.33
ZLT-CW-03	0007	NCB	Construction of Thermal Source Station	Beijing Hengjia Yongqin Science & Technology Development Co., Ltd.	15-Oct-12	\$6,055,737.75	\$3,204,757.22
ZLT-DHS-05	0008	NCB	Coal System, Slag System & Ash Handling System	Beijing Hengjia Yongqin Science & Technology Development Co., Ltd.	15-Oct-12	\$551,690.83	\$502,986.46
HHHT-EP-02	0009	ICB	Heat Exchange Unit Valves, Electrical Equipment and Control System in Area K	China National Automation Control System Corporation	14-Mar-13	\$5,219,135.18	\$5,219,135.18
HHHT-EP-03	0010	ICB	Boilers and accessories in Area F and G, Hohhot DHS	China National Precision Machinery Corporation		Cancelled	
HHHT-EP-05	0011	ICB	Heat Exchange Unit, Valves, Electrical Equipment and Control System in Area F And G	Tsinghua Tongfang Co., Ltd.	14-Mar-13	\$4,093,509.24	\$4,093,509.24
HHHT-EP-06	0012	ICB	Cement and Steel Products (1)	Merit Technologies, Inc. (Beijing)	14-Mar-13	\$3,598,701.81	\$405,626.68
CF-EP-02	0013	ICB	Ball Valves and Butterfly Valves	The Oriental Scientific Instrument Import Co., Ltd.	30-Mar-13	\$814,675.99	\$814,675.99
CF-EP-04	0014	ICB	Heat Exchange Unit, Electrical Equipment and Control System	Tsinghua Tongfang Co., Ltd.	20-Mar-13	\$4,256,611.90	\$4,256,611.90

ZLT-EP-04	0015	ICB	Procurement of Heat Exchange Unit (Zhalaite Banner Yindeer Town Heating)	Beijing Bril Sanyou Technology Development Co., Ltd.	30-May-13	\$1,828,407.45	\$610,253.00
	0016	Others	Project Management Support	Inner Mongolia Autonomous Region, Project Management Office	26-Aug-13	\$750,000.00	\$209,813.70
CF-EP-01	0017	ICB	Pre-insulated Pipe and Steel Pipe	China IPPR International Engineering Corporation	03-Sep-13	\$12,455,953.90	\$12,455,953.90
CF-EP-03	0018	ICB	Pipe Fitting, Filter and Ultrasonic Flow Meter	Tianjin Pipeline Engineering Group Co., Ltd.	22-Mar-13	\$716,790.95	\$716,790.95
HHHT-EP-04	0019	ICB	Hohhot District Heating Supply Subproject	Hubei Rich States Industry Investment Co Ltd.	08-Nov-13	\$7,123,076.89	\$7,122,486.53
CS01	0020	QCBS	Consulting Service for Inner Mongolia Autonomous Region Environmental Improvement Project (Phase II)	Energy and Environmental Development Research Center	24-Jun-14	\$997,640.00	\$913,841.66
AES-CW-03	0021	NCB	Civil Works of Aershan District Heating Supply Subproject	JV of China IPPR International Engineering Co., Ltd & Ulanhot Hongtu Construction Engineering Co., Ltd.	20-Feb-15	\$1,489,002.37	\$1,419,189.97
HHHT-EP-01	0022	ICB	Procurement of Pre-Insulated Pipe and Fittings in Area K Contract, Hohhot District Heating Subproject	Beijing IST Machinery Engineering & Technology Co., Ltd. and Jiangfeng Pipeline Group Co., Ltd.	08-May-15	\$2,849,981.14	\$2,849,981.14
AT-EP-01	0023	ICB	Supply and Installation of Boiler, Auxiliary Equipment and ECT for Aershan and Tuquan Component	Beijing Bril Sanyou Technology Development Co., Ltd.	08-Sep-15	\$6,712,294.94	\$6,087,053.28
AT-EP-02	0024	ICB	Supply and Installation of Boiler, Auxiliary Equipment and ECT for Aershan and Tuquan Component	Beijing Bril Sanyou Technology Development Co., Ltd.	08-Sep-15	\$5,928,694.93	\$5,375,982.64
AT-EP-03	0025	ICB	Procurement of Steel Pipes Under Aershan And Tuquan Components	Beijing Bril Sanyou Technology Development Co., Ltd.	08-Sep-15	\$7,593,770.26	\$6,886,420.30
AT-EP-04	0026	ICB	Procurement of Steel Pipes Under Aershan And Tuquan Components	Beijing Bril Sanyou Technology Development Co., Ltd.	08-Sep-15	\$3,646,492.97	\$3,306,542.69
AT-EP-05	0027	NCB	Procurement of Engineering Vehicles Under Aershan And Tuquan Components	Yishang Innovation Technology Co., Ltd.	08-Sep-15	\$609,277.42	\$552,482.63

CF-EP-05	0028	ICB	Prefabricated Insulating Pipe and Pipe Fitting Contract Under Chifeng District Heating Component	Hebei Gaosheng Thermal Insulation Anticorrosive Material Co., Ltd.	31-Aug-15	\$4,795,471.42	\$4,795,471.42
BT-EP-02	0029	ICB	Ball Valve and Butterfly Valve (2) For Chifeng District Heating Component	China National Scientific Instruments & Materials Corporation	28-Aug-15	\$1,627,100.56	\$1,627,100.56
CF-EP-07	0030	ICB	Prefabricated Insulating Pipe and Pipe Fitting (2) Contract under Chifeng District Heating Component	China National Scientific Instruments & Materials Corporation & Tianjin Zhonghao Insulation Engineering Co., Ltd.	28-Aug-15	\$7,908,800.07	\$7,908,800.07
CF-EP-08	0031	ICB	Heat Exchange Unit and Auto-Control Equipment Contract Under Chifeng District Heating Component	Tsinghua Tongfang Co., Ltd.	28-Aug-15	\$3,697,417.50	\$3,697,417.50
HHHT-EP-07	0032	ICB	Valve Equipment Procurement Contract Under Hohhot District Heating Subproject	JV of Yishang Innovation Technology Co. Ltd.	20-Aug-16	\$1,614,523.03	\$993,618.57
HHHT-EP-08	0033	ICB	Heat Exchange Unit and Control Equipment Procurement Contract	JV of China National Automation Control System Company and China IPPR International Engineering Co., Ltd.	01-Aug-16	\$3,824,425.37	\$3,824,425.37
HHHT-EP-09	0034	ICB	Prefabricated Insulation Pipe, Pipe Fitting and Steel Equipment Procurement Contract	Ogawa Seiki Co., Ltd.		Cancelled	
ZLT-EP-06	0035	ICB	Boiler, Desulfurization, Dedusting And Draught Fan etc. Equipment Procurement of Zhalaite	Beijing Bril Sanyou Technology Development Co., Ltd.	25-Aug-17	\$3,323,705.00	\$3,323,705.00
ZLT-EP-07	0036	ICB	Heat Exchange Unit Equipment Procurement Contract of Zhalaite	Beijing Bril Sanyou Technology Development Co., Ltd.	25-Aug-17	\$4,530,397.19	\$4,530,397.19
HHHT-EP-10	0037	ICB	Procurement of Goods Under Hohhot District Heating Supply Component (Heat Exchange Unit)	North China Power Engineering (Beijing) Co., Ltd.	25-Sep-17	\$3,504,160.45	\$2,835,825.46
HHHT-EP-09	0038	ICB	Prefabricated Insulation Pipe and Pipefitting Procurement Contract Under Hohhot District	North China Power Engineering (Beijing) Co., Ltd.	25-Oct-17	\$8,353,498.67	\$8,351,689.47
	0039	Others	Transaction Service Charges	Inner Mongolia Finance Department	25-Jul-19	\$20.00	\$20.00
Total							132,348,886.38

ICB=international competitive bidding, QCBS= quality-and cost-based selection.

Source: Asian Development Bank and Inner Mongolia Autonomous Region Project Management Office.

ENVIRONMENTAL IMPACT ANALYSIS

A. Introduction

1. The project mainly consisted of seven district heating supply subprojects in six cities/counties including Hohhot, Baotou, Chifeng, Zhalaite, Tuquan and Aershan (Table A9.1):

Table A9.1: Subprojects list

Sub-project	New Boiler (MW)	Heat transfer station	SCADA	Pipelines (km)	Small boilers disclosure	Heating area (million m ²)		Population coverage (thousands)
						Newly increase	transform	
Hohhot		92	2	110.37	144	5.964	4.41	240.00
Chifeng		151	1	54.16	37	12.48	0.65	561.50
Baotou		305	1	54.01	164	9.76	9.6	450.00
Zhalaite	116	29	1	24.10	37	1.78	0.44	57.79
Zhalaite Expansion	116	29	1	29.90	30	2.674		81.90
Aershan	42		1	14.00	34	0.4	0.21	15.00
Tuquan	205	6	1	49.34	36	2.59		80.00
Total	479	612	8	335.88	482	35.648	15.31	1,486.19

m² = square meter, MW = megawatt, km = kilometer

Sources: Asian Development Bank and Inner Mongolia Autonomous Region Project Management Office.

2. The project is classified as category B for environment in accordance with the Asian Development Bank (ADB) Environmental Assessment Guidelines (2003) and Environment Policy (2002). Ten separate domestic environmental impact assessment (EIA) reports were prepared by five local EIA institutes in accordance with the People's Republic of China (PRC) regulations and approved by local environmental protection bureaus (EPBs) in 2008. The summary initial environmental examination (SIEE) was prepared based on domestic EIAs and disclosed on ADB website in September 2008. In response to two minor changes in scope in 2013 and 2016 to accommodate new subprojects with original subprojects cancellation, the SIEE was updated twice in accordance with the ADB Safeguard Policy Statement (2009) and disclosed on ADB website in April 2013 and July 2016.

3. As required under national laws and regulations of the PRC, all subprojects were reviewed through the environment protection completion audit by the local EPBs in 2018-2019. The demolition of small boilers was carried out in accordance with the applicable environmental and safety standards of the PRC.

B. Institutional Setup and Environmental Management

4. The Government of Inner Mongolia Autonomous Region had overall responsibility for ensuring the environmental management plan (EMP) was implemented in accordance with the domestic environment impact assessments and SIEE. The project management office (PMO) was established in the Inner Mongolia Provincial Development and Reform Commission and was responsible for managing, coordinating, and supervising EMP implementation. A grievance redress committee was established inside the PMO. Each project implementing agency (PIA) established an environmental management unit responsible for implementation and monitoring of the EMP during subproject construction and operation. The PMO designated environmental staff to coordinate with each environmental management unit, and oversee EMP implementation and monitoring for all subprojects, with assistance from the consultant engaged.

5. During the construction phase, all contractors kept regular construction records, and prepared progress reports that were submitted to the PIAs. The monitoring of external environment is carried out by qualified monitoring units entrusted by the owners of each subproject. Environmental monitoring was carried out with specific monitoring frequency, time, parameters and monitoring procedures in the project area, according to the environmental impact assessment and environmental management plan in the designated location. During operations, the PIAs were responsible for implementing the mitigation measures contained in the domestic environment impact assessment and SIEE; and reported to provincial and municipal environment protection bureaus and the PMO. Due to delay in external environment monitoring agency mobilization, the PMO only submitted five environmental monitoring reports to ADB, at twice per year during construction and once per year for 2 years following completion of construction from 2016. Public opinion surveys in six subproject areas at completion indicated that people were generally satisfied with project performance during construction and operation, and that no formal complaint was received during project implementation.

C. Environmental Impacts and Mitigation Measures Undertaken

6. The SIEE contained information on likely environmental impacts, mitigation measures, and monitoring requirements during construction and operation. The responsible parties carried out all mitigation measures needed to reduce adverse environmental impacts in accordance with the SIEE. Table A9.2 presents the implementation status of mitigation measures during construction and operation.

Table A9.2: Environmental impacts, mitigation measures, and implementation status

Issue	Major Impacts, Mitigation Measures, and Monitoring Frequency	Responsible party
Construction Phase		
Soil erosion	Temporary soil stockpiles were covered, excavated trenches re-compacted, sediment fences installed to minimize sediment runoff, and disturbed surfaces revegetated to minimize erosion. Implementation of soil erosion mitigation measures was monitored by the EMUs and construction supervision companies.	Contractors, construction supervision companies and EMUs, Complied with.
Soil contamination by hazardous waste and materials, including hydrocarbons	All hazardous and non-hazardous waste from subproject construction and demolition of small, inner-city coal-fired boilers was collected, stored onsite in designated storage facilities, and transported offsite to approved disposal facilities. Spill cleanup equipment was provided. No contaminated land legacy issues due to demolition of small coal-fired boilers were reported. Implementation of soil pollution prevention measures was monitored by the EMUs and construction supervision companies.	Contractors, construction supervision companies, EMUs, and local EPBs. Complied with.
Water	To mitigate siltation of water bodies and dispose of wastewater appropriately, (i) sediment fences were installed to minimize sediment runoff, (ii) wastewater was treated using septic tanks, and (iii) all construction equipment washdown areas were fitted with water collection basins equipped with oil separators and sediment traps. Implementation of wastewater mitigation measures was monitored by the EMUs and construction supervision companies.	Contractors, construction supervision companies, EMUs, and local EPBs. Complied with.
Air quality	To mitigate generation and emission of dust from construction machinery, transportation routes and material handling sites were sprayed with water, and materials were covered during transportation. Local EPBs confirmed that the air quality of subproject construction sites met the Grade II air quality standard (GB3095-2012). Implementation of air pollution mitigation measures was monitored by the EMUs, construction supervision companies, and the local EPBs.	Contractors, construction supervision companies, EMUs, and local EPBs. Complied with.

Issue	Major Impacts, Mitigation Measures, and Monitoring Frequency	Responsible party
Noise	Construction-related noise from vehicles and construction machinery did not exceed noise levels in the Emission Standard of Environmental Noise for Boundary of Construction Site (GB12523-2011). Construction works were prohibited between 7 pm and 6 am. Implementation of noise mitigation measures monitored by EMU, construction supervision companies, and local EPBs.	Contractors, construction supervision companies, EMUs, and local EPBs. Complied with.
Operation phase		
District Heating	The heat source plants were completed with (i) some 80 meters of high stacks to minimize direct impacts on adjacent areas, (ii) filter baghouse emission control systems with 95%-98% efficiency, and (iii) dual alkali flue gas desulfurization scrubbers with more than 85% efficiency. Each subproject was also equipped with soundproof covers and walls for noise mitigation, and coal and fly- ash stockyards with clay and synthetic liners to avoid groundwater contamination. All industrial wastewater was fully recycled, without discharge outside, excluding seasonal tail wastewater from desulfurization unit further treated by local wastewater treatment plant. Domestic wastewater was collected and pretreated by septic tank before being discharged into municipal network. Each subproject prepared and is implementing an operations manual that includes spraying water on coal and fly- ash, and covering coal yards to minimize airborne dust dispersion. Wastewater is used for water spraying. All coal stove ash and slag were fully sold out and 100% recycled for building material. The heat source plants under Part A fully complied with the Emission standard of air pollutants for boiler (GB13271-2014). Hourly emission monitoring from each heat source plant is required. Currently all heat source plants under Part A are equipped with emission monitoring devices that are also connected to the environment monitoring system of local EPBs.	EMUs and local EPBs Complied with. Reported annual emission from the constructed heat plants were below the government and the EHS guideline standard maximum emission values.

EHS = Environment, Health and Safety, EMUs=Environment Management Unit, EPB=Environmental Protection Bureau.

7. All project components were constructed and are operated in accordance with the EMP. The total actual cost of environmental protection measures at completion was CNY13.904 million, including CNY937,100 of environmental monitoring cost. Monitoring stations to measure annual emissions from newly installed boilers under the project were installed around the heating plants and the surrounding residential quarters and are linked with the air quality monitoring system under local EPBs. Emissions of particulate matter smaller than 10 micrometers (PM₁₀), sulfur dioxide (SO₂), and nitrogen oxide (NO_x) from newly installed boilers were measured and verified by local EPBs, and the results met *Emission standard of air pollutants for boiler* (GB13271-2014).

D. Environmental Benefits

8. As of December 2018, the environmental benefits generated by the implementation of the project are: annual reduction of fossil fuel consumption by 851,000 tons of raw coal; annual reduction of carbon dioxide (CO₂) by 1.365 million tons; annual reduction of SO₂ by 12,137 tons; annual reduction of 17,947 tons of total suspended particulates (TSP); and annual reduction of NO_x by 3,845 tons (Table A9.3).

Table A9.3: Environmental Benefits Statistics

No.	Location	Coal Reduction ('000 tons of raw coal)	CO ₂ reduction ('000 tons)	SO ₂ reduction (ton)	TSP Reduction (ton)	NOx Reduction (ton)
1	Hohhot	164	263	2,336	3,454	740
2	Baotou	203	325	2,892	4,276	916
3	Chifeng	265	424	3,775	5,582	1,196
4	Zhalaite	103	165	1,467	2,170	465
5	Tuquan	106	170	1,510	2,233	478
6	Aershan	11	18	157	232	50
	Total	852	1,365	12,137	17,947	3,845

CO₂= carbon dioxide, NOx= nitrogen oxides, SO₂=sulfur dioxide, TSP=total suspended particulates.

Sources: Asian Development Bank and Inner Mongolia Autonomous Region Project Management Office.

9. At appraisal, air quality in the subproject urban areas in Hohhot and Kalaqin exceeded category II of the PRC Ambient Air Quality Standards¹ for particulate matter. The World Bank standards for ambient air quality are exceeded for SO₂ in Chifeng and Baotou and for TSP in Hohhot, Chifeng, and Baotou. The major pollutants are SO₂ and TSP from numerous small, inefficient, domestic and industrial coal-fired boilers. Background ambient noise levels in subproject areas are within category II of the PRC's Environmental Noise Standard of Urban Area (GB3096-1993). This project serves as important part of these subproject city/county governments' initiatives combatting Beijing-Tianjin-Hebei regional air pollution.

E. Conclusion

10. The project met the initial objectives and delivered substantial environmental benefits to improve ambient air quality in targeted areas of Inner Mongolia Autonomous Region in PRC. Environmental management and associated mitigation measures were properly implemented during construction and operation. Environment monitoring was implemented by environmental management units of the PMO and each PIA. No environmental complaints were received during construction and operation.

STATUS OF COMPLIANCE WITH LOAN COVENANTS

Covenant	Reference in Legal Agreement	Status of Compliance
<p>(a) The Borrower shall cause GIMAR, and shall ensure that GIMAR causes the PIAs, to carry out the Project with due diligence and efficiency and in conformity with sound administrative, financial, engineering, environmental, heating supply, and gas transmission and distribution practices.</p> <p>(b) In the carrying out of the Project and operation of the Project facilities, the Borrower shall perform, or cause to be performed, all obligations set forth in Schedule 5 to this Loan Agreement and the Schedule to the Project Agreement.</p>	<p>LA, Art. IV, Section 4.01</p> <p>PA, Art. II, Section 2.01</p>	<p>Complied with.</p> <p>The GIMAR fulfilled its obligations of the covenant for implementation of the project.</p>
<p>The Borrower shall make available to GIMAR, and through GIMAR, the Participating Municipal Governments and/or the County Governments to each concerned PIA, promptly as needed and on terms and conditions acceptable to ADB, the funds, facilities, services, land and other resources which are required, in addition to the proceeds of the Loan, for the carrying out of the Project.</p>	<p>LA, Art. IV, Section 4.02</p> <p>PA, Art. II, Section 2.02</p>	<p>Complied with.</p> <p>The required funds, facilities, services, land and other resources were generally provided in a timely manner.</p>
<p>The Borrower shall ensure that the activities of its departments and agencies with respect to the carrying out of the Project and operation of the Project facilities are conducted and coordinated in accordance with sound administrative policies and procedures.</p>	<p>LA, Art. IV, Section 4.03</p>	<p>Complied with.</p> <p>The PIAs implemented the project in accordance with sound administration procedures.</p>
<p>The Borrower shall take all actions which shall be necessary on its part to enable GIMAR to perform its obligations under the Project Agreement and shall not take or permit any action which would interfere with the performance of such obligations.</p>	<p>LA, Art. IV, Section 4.04</p>	<p>Complied with.</p> <p>Compliance was confirmed in progress reports.</p>
<p>(a) The Borrower shall cause GIMAR to exercise its rights under the Subsidiary Loan Agreement in such a manner as to protect the interests of the Borrower and ADB and to accomplish the purposes of the Loan. The Borrower shall cause GIMAR to ensure that the Participating Municipal Governments, County Governments and PIAs exercise their respective rights under the Municipality Onlending Agreements, the County Onlending Agreements and the PIA Onlending Agreements, respectively, in each case, in such a manner as to protect the interests of the Borrower and ADB and to accomplish the purposes of the Loan.</p> <p>(b) The Borrower shall cause GIMAR to ensure that no rights or obligations under the Subsidiary Loan Agreement, and the Onlending Agreements shall be assigned, amended, abrogated or waived without the prior concurrence of ADB.</p>	<p>LA, Art. IV, Section 4.05</p>	<p>Complied with.</p> <p>Compliance was confirmed in progress reports.</p>
<p><u>Retroactive Financing</u></p> <p>Withdrawals from the Loan Account may be made for reimbursement of reasonable expenditures incurred under the Project before the Effective Date, but not earlier than 12 months before the date of this Loan Agreement in connection with procurement of Goods, Works, and Consulting Services, subject to a maximum amount equivalent to 20% of the Loan amount.</p>	<p>LA, Schedule 3, para. 7</p>	<p>Not applicable. The project did not use retroactive financing.</p>

Covenant	Reference in Legal Agreement	Status of Compliance
<p><u>Condition of Withdrawals from Loan Account</u></p> <p>Notwithstanding any other provision of this Loan Agreement, no withdrawals shall be made from the Loan Account for the benefit of any PIA until the Borrower shall have certified to ADB, in form and substance satisfactory to ADB, that the PIA Onlending Agreement with such PIA, which shall include the terms and conditions as referred to in Section 3.01 of this Loan Agreement, shall have been duly executed and delivered on behalf of the Participating Municipal Government or County Government and the concerned PIA and shall have become fully effective and binding upon the parties thereto in accordance with its terms.</p>	LA, Schedule 3, para. 8	<p>Complied with.</p> <p>Onlending Agreement was fulfilled between the provincial finance department and participating local government.</p>
<p><u>Implementation Arrangements</u></p> <p>The Borrower and the GIMAR shall ensure that the Project is implemented in accordance with the detailed arrangements set forth in the PAM. Any subsequent change to the PAM shall become effective only after approval of such change by the Borrower and ADB. In the event of any discrepancy between the PAM and this Loan Agreement, the provisions of this Loan Agreement shall prevail.</p>	LA, Schedule 5, para. 1	<p>Complied with.</p> <p>The PMO was in place and functioned well during project implementation.</p>
<p><u>Counterpart Financing</u></p> <p>GIMAR shall ensure that all necessary financing (other than from the Loan proceeds) including equity contributions and local loans are provided on a timely basis to enable the full and timely completion of the Project. In the event of any shortfall or disruption in the financing of the Project due to, inter alia, the lack or inadequacy of funding of, or delay in financing by, or change of control within, any of the PIAs, GIMAR shall promptly inform the Borrower and ADB and provide additional funds as maybe necessary for successful implementation of the Project.</p>	<p>LA, Schedule 5, para. 2</p> <p>PA, Schedule, para. 1</p>	<p>Complied with.</p> <p>Counterpart funds were earmarked and generally provided on time for each subproject.</p>
<p>(a) In the carrying out of the Project, GIMAR shall, and shall cause the PIAs, to employ competent and qualified consultants and contractors, acceptable to ADB, to an extent and upon terms and conditions satisfactory to ADB.</p> <p>(b) Except as ADB may otherwise agree, all Goods, Works and Consulting Services to be financed out of the proceeds of the Loan shall be procured in accordance with the provisions of Schedule 4 to the Loan Agreement. ADB may refuse to finance a contract where Goods, Works or Consulting Services have not been procured under procedures substantially in accordance with those agreed between the Borrower and ADB or where the terms and conditions of the contract are not satisfactory to ADB.</p>	PA, Art. II, Section 2.03	<p>Complied with.</p> <p>PMO engaged implementation consulting firm using the quality- and cost-based selection procedure.</p> <p>All packages financed by ADB were procured in accordance with ADB's Procurement Guidelines and the provisions of schedule 4 of the Loan Agreement.</p>
<p>GIMAR shall, and shall cause the PIAs, to carry out the Project in accordance with plans, design standards, specifications, work schedules and construction methods acceptable to ADB. GIMAR shall furnish, or cause to be furnished, to ADB, promptly after their preparation, such plans, design standards, specifications and work schedules, and any material modifications subsequently made therein, in such detail as ADB shall reasonably request.</p>	PA, Art. II, Section 2.04	<p>Complied with.</p> <p>The project was carried out following the requirements, standards, technical specifications and met the PRC's construction quality criteria.</p>

Covenant	Reference in Legal Agreement	Status of Compliance
<p>(a) GIMAR shall, and shall cause the PIAs, to take out and maintain with responsible insurers, or make other arrangements satisfactory to ADB for, insurance of Project facilities to such extent and against such risks and in such amounts as shall be consistent with sound practice.</p> <p>(b) Without limiting the generality of the foregoing, GIMAR undertakes, and shall cause the PIAs, to insure, or cause to be insured, the Goods to be imported for the Project and to be financed out of the proceeds of the Loan against hazards incident to the acquisition, transportation and delivery thereof to the place of use or installation, and for such insurance any indemnity shall be payable in a currency freely usable to replace or repair such Goods.</p>	PA, Art. II, Section 2.05	<p>Complied with.</p> <p>Project facilities were insured with sound practice.</p>
GIMAR shall maintain, or cause the concerned PIA to maintain, records and accounts adequate to identify the Goods, Works and Consulting Services and other items of expenditure financed out of the proceeds of the Loan, to disclose the use thereof in the Project, to record the progress of the Project (including the cost thereof) and to reflect, in accordance with consistently maintained sound accounting principles, its operations and financial condition.	PA, Art. II, Section 2.06	<p>Complied with.</p> <p>The PMO submitted the required reports, audited project accounts and financial statements as stipulated in the Loan Agreement. ADB loan proceeds were utilized appropriately.</p>
<p>(a) ADB and GIMAR shall cooperate fully to ensure that the purposes of the Loan will be accomplished.</p> <p>(b) GIMAR shall promptly inform ADB of any condition which interferes with, or threatens to interfere with, the progress of the Project, the performance of its obligations under this Project Agreement, the Subsidiary Loan Agreement, or any Onlending Agreements, or the accomplishment of the purposes of the Loan.</p> <p>(c) ADB and GIMAR shall, and GIMAR shall enable ADB and the PIAs to, from time to time, at the request of either party, exchange views through their representatives with regard to any matters relating to the Project, GIMAR, any concerned PIA and the Loan.</p>	PA, Art. II, Section 2.07	<p>Complied with.</p> <p>Complied with. GIMAR fulfilled its obligations as stated in the covenant.</p> <p>Complied with. The PMO regularly reported project progress and issues to ADB the project leading group.</p>
<p>(a) GIMAR shall, and shall cause the PIAs to, furnish to ADB all such reports and information as ADB shall reasonably request concerning (i) the Loan and the expenditure of the proceeds thereof; (ii) the Goods, Works Consulting Services and other items of expenditure financed out of such proceeds; (iii) the Project; (iv) the administration, operations and financial condition of GIMAR and the concerned PIA; and (v) any other matters relating to the purposes of the Loan.</p> <p>(b) Without limiting the generality of the foregoing, GIMAR shall, and where required, shall cause the PIAs, to furnish to ADB (i) quarterly progress reports on Project implementation; (ii) 2 environmental monitoring reports every year; (iii) annual reports on resettlement and social objectives; and (iv) annual financial reports. Such reports shall be submitted in such form and in such detail and within such a period as ADB shall reasonably request, and shall indicate, among other things, progress made and problems encountered during the period under review, steps taken or proposed to be taken to remedy these problems, and proposed program of activities and expected progress during the following reporting period.</p> <p>(c) Promptly after physical completion of the Project, but in any event not later than 6 months thereafter or such later date as ADB may agree for this purpose, GIMAR shall prepare and furnish to ADB a report, in such form and in such detail as ADB shall reasonably request, on the execution and initial operation of the Project, including its cost, the performance by GIMAR of its obligations under this Project Agreement and the accomplishment of the purposes of the Loan.</p>	PA, Art. II, Section 2.08	<p>Complied with.</p> <p>The PMO submitted annual project financial statement audited by Inner Mongolia Autonomous Region Auditing Department in timely manner. The auditor issued unqualified auditor's opinion every year since 2012.</p> <p>The PMO provided progress reports to ADB on semi-annual basis.</p>

Covenant	Reference in Legal Agreement	Status of Compliance
<p>(a) GIMAR shall maintain separate accounts for the Project and shall cause the PIAs to maintain separate accounts for their respective subprojects. GIMAR shall, and shall cause the PIAs to, (i) have such accounts and related financial statements (balance sheet, statement of income and expenses, and related statements) audited annually, in accordance with appropriate auditing standards consistently applied, by independent auditors whose qualifications, experience and terms of reference are acceptable to ADB; and (ii) furnish to ADB, promptly after their preparation but in any event not later than 6 months after the close of the fiscal year to which they relate, certified copies of such audited accounts and financial statements and the report of the auditors relating thereto (including the auditors' opinion on the use of the Loan proceeds and compliance with the covenants of the Loan Agreement as well as a separate opinion on the use of the procedures for imprest account and statement of expenditures), all in the English language. GIMAR shall, and shall cause the PIAs to, furnish to ADB such further information concerning such accounts and financial statements and the audit thereof as ADB shall from time to time reasonably request.</p> <p>(b) GIMAR shall enable ADB, upon ADB's request, to discuss the financial statements maintained by GIMAR for the Project and any PIA's financial statements and their respective financial affairs from time to time with GIMAR's and PIAs' auditors, and shall authorize and require any representative of such auditors to participate in any such discussions requested by ADB, provided that any such discussion shall be conducted only in the presence of an authorized officer of GIMAR or the concerned PIA, unless GIMAR or concerned PIA shall otherwise agree.</p>	PA, Art. II, Section 2.09	<p>Complied with.</p> <p>The PMO maintained financial accounts effectively, which were audited as per the PA requirements. All audited reports were submitted on schedule. Annual audited project financial statements were submitted every year until the loan closing date.</p>
GIMAR shall enable ADB's representatives to inspect the Project, the Goods and Works financed out of the proceeds of the Loan, all other plants, sites, properties and equipment of the PIAs and any relevant records and documents.	PA, Art. II, Section 2.10	<p>Complied with.</p> <p>Satisfactory record and document management.</p>
<p>(a) GIMAR shall cause each PIA to promptly as required, take all action within its powers to maintain its corporate existence, to carry on its operations, and to acquire, maintain and renew all rights, properties, powers, privileges and franchises which are necessary in the carrying out of the Project or in the conduct of its business.</p> <p>(b) GIMAR shall ensure that each PIA at all times conduct its business in accordance with sound administrative, financial, environmental, heating supply, gas transmission and distribution, and utilization of geothermal resources practices, and under the supervision of competent and experienced management and personnel.</p> <p>(c) GIMAR shall ensure that each PIA at all times operate and maintain its plants, equipment and other property, and from time to time, promptly as needed, make all necessary repairs and renewals thereof, all in accordance with sound administrative, financial, engineering, environmental, heating supply, gas transmission and distribution, and maintenance and operational practices.</p>	PA, Art. II, Section 2.11	<p>Complied with.</p> <p>Proper maintenance of project facilities was in place.</p>
Except as ADB may otherwise agree, GIMAR shall not, and shall ensure that nor does PIA, sell, lease or otherwise dispose of any of its assets which shall be required for the efficient carrying on of its operations or the disposal of which may prejudice its ability to perform satisfactorily any of its obligations under this Project Agreement.	PA, Art. II, Section 2.12	Complied with.
Except as ADB may otherwise agree, GIMAR shall, and shall ensure that each PIA, apply the proceeds of the Loan to the financing of expenditures on the Project in accordance with the provisions of the Loan Agreement and this Project Agreement, and shall ensure that all Goods, Works and Consulting Services financed out of such proceeds are used exclusively in the carrying out of the Project.	PA, Art. II, Section 2.13	<p>Complied with.</p> <p>All loan proceeds were properly allocated to goods, works and consulting services.</p>

Covenant	Reference in Legal Agreement	Status of Compliance
Except as ADB may otherwise agree, GIMAR shall, and shall cause each PIA to, duly perform all its respective obligations under the Subsidiary Loan Agreement and the Onlending Agreements, and shall not take, or concur in, any action which would have the effect of assigning, amending, abrogating or waiving any rights or obligations of the parties under any such agreement.	PA, Art. II, Section 2.14	Complied with. Each PIA duly performed its respective obligations.
GIMAR shall cause the relevant PIA to promptly notify ADB of any proposal to amend, suspend or repeal any provision of its Charter and shall afford ADB an adequate opportunity to comment on such proposal prior to taking any action thereon.	PA, Art. II, Section 2.15	Complied with.
<p><u>Change in Ownership and Operation</u></p> <p>In the event of (a) any change in ownership of the Project facilities or (b) any sale, transfer or assignment of share or interest that results in change of control in any PIA is anticipated, GIMAR shall, and shall cause the PIA to, consult with ADB at least 6 months prior to the implementation of such change. GIMAR shall, and shall cause the PIA to, further ensure that the controlling management of the concerned PIA concurs with (a) all Project related agreements executed between ADB and the Borrower or GIMAR; and (b) policies of ADB relevant to the Project.</p>	PA, Schedule, para. 2	Complied with. Two scope changes were processed during project implementation, but no change in ownership of the project facilities occurred.
<p><u>Financial Performance of PIAs</u></p> <p>From the commencement of the commercial operations of the Project, GIMAR shall ensure that PIAs maintain (i) a debt service coverage ratio of at least 1.2 times; (ii) a current ratio of more than 1:1; and (iii) a debt-equity ratio of not more than 70:30.</p>	PA, Schedule, para. 3	Partly complied with. Except Zhalaite Xingda Heating Company, other PIAs did not satisfy the covenanted ratios. The main reasons include high debt ratios and the operating losses resulted from the low heat tariff, high coal costs, and low operational efficiency. The local governments have been providing subsidies to support these companies considering the nature of the project.
<p><u>Closure of Small Coal-fired Heat Boilers</u></p> <p>GIMAR shall ensure that the PIAs complete the closure of 383 small coal fired heating boilers identified for closure, in the subproject areas in IMAR, under the Project by the end of Project implementation. GIMAR shall further ensure that the said small coal-fired heat boilers are not re-used elsewhere.</p>	PA, Schedule, para. 4	Complied with. By project completion, PIAs completed the closure of 482 small coal fired heating boilers.
<p><u>Displaced Boiler Workers</u></p> <p>GIMAR shall ensure that all employees who lose their jobs due to closure of small Coal-fired heat boilers will be covered by, and dealt in accordance with, the labor restructuring plan, prepared for the Project and agreed between GIMAR and ADB. GIMAR shall further ensure that compliance with the labor restructuring plan is strictly monitored and reported to ADB.</p>	PA, Schedule, para. 5	Complied with. By project completion, the closure of inefficient small boilers affected 980 boiler workers. Reemployment of the affected boiler workers was arranged by each project implementing agency upon subproject completion.

Covenant	Reference in Legal Agreement	Status of Compliance
<p><u>Heating Assistance to the Poor</u></p> <p>GIMAR shall ensure that the Project areas maintain government-funded heating assistance programs to assist the poor to pay heating bills.</p>	PA, Schedule, para. 6	<p>Complied with.</p> <p>Heating assistance programs for the poor households have been implemented in Hohhot, Chifeng, Baotou, Zhalaite, Aershan and Tuquan by the local governments.</p>
<p><u>Project Review</u></p> <p>A midterm review of the Project shall be undertaken by GIMAR, PIAs and ADB in 2011, covering all institutional, administrative, organizational, technical, environmental, social, poverty reduction, resettlement, economic, financial, and other relevant aspects that may have an impact on the performance of the Project and its continuing viability. The review shall examine progress in sector reforms, and evaluate development and poverty impact, and compliance with covenants of the Loan and Project Agreements. The review shall also undertake a comprehensive review of potential Loan savings, identify areas for reallocation of Loan proceeds, and change disbursement percentages, as appropriate.</p>	PA, Schedule, para. 7	<p>Complied with.</p> <p>A midterm review mission was conducted in from 28 July to 1 August 2014 and covered all areas as stated in the covenant.</p>
<p><u>Anticorruption and Governance Measures</u></p> <p>GIMAR shall, and shall cause the PIAs to ensure that (i) Borrower's anticorruption laws and regulations and ADB's Anticorruption Policy, (1998, as amended to date), are strictly enforced and are being complied with during Project implementation, and that relevant provisions of ADB's Anticorruption Policy are included in all bidding documents for the Project, (ii) consultants are engaged promptly to provide assistance in procurement of Goods and services; (iii) full-time officials from the Finance Bureau of IMAR are involved for the supervision of bidding, construction, and operations, and conducting of periodic inspections of the contractors' activities related to fund withdrawals and settlements; and (iv) within 9 months from the Effective Date, establish a complaints unit to receive and resolve grievances or act upon stakeholders' reports or irregularities. The unit shall (i) review and address grievances of Project stakeholders; and (ii) set the threshold criteria and procedures for handling and proactively responding to grievances.</p>	PA, Schedule, para. 8	<p>Complied with.</p> <p>ADB Anti-Corruption requirements were complied with and incorporated into bidding documents. Domestic prevailing anti-corruption measures were adopted during project implementation.</p>
<p><u>Monitoring and Evaluation</u></p> <p>GIMAR shall monitor and evaluate Project impacts, with the assistance of consultants, as specified in the PPMS, to ensure that the Project facilities are managed effectively and the benefits, particularly to the poor, are maximized. GIMAR shall further ensure that (i) consultants for monitoring and evaluation are engaged; (ii) data collection from local governments to measure the indicators in the PPMS at the frequency specified in the PPMS is facilitated; and (iii) reports as detailed in the PPMS are submitted to ADB.</p>	PA, Schedule, para. 9	<p>Partially complied with.</p> <p>Due to delayed mobilization of project implementation consulting services, there was inadequate project management support during early project implementation. The PPMS was not established on time or operated effectively. There were delays in submitting the project progress and monitoring reports during early stages of project implementation.</p>
<p><u>Environment</u></p> <p>GIMAR shall ensure, and shall cause the PIAs to ensure, that (i) the Project is designed, constructed and operated in accordance with</p>	PA, Schedule, para. 10	<p>Partly complied with.</p> <p>Due to delayed mobilization of external</p>

Covenant	Reference in Legal Agreement	Status of Compliance
national and local government environmental laws, regulations, procedures and guidelines of the Borrower, the ADB Environment Policy (2002), and the SIEE; (ii) the boilers constructed under the Project comply with air emissions standards stipulated in the World Bank Pollution Prevention and Abatement Handbook, 1998; (iii) the environmental monitoring reports are submitted to ADB two times per year during construction and annually for 2 years during the operational period of the Project; and (iv) the Environmental Management Plan (mitigation measures, monitoring plan, and institutional arrangements), as set forth in the SIEE, is updated during the engineering design stage, and incorporated in the bidding documents and Works contracts.		environment monitoring agency, the PMO only submitted five environmental monitoring reports to ADB, at twice per year during construction and once per year for 2 years following completion of construction from 2016.
<p><u>Land Acquisition and Resettlement</u></p> <p>GIMAR shall ensure that (i) the RP for the Project is implemented in accordance with its terms; (ii) all land and rights-of-way required by the Project is made available in a timely manner; (iii) the provisions of the RP, including compensation and entitlements for AP, are implemented in accordance with all the Borrower's applicable laws and regulations and ADB's Involuntary Resettlement Policy (1995); (iv) compensation and resettlement assistance is given to the AP prior to dispossession and displacement; (v) the timely provision of counterpart funds is made for land acquisition and resettlement activities; (vi) any obligations in excess of the RP budget estimates are met; (vii) the AP are compensated in a manner that they are at least as well off as they would have been in the absence of the Project; (viii) the RP is updated upon completion of the detailed design and detailed measurement survey and submitted to ADB for approval prior to commencement of land acquisition; (ix) Works contract includes requirements to comply with the RP and entitlements for permanent and temporary impacts to AP; and (x) implementation of the RP is monitored, evaluated and reported to ADB.</p>	PA, Schedule, para. 11	<p>Complied with.</p> <p>Zhalaite DHS has impact on LAR in RP, while the remaining subprojects have no resettlement impacts as they were implemented on government-reserved land or existing premises. During implementation, Zhalaite DHS was constructed within the scope of original site without affecting the buildings of two private entities. At completion, the project has not induced land acquisition and resettlement impacts due to avoiding demolition of two private entities in Zhalaite DHS.</p>
<p><u>Gender and Development</u></p> <p>GIMAR shall ensure that the PIAs follow the principles of the ADB's Policy on Gender and Development (1998) during implementation of the Project, including taking all necessary actions to encourage women living in the Project area to participate in planning and implementing Project activities. GIMAR, in coordination with the appropriate agencies, shall ensure the effective implementation of measures aimed at increasing project benefits and impacts on women in and around the Project area.</p>	PA, Schedule, para. 12	<p>Complied with.</p> <p>Women have benefited more from the project while the environmental impacts have a disproportionately high impact on women who take more responsibility for household activities such as collecting fuel and operating household heating.</p>
<p><u>Health and Social Risks</u></p> <p>GIMAR shall ensure that the PIAs, together with the appropriate government authorities, require contractors employed under the Project to disseminate information (in local languages) on the risks of sexually-transmitted infections, including HIV/AIDS, in health and safety programs to those employed during Project implementation. Specific provisions to this effect shall be included in bidding documents and Works contracts, and compliance shall be strictly monitored by GIMAR and the PIAs.</p>	PA, Schedule, para. 13	<p>Complied with.</p> <p>Information was disseminated with support of contractors.</p>

Covenant	Reference in Legal Agreement	Status of Compliance
<p><u>Labor and Employment</u></p> <p>GIMAR shall, and shall cause the PIAs to ensure, that the construction contractors (i) follow all applicable labor laws and regulations of the Borrower; and (ii) do not employ child labor as required by the relevant laws and regulations of the Borrower. GIMAR shall further ensure that specific clauses concerning compliance with labor and employment laws are included in bidding documents.</p>	<p>PA, Schedule, para. 14</p>	<p>Complied with.</p> <p>Specific provisions on compliance with labor and employment laws have been included in the bidding documents. By project completion, no violations were reported.</p>

ADB=Asian Development Bank, Art=article, AP=affected person, DHS=district heating supply, GIMAR=Government of Inner Mongolia Autonomous Region, LA=loan agreement, PA=project agreement, PAM=project administration manual, PIA=project implementation agency, PPMS=project performance management system, PRC=People's Republic of China, RP=resettlement plan, SIEE=summary initial environmental examination.

ECONOMIC REEVALUATION

1. The project constructed seven district heating supply (DHS) subprojects in cities of Hohhot, Baotou, Chifeng, Zhalaite, Tuquan and Aershan respectively in Inner Mongolia Autonomous Region (IMAR). The economic reevaluation was undertaken for these subprojects respectively, as well as the whole project. Compared with the original project scope, two DHS subprojects in Kalaqin and Keyouqian and the NGS subproject in Output B in the original project scope were cancelled, three new DHS subprojects in Aershan, Tuquan, and Zhalaite were included; and the DHS subproject in Hohhot was revised. The analysis followed the same methodologies and major assumptions as at appraisal in accordance with ADB's *Guidelines for the Economic Analysis of Project* (2017).¹

A. Methodology and Basic Assumptions

2. Incremental costs and benefits are estimated by comparing with-project and without-project scenarios for each subproject and the project as a whole. Basic assumptions used in the economic analysis include:

- (i) The project life is assumed 25 years, including an implementation period of 3-7 years and an operating period of 20 years. The residual value at the end of the project life is assumed to be zero. The project capital costs are expressed in the prices of the year that they were actually incurred. Costs and revenues after project completion are expressed in constant 2019 prices;
- (ii) Financial prices were converted to economic prices by excluding transfer payments such as taxes and duties, and applying a standard conversion factor of 0.987 on the non-traded costs and benefits, and a shadow wage rate of 0.67 on unskilled labor;
- (iii) The updated economic prices per ton of emissions are CNY57 per ton for carbon dioxide (CO₂), and CNY1,200 per ton for sulfur dioxide (SO₂), nitrogen oxides (NO_x), and suspended particulates (TSP) respectively. These values are based on the latest trading values in PRC.² These values reflect the economic price of respective emissions;
- (iv) Following the value suggested by the Guidelines for the Economic Analysis of Projects (footnote 1), i.e., \$36.30 per ton of CO₂ in 2016 prices and escalated by 2.0% annually in real terms to 2019, the cost for carbon dioxide is CNY273.5 per ton. This value is used for another version of the results in view of the global impact of carbon reduction;
- (v) The threshold rate for the economic internal rate of return (EIRR) at appraisal was 12%, which is adopted as the discount rate.

B. Economic Costs

3. The capital costs of district heating include costs related to boilers, pipelines, heat exchange stations, other associated costs, and physical contingency. The financial capital costs are converted to the relevant economic values after deducting taxes, subsidies, and price contingencies, then applying the respective conversion factors as specified above. The operation and maintenance (O&M) costs comprising of costs for maintenance, raw materials, energy inputs, salaries, overhead, and administration expenses were provided by each project implementing agencies. The unit O&M costs remain constant in real terms throughout the lifespan of each subproject.

¹ ADB. 2017. *Guidelines for the Economic Analysis of Projects*. Manila.

² The values for SO₂, NO_x, and TSP are comparable with the economic values of emissions used in the recent PRC project (Air Quality Improvement in the Greater Beijing-Tianjin-Hebei Region- Henan Cleaner Fuel Switch Investment Program).

C. Economic Benefits

4. The economic benefits for the district heating subprojects include (i) improvements in energy efficiency in the existing heating area due to coal savings after conversion from small boilers and single-family stoves to large boilers, multiplied by the economic coal price; (ii) incremental heating revenues (proxy to willingness to pay) due to expansion of the district heating area; and (iii) environmental benefits, which are reflected in the reduction of environmental costs from the new boilers relative to the old boiler system (the baseline scenario). The relative project outputs at completion by subproject are provided in Table A11.1.

Table A11.1: Project Outputs at Completion

Sub-project	New Capabilities	Heat transfer station	Pipeline Length	Demolition of Small Boilers	Heating Area		Population Benefited
					New Area	Upgraded Area	
	(MW)	No.	(km)	No.	(million m ²)		(000)
Hohhot DHS		92	110.37	144	5.96	4.41	240.00
Chifeng DHS		151	54.16	37	12.48	0.65	561.50
Baotou DHS		305	54.01	164	9.76	9.60	450.00
Zhalaite DHS	116	29	24.10	37	1.78	0.44	57.79
Zhalaite DHS Expansion	116	29	29.90	30	2.67		81.90
Aershan DHS	42	0	14.00	34	0.40	0.21	15.00
Tuquan DHS	205	6	49.34	36	2.59		80.00
Total	479	612	335.88	482	35.64	15.31	1,486.19

DHS = district heating supply, km = kilometer, m² = square meter, MW = megawatt

Source: EA's Project Completion Report.

D. Results of the Economic Analysis

5. Economic internal rates of returns (EIRRs) were computed to re-examine the economic viability of the five subprojects and the consolidated seven subprojects at the completion. The overall project economic analysis was based on an aggregation of the economic benefits and economic costs of seven subprojects. Table A11.2 shows the EIRR for all the subprojects at the completion as compared with those at appraisal and whole project at the completion.

TABLE A11.2: Summary of Economic Internal Rates of Return

Subprojects	EIRR with Environmental Benefits (%)		
	At Appraisal	At Completion (with National Carbon Dioxide Price)	At Completion (with International Carbon Dioxide Price)
Hohhot DHS	25.7	9.6	30.5
Chifeng DHS	31.5	22.8	31.1
Baotou DHS	27.6	15.1	25.5
Zhalaite DHS	-	15.1	18.9
Zhalaite DHS Expansion	-	16.1	26.7
Aershan DHS	-	1.9	11.4
Tuquan DHS	-	8.2	20.7
Whole Project	27.6	15.7	

DHS = district heating supply, EIRR = economic internal rate of return.

Sources: Report and recommendation of the President, executing agency's Project Completion Report and ADB estimates.

6. The EIRRs of the individual subprojects at the completion ranged from 1.9% to 22.8% with environment benefits with national carbon price. The consolidated EIRR for the whole project was 15.7%. The Chifeng, Baotou, Zhalaite, and the Zhalaite expansion subprojects, as well as the overall project are economically viable as they indicated EIRR higher than the threshold rate. Other subprojects are not viable. With the international carbon price, the EIRR results ranged from 11.4% to 31.1%. The benefits and costs of the whole project and subprojects are in Table A11.3 and Table A11.4.

Table A11.3: Economic Analysis of Whole Project
(CNY million)

Year	Capital Costs	O&M	Economic Benefits	Environmental Benefits	Net Benefit
2012	188.43	160.93	253.32	4.20	(91.85)
2013	279.98	245.58	256.53	11.24	(257.79)
2014	192.72	556.47	674.32	24.50	(50.36)
2015	299.10	714.43	710.93	33.50	(269.10)
2016	345.64	850.73	849.72	47.55	(299.09)
2017	319.79	796.94	940.40	58.22	(118.11)
2018	97.20	972.80	1,231.48	86.84	248.32
2019	283.83	1,036.59	1,234.44	94.65	8.67
2020		1,036.59	1,234.44	94.65	292.50
2021		1,036.59	1,234.44	94.65	391.43
2022		1,036.59	1,234.44	94.65	292.50
2023		1,036.59	1,234.44	94.65	292.50
2024		1,036.59	1,235.60	95.04	294.06
2025		1,036.59	1,235.60	95.04	294.06
2026		1,036.59	1,235.60	95.04	294.06
2027		1,036.59	1,235.60	95.04	294.06
2028		1,036.59	1,235.60	95.04	294.06
2029		1,036.59	1,235.60	95.04	294.06
2030		1,036.59	1,235.60	95.04	294.06
2031		1,036.59	1,235.60	95.04	294.06
2032		1,036.59	1,235.60	95.04	294.06
2033		1,036.59	1,235.60	95.04	294.06
2034		1,036.59	1,235.60	95.04	294.06
2035		1,036.59	1,235.60	95.04	294.06
2036		616.76	763.73	67.04	214.01
2037		129.15	180.17	18.56	69.58
2038		129.15	182.89	18.56	72.30
EIRR (without environmental benefits)					9.3%
(with environmental benefits)					15.7%
ENPV (without environmental benefits)					(188.7)
(with environmental benefits)					269.7

() = negative, CNY = yuan, EIRR = economic internal rate of return, ENPV = economic net present value, O&M = operation and maintenance.

Sources: Executing Agency's Project Completion Report and Asian Development Bank estimates.

Table A11.4: Economic Analysis of Subprojects
(CNY million)

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Hohhot DHS																											
Capital Costs		13.82	17.57	45.98	11.20	94.08	47.30	118.66																			
O&M Costs				211.39	255.76	226.44	258.59	229.25	229.25	229.25	229.25	229.25	229.25	229.25	229.25	229.25	229.25	229.25	229.25	229.25	229.25	229.25	229.25	229.25	229.25	229.25	
Economic Benefits				213.32	277.49	242.34	292.34	237.49	237.49	237.49	237.49	237.49	237.49	237.49	237.49	237.49	237.49	237.49	237.49	237.49	237.49	237.49	237.49	237.49	237.49	237.49	
Environmental Benefits		0.00	0.00	11.85	15.94	16.45	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	
Net Benefits		-13.82	-17.57	-32.21	26.47	-61.73	4.98	-91.89	26.77	26.77	26.77	26.77	26.77	26.77	26.77	26.77	26.77	26.77	26.77	26.77	26.77	26.77	26.77	26.77	26.77	26.77	
Chifeng DHS																											
Capital Costs		115.68	79.99	59.59	114.65	150.56	26.72	17.69																			
O&M Costs		15.34	33.68	93.69	126.45	186.29	245.62	258.36	258.36	258.36	258.36	258.36	258.36	258.36	258.36	258.36	258.36	258.36	258.36	258.36	258.36	258.36	258.36	258.36	258.36	258.36	
Economic Benefits		19.29	44.63	117.54	162.33	244.87	346.00	346.06	346.06	346.06	346.06	346.06	346.06	346.06	346.06	346.06	346.06	346.06	346.06	346.06	346.06	346.06	346.06	346.06	346.06	346.06	
Environmental Benefits		1.07	2.59	5.28	9.34	14.48	29.96	29.96	29.96	29.96	29.96	29.96	29.96	29.96	29.96	29.96	29.96	29.96	29.96	29.96	29.96	29.96	29.96	29.96	29.96	29.96	
Net Benefits		-110.65	-66.45	-30.47	-69.44	-77.51	103.62	99.97	117.66	117.66	117.66	117.66	117.66	117.66	117.66	117.66	117.66	117.66	117.66	117.66	117.66	117.66	117.66	117.66	117.66	117.66	
Baotou DHS																											
Capital Costs	159.62	101.13	81.19	60.35	1.43	3.23	12.17	0.22																			
O&M Costs	160.93	230.25	522.79	390.92	426.07	339.33	338.90	369.21	369.21	369.21	369.21	369.21	369.21	369.21	369.21	369.21	369.21	369.21	369.21	369.21	369.21	369.21	369.21	369.21	369.21	369.21	
Economic Benefits	253.32	237.24	629.69	350.71	348.61	384.78	395.78	396.43	396.43	396.43	396.43	396.43	396.43	396.43	396.43	396.43	396.43	396.43	396.43	396.43	396.43	396.43	396.43	396.43	396.43	396.43	
Environmental Benefits	4.20	10.17	21.91	14.92	18.41	22.79	22.98	22.98	22.98	22.98	22.98	22.98	22.98	22.98	22.98	22.98	22.98	22.98	22.98	22.98	22.98	22.98	22.98	22.98	22.98	22.98	
Net Benefits	-63.03	-83.97	47.63	-85.64	-60.48	65.01	67.69	49.97	50.20	50.20	50.20	50.20	50.20	50.20	50.20	50.20	50.20	50.20	50.20	50.20	50.20	50.20	50.20	50.20	50.20	50.20	
Zhalaithe DHS																											
Capital Costs	28.81	49.35	13.97	37.51	32.45	0.00	0.29	0.13																			
O&M Costs				18.43	42.45	44.87	50.31	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	
Economic Benefits				29.37	61.30	68.42	75.33	75.45	75.45	75.45	75.45	75.45	75.45	75.45	75.45	75.45	75.45	75.45	75.45	75.45	75.45	75.45	75.45	75.45	75.45	75.45	
Environmental Benefits				1.46	3.87	4.51	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	5.02	
Net Benefits	-28.81	-49.35	-13.97	-25.11	-9.74	28.05	29.75	29.72	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	29.85	
Zhalaithe DHS Expansion																											
Capital Costs				52.91	58.86	67.60	7.99	56.38																			
O&M Costs							51.91	52.22	52.22	52.22	52.22	52.22	52.22	52.22	52.22	52.22	52.22	52.22	52.22	52.22	52.22	52.22	52.22	52.22	52.22	52.22	52.22
Economic Benefits							90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09	90.09
Environmental Benefits							5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18
Net Benefits				-52.91	-58.86	-67.60	35.37	-13.33	43.05	43.05	43.05	43.05	43.05	43.05	43.05	43.05	43.05	43.05	43.05	43.05	43.05	43.05	43.05	43.05	43.05	43.05	43.05
Aershan DHS																											
Capital Costs				12.90	31.31	1.07	1.32	11.21																			
O&M Costs								19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19
Economic Benefits								19.77	19.77	19.77	19.77	19.77	20.93	20.93	20.93	20.93	20.93	20.93	20.93	20.93	20.93	20.93	20.93	20.93	20.93	20.93	23.65
Environmental Benefits								1.81	1.81	1.81	1.81	1.81	1.81	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
Net Benefits	0.00	0.00	0.00	-12.90	-31.31	-1.07	-1.32	-8.82	2.39	2.39	2.39	2.39	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	6.67
Tuquan DHS																											
Capital Costs				29.87	95.72	3.25	1.42	79.54																			
O&M Costs							27.46	57.74	57.74	57.74	57.74	57.74	57.74	57.74	57.74	57.74	57.74	57.74	57.74	57.74	57.74	57.74	57.74	57.74	57.74	57.74	57.74
Economic Benefits							31.93	69.15	69.15	69.15	69.15	69.15	69.15	69.15	69.15	69.15	69.15	69.15	69.15	69.15	69.15	69.15	69.15	69.15	69.15	69.15	69.15
Environmental Benefits							5.18	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17
Net Benefits				-29.87	-95.72	-3.25	8.23	-56.95	22.59	22.59	22.59	22.59	22.59	22.59	22.59	22.59	22.59	22.59	22.59	22.59	22.59	22.59	22.59	22.59	22.59	22.59	22.59

DHS=district heating supply

Sources: Executing agency's Project Completion Report and Asian Development Bank estimates.

7. The sensitivity analysis tested the robustness of the economic viability of the subprojects and whole project, using three scenarios: (i) a 10% benefit decline, (ii) a 10% O&M cost increase, and (iii) a combination of both. The analysis shows that Chifeng and Zhalaite DHS expansion subprojects will remain viable in the scenario of benefit decline of 10% or O&M cost increase of 10%. The whole project and other subprojects are very sensitive to any negative changes indicating limited robustness in their economic viability. The results are provided in Table A11.5.

Table A11.5: EIRR Results of Sensitivity Analysis (%)

Subproject	Base Case	O&M +10%	Benefit -10%	O&M +10% Benefit -10%
Hohhot DHS	9.6	-	-	-
Chifeng DHS	22.8	18.2	15.8	10.8
Baotou DHS	15.1	12.5	10.0	-
Zhalaite DHS	15.1	12.3	10.6	7.3
Zhalaite DHS Expansion	16.1	14.0	12.1	9.7
Aershan DHS	1.9	-	-	-
Tuquan DHS	8.2	-	-	-
Whole Project	15.7	7.5	6.0	-

DHS = district heating supply, EIRR = economic internal rate of return, O&M= operation and maintenance cost, “-“ refers to negative values.

Sources: Executing agency's Project Completion Report and Asian Development Bank estimates.

FINANCIAL REEVALUATION

1. Financial reevaluation was conducted on the revenue-generating subprojects under the project, including seven district central heating subprojects in cities of Hohhot, Baotou, Chifeng, Zhalaite, Tuquan and Aershan in Inner Mongolia Autonomous Region (IMAR).

A. Methodology and Major Assumptions

2. The financial reevaluation for the seven subprojects and overall project was carried out by applying the same methodologies and major assumptions at appraisal. The analysis was in accordance with the Guidelines on Financial Management and Analysis of Projects of the Asian Development Bank (ADB). The specific assumptions applied in the analysis are as follows:

- (i) Financial viability was assessed by calculating individual financial internal rate of return (FIRR) of each subproject. The weighted average cost of capital (WACC) of each subproject re-estimated based on the actual capital costs and funding sources was used as the benchmark to determine the financial viability and as the discount rate to estimate the financial net present value (FNPV);
- (ii) Subproject FIRRs were based on project incremental revenues derived from heating tariff charges and incremental costs incurred in subproject investment and operation and maintenance. A projection period of 25 years including the construction period was assumed with no residual value;
- (iii) The capital investments were derived from the project actual expenditures incurred during the project implementation period. The project costs were expressed in the prices of the year that they were actual incurred. Costs and revenues after project completion were expressed in constant 2019 prices. The capital cost, incremental revenue income, and operation and maintenance (O&M) costs were provided by project implementing agencies (PIAs);
- (iv) No increase in tariffs in real terms was assumed;
- (v) All subprojects achieved full capacity by the heating season of 2019-2020;
- (vi) Subproject-specific FIRRs are calculated after taxes. The income tax rate is assumed at 25%;
- (vii) Sensitivity analysis has been undertaken to assess the impact of potential adverse changes in operating costs and revenues.

B. Weighted Average Costs of Capital

3. The WACC of subproject was recalculated with the actual funding sources of ADB loans, local government funds, equity contributions, and domestic bank borrowings. The cost of the ADB loan was based on the London interbank offered rate on 10-year fixed-rate swap at the time of project completion plus a loan spread of 0.20% per annum. The cost of equity was assumed to be 8.0% per annum, and the cost of domestic borrowing was 5.80% per annum. The resulting WACCs of subprojects were from 2.79% to 4.36% and the aggregated WACC was 3.75% as compared with 3.60% estimated at appraisal. The changes in WACC were due to higher ADB loan interest rate, different capital composition, and higher equity input under some subprojects.

C. Results of the Financial Reevaluation

4. FIRR for the seven subprojects ranged from -7.83% to 9.74%, while FIRR for overall project was 2.31%. FIRRs for Baotou and Tuquan subprojects exceeded the WACCs indicating their financial viability. Other subprojects and the whole project registered FIRR lower than their respective WACC, indicating lack of financial viability. This was mainly due to the higher O&M costs, longer construction period, and lower tariff prevailing at completion than those anticipated at appraisal. Table 12.1 shows the results of WACC and FIRR in comparison with the appraisal estimates. Consolidated cash flows of all subprojects are shown in Table 12.2. The cashflow of individual subprojects are provided in Table 12.3.

Table A12.1: Financial Reevaluation Results

Subproject	At Appraisal ^a			At Completion		
	WACC (%)	FIRR (%)	FNPV (CNY million)	WACC (%)	FIRR (%)	FNPV (CNY million)
Hohhot DHS	1.81	6.25	274.45	3.10	-7.38	-190.55
Baotou DHS	2.16	6.81	100.74	3.90	9.74	213.62
Chifeng DHS	2.58	7.42	277.79	3.85	1.12	-128.54
Tuquan DHS	2.36	9.68	236.8	3.68	2.44	-46.88
Aershan DHS	1.40	8.83	67.99	2.79	-3.34	-31.81
Zhalaite DHS	2.31	6.63	64.52	3.88	3.17	-26.00
Zhalaite DHS Expansion	3.43	10.19	177.83	4.36	0.48	-83.53
Overall Project	3.60	7.40	1,200.12	3.75	2.31	-231.22

DHS = district heating supply, FIRR = financial internal rates of return, FNPV = financial net present value, WACC = weighted average cost of capital,

^a including values of subprojects resulted from scope changes during implementation, DHS = district heating supply.

Sources: Report and recommendation of the President, executing agency's Project Completion Report, and Asian Development Bank estimates.

Table A12.2: Financial Internal Rate of Return for the Whole Project
(CNY million)

Year	Capital Costs	Revenues	O&M Costs	Income Tax	Net Cash Flow
2012	222.44	229.10	164.74	15.43	(173.51)
2013	329.91	283.67	249.57	7.52	(303.33)
2014	226.40	709.25	565.74	30.36	(113.26)
2015	354.26	773.16	726.07	4.44	(311.60)
2016	411.43	898.33	864.89	8.76	(386.75)
2017	375.75	938.61	810.27	19.33	(266.74)
2018	113.73	1,188.51	990.75	28.39	55.64
2019	335.64	1,199.61	1,056.63	9.56	(202.22)
2020		1,199.61	1,056.63	8.92	134.06
2021		1,199.61	1,056.63	9.04	133.94
2022		1,199.61	1,056.63	9.18	133.80
2023		1,199.61	1,056.63	9.33	133.65
2024		1,199.61	1,056.63	9.49	133.49
2025		1,199.61	1,056.63	9.67	133.31
2026		1,199.61	1,056.63	9.87	133.11
2027		1,199.61	1,056.63	10.09	132.89
2028		1,199.61	1,056.63	10.34	132.64
2029		1,199.61	1,056.63	10.60	132.38
2030		1,199.61	1,056.63	10.90	132.08
2031		1,199.61	1,056.63	11.23	131.76
2032		1,199.61	1,056.63	12.25	130.73
2033		1,199.61	1,056.63	14.05	128.93
2034		1,199.61	1,056.63	18.99	123.99
2035		1,199.61	1,056.63	20.46	122.52
2036		776.47	681.68	9.94	84.86
2037		235.19	186.59	5.41	43.19
2038		235.19	186.59	8.68	39.92
FIRR					2.31%
WACC					3.75%

() = negative, CNY = yuan, FIRR = financial internal rate of return, WACC = weighted average cost of capital, O&M = operation and maintenance.

Sources: Executing agency's project completion report and Asian Development Bank estimates.

Table A12.3: Cashflows of Individual Subprojects
(CNY million)

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Hohhot DHS																											
Capital Costs		16.04	20.39	53.35	13.00	109.17	54.89	137.69																			
Revenues				226.48	285.38	246.28	295.38	240.67	240.67	240.67	240.67	240.67	240.67	240.67	240.67	240.67	240.67	240.67	240.67	240.67	240.67	240.67	240.67	240.67	240.67	240.67	240.67
O&M Costs				214.67	259.80	229.94	262.62	232.69	232.69	232.69	232.69	232.69	232.69	232.69	232.69	232.69	232.69	232.69	232.69	232.69	232.69	232.69	232.69	232.69	232.69	232.69	232.69
Income Tax				2.95	6.40	4.08	5.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net Cashflows		-16.04	-20.39	-44.50	6.19	-96.91	-27.36	-129.71	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98
Chifeng DHS																											
Capital Costs		135.51	93.70	69.80	134.30	176.36	31.30	20.72																			
Revenues		16.97	39.13	102.47	141.15	211.40	299.69	300.61	300.61	300.61	300.61	300.61	300.61	300.61	300.61	300.61	300.61	300.61	300.61	300.61	300.61	300.61	300.61	300.61	300.61	300.61	
O&M Costs		15.58	34.22	95.19	128.48	189.24	249.52	262.39	262.39	262.39	262.39	262.39	262.39	262.39	262.39	262.39	262.39	262.39	262.39	262.39	262.39	262.39	262.39	262.39	262.39	262.39	
Income Tax		0.00	0.00	0.00	0.00	0.00	5.98	0.86	0.91	0.96	1.01	1.08	1.14	1.22	1.30	1.40	1.50	1.61	1.73	1.87	2.02	3.59	4.62	4.74	5.81		
Net Cashflows		-134.12	-88.79	-62.52	-121.63	-154.20	12.88	16.64	37.32	37.26	37.21	37.14	37.08	37.00	36.92	36.82	36.72	36.61	36.49	36.35	36.20	34.63	33.60	33.48	32.41		
Baotou DHS																											
Capital Costs	187.74	118.94	95.49	70.98	1.68	3.80	14.31	0.26																			
Revenues	229.10	266.70	670.11	418.23	418.23	420.64	421.87	423.13	423.13	423.13	423.13	423.13	423.13	423.13	423.13	423.13	423.13	423.13	423.13	423.13	423.13	423.13	423.13	423.13	423.13	423.13	
O&M Costs	164.74	233.99	531.52	397.11	432.72	344.76	344.28	374.95	374.95	374.95	374.95	374.95	374.95	374.95	374.95	374.95	374.95	374.95	374.95	374.95	374.95	374.95	374.95	374.95	374.95	374.95	
Income Tax	15.43	7.52	30.36	0.00	0.00	13.17	13.48	6.13	5.40	5.42	5.45	5.47	5.51	5.54	5.58	5.62	5.67	5.72	5.77	5.83	6.56	6.64	10.36	11.59			
Net Cashflows	-138.81	-93.74	12.74	-49.86	-16.18	58.90	49.80	41.80	42.79	42.76	42.74	42.71	42.68	42.64	42.60	42.56	42.52	42.47	42.41	42.35	41.62	41.54	37.83	36.59			
Zhalaithe DHS																											
Capital Costs	34.70	59.43	16.83	45.17	39.08	0.00	0.35	0.16																			
Revenues		25.98	53.57	60.31	66.81	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	67.01	
O&M Costs		19.10	43.89	46.33	51.94	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	52.27	
Income Tax		1.48	2.37	2.08	2.16	1.94	1.95	1.96	1.98	2.00	2.02	2.04	2.06	2.09	2.12	2.15	2.18	2.22	2.26	2.31	2.37	2.41	2.41	3.69	3.69		
Net Cashflows	-34.70	-59.43	-16.83	-39.77	-31.77	11.90	12.35	12.81	12.79	12.78	12.76	12.75	12.73	12.70	12.68	12.65	12.63	12.59	12.56	12.52	12.48	12.43	12.37	12.34	12.34	11.06	11.06
Zhalaithe DHS Expansion																											
Capital Costs				63.57	70.74	81.23	9.60	67.75																			
Revenues							68.92	69.13	69.13	69.13	69.13	69.13	69.13	69.13	69.13	69.13	69.13	69.13	69.13	69.13	69.13	69.13	69.13	69.13	69.13	69.13	
O&M Costs							53.59	53.93	53.93	53.93	53.93	53.93	53.93	53.93	53.93	53.93	53.93	53.93	53.93	53.93	53.93	53.93	53.93	53.93	53.93	53.93	
Income Tax							0.50	0.17	0.18	0.19	0.21	0.22	0.23	0.25	0.27	0.29	0.31	0.34	0.36	0.39	0.43	0.46	0.51	0.53	0.53	3.80	
Net Cashflows				-63.57	-70.74	-81.23	5.23	-52.72	15.02	15.01	15.00	14.98	14.97	14.95	14.93	14.91	14.89	14.87	14.84	14.81	14.78	14.74	14.70	14.67	14.67	11.40	
Aershan DHS																											
Capital Costs			15.47	37.55	1.29	1.58	13.44																				
Revenues							21.62	21.62	21.62	21.62	21.62	21.62	21.62	21.62	21.62	21.62	21.62	21.62	21.62	21.62	21.62	21.62	21.62	21.62	21.62	21.62	
O&M Costs							19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	
Income Tax							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Net Cashflows				-15.47	-37.55	-1.29	-1.58	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	
Tuquan DHS																											
Capital Costs		2.4%																									
Revenues			35.91	115.08	3.91	1.71	95.62																				
O&M Costs							35.84	77.42	77.42	77.42	77.42	77.42	77.42	77.42	77.42	77.42	77.42	77.42	77.42	77.42	77.42	77.42	77.42	77.42	77.42	77.42	
Income Tax							28.79	60.55	60.55	60.55	60.55	60.55	60.55	60.55	60.55	60.55	60.55	60.55	60.55	60.55	60.55	60.55	60.55	60.55	60.55	60.55	
Net Cashflows			-35.91	-115.08	-3.91	4.32	-79.22	16.39	16.37	16.34	16.31	16.28	16.25	16.21	16.17	16.13	16.08	16.03	15.97	15.90	15.83	15.74	15.68	15.68	15.68	15.68	

DHS = district heating supply

Sources: Executing agency's project completion report and Asian Development Bank estimates.

5. Sensitivity analysis tested three scenarios: (i) revenues decrease by 10%; (iii) O&M costs increase by 10%; and (iii) combination of (i) and (ii). The resulting FIRR indicated that except Baotou subproject, in most scenarios the subprojects and the project as a whole will not be viable. Table A12.4 summarizes the sensitivity analysis.

Table A12.4: Sensitivity Analysis on FIRR

Subproject	WACC	FIRR (%)			
		Base Case	Revenue -10% (i)	O&M Cost +10% (ii)	Combined (i) and (ii)
Hohhot DHS	3.10	-7.38	-8.99	-	-
Baotou DHS	3.90	9.74	7.58	1.81	-
Chifeng DHS	3.85	1.12	0.47	-2.77	-
Tuquan DHS	3.68	2.44	1.60	0.53	-
Aershan DHS	2.79	-3.34	-	-	-
Zhalaite DHS	3.88	3.17	2.23	1.37	-
Zhalaite DHS Expansion	4.36	0.48	-0.44	-1.41	-
Overall Project	3.75	2.31	-	-	-

(-) refers to no value or negative values, DHS = district heating supply, FIRR = financial internal rate of return, O&M = operation and maintenance, WACC = weighted average cost of capital.

Source: Asian Development Bank estimates.

D. Financial Performance of Project Implementing Agencies

6. According to the Project Agreement, from the commencement of the commercial operations of the Project, project implementing agencies (PIAs) shall maintain (i) a debt service coverage ratio of at least 1.2 times; (ii) a current ratio of more than 1:1; and (iii) a debt-equity ratio of not more than 70:30. Table A12.5 shows these ratios based on the entity financial statements of fiscal years of 2016-2018.

Table A12.5: Summary Financial Statements and Key Ratios of PIAs

PIAs	2016	2017	2018
Hohhot Futai Heating Supply			
Summary Financial Statements in CNY			
Current Assets	441,310,360.70	486,482,178.69	803,861,432.41
Non-current Assets	935,816,664.91	991,864,730.08	1,013,522,452.95
Current Liabilities	851,083,297.93	902,068,527.37	578,152,394.63
Long Term Liabilities	228,976,673.78	307,190,678.75	817,387,774.41
Equity	297,067,053.90	269,087,702.65	421,843,716.32
Operating Revenue	388,625,976.90	421,226,722.16	447,290,342.68
Operating Costs	371,849,197.23	385,087,262.49	420,151,150.39
Net Income	(16,037,077.83)	(25,827,287.78)	(42,015,577.65)
Financial Ratios			
Current Ratio	0.52	0.54	1.39
Debt-to-equity Ratio	78:22	82:18	77:23
DSCR	0.46	0.42	0.14
Baotou Municipal Heating Supply Company			
Summary Financial Statements in CNY			
Current Assets	767,922,823.15	405,406,526.54	517,496,285.47
Non-current Assets	1,249,829,445.96	1,436,851,935.38	1,384,436,262.27
Current Liabilities	681,129,692.40	540,183,025.45	698,855,563.74
Long Term Liabilities	730,957,054.45	546,991,930.69	491,359,496.76
Equity	605,665,522.26	755,083,505.78	711,717,487.24
Operating Income	563,291,076.49	691,555,681.25	708,568,783.21
Operating Costs	592,683,287.09	577,300,919.33	593,819,426.26
Net Income	(50,354,068.20)	5,693,892.69	(25,323,493.21)
Financial Ratios			
Current Ratio	1.13	0.75	0.74
Debt-to-equity Ratio	70:30	59:41	63:37
DSCR	0.75	0.31	1.11
Zhaqi Xingda Heating Company			
Summary Financial Statements in CNY			
Current Assets	334,246,961.23	399,744,884.37	294,087,784.76
Non-current Assets	58,086,646.48	77,241,645.93	207,143,881.89
Current Liabilities	196,185,279.30	220,076,376.36	198,513,308.33
Long Term Liabilities	20,000,000.00	29,513,600.00	34,333,600.00
Equity	176,148,328.41	227,396,553.94	268,384,858.32
Operating Income	91,499,901.37	133,413,366.74	139,015,902.71
Operating Costs	62,338,820.90	86,392,916.57	92,783,510.07
Net Income	11,470,624.34	20,167,266.54	30,988,304.38
Financial Ratios			
Current Ratio	1.70	1.82	1.48
Debt-to-equity Ratio	55:45	52:48	46:54
DSCR	1.71	0.41	2.63

Tuquan Xinguang Heating Company			
Summary Financial Statements in CNY			
Current Assets	242,618,507.98	281,670,887.46	320,399,832.15
Non-current Assets	189,601,365.92	188,395,905.76	187,474,374.45
Current Liabilities	382,557,428.75	414,256,183.65	333,905,669.96
Long Term Liabilities	1,100,000.00	5,090,000.00	123,090,000.00
Equity	48,562,445.15	50,720,609.57	50,878,536.64
Operating Income	60,166,817.79	63,699,597.59	65,886,562.98
Operating Costs	60,942,514.61	67,308,899.23	68,871,005.06
Net Income	490,378.60	1,018,164.42	157,927.07
Financial Ratios			
Current Ratio	0.63	0.68	0.96
Debt-to-equity Ratio	89:11	89:11	90:10
DSCR	0.84	-1.95	-5.50
Chifeng Fulong Heating Supply			
Summary Financial Statements in CNY			
Current Assets	967,037,223.34	891,628,514.15	1,256,211,888.23
Non-current Assets	721,747,588.51	966,897,579.58	1,035,693,686.33
Current Liabilities	694,434,961.84	602,638,552.97	926,454,393.20
Long Term Liabilities	531,275,494.13	755,874,261.33	959,153,008.50
Equity	463,074,355.88	500,013,279.43	406,298,172.86
Operating Income	424,160,281.81	468,881,642.91	531,828,126.67
Operating Costs	375,460,524.31	403,992,133.14	429,632,290.31
Net Income	5,644,023.14	35,264,503.94	34,004,770.49
Financial Ratios			
Current Ratio	1.39	1.48	1.36
Debt-to-equity Ratio	73:27	73:27	82:18
DSCR	-0.52	0.29	0.67
Aershan Xinguang Heating Company			
Summary Financial Statements in CNY			
Current Assets	16,020,609.19	14,454,848.50	14,956,001.82
Non-current Assets	7,225,634.30	6,221,720.04	5,187,337.23
Current Liabilities	15,643,023.76	12,916,274.39	12,210,300.48
Long Term Liabilities	5,000,000.00	5,000,000.00	5,000,000.00
Equity	2,603,219.73	2,760,294.15	2,933,038.57
Operating Income	21,384,735.60	21,036,455.86	22,037,455.86
Operating Costs	20,252,062.64	20,079,875.70	21,076,845.70
Net Income	123,942.56	157,074.42	172,744.42
Financial Ratios			
Current Ratio	1.02	1.12	1.22
Debt-to-equity Ratio	89:11	87:13	85:15
DSCR	-	-	-

Sources: Project implementing agencies.

7. Except Zhalaite Xingda Heating Company, other PIAs did not satisfy the ratios as stated in the covenants. The main reasons include high debt ratios and the operating losses resulted from the low heat tariff, high coal costs, and low operational efficiency. It is noted the local governments have been providing subsidies to support these companies considering the nature of the project. It is recommended that local governments should timely review the heat tariff as compared with the operating costs of heating supply companies and initiate tariff adjustment appropriately to ensure cost recovery as well as debt payment.