



Completion Report

Project Number: 39019-013
Loan Number: 2260
September 2017

People's Republic of China: Inner Mongolia Autonomous Region Environment Improvement Project

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Asian Development Bank

CURRENCY EQUIVALENTS

Currency Unit – yuan (CNY)

		At Appraisal (03 April 2006)	At Project Completion (31 January 2016)
CNY1.00	=	\$0.1247	\$0.1521
\$1.00	=	CNY8.0172	CNY6.5754

ABBREVIATIONS

ADB	–	Asian Development Bank
CFB	–	circulating fluidized bed
CNG	–	compressed natural gas
CO ₂	–	carbon dioxide
EIRR	–	economic internal rate of return
EMP	–	environmental management plan
EMR	–	environmental monitoring report
FIRR	–	financial internal rate of return
GDP	–	gross domestic product
GIMAR	–	government of Inner Mongolia Autonomous Region
IEE	–	initial environmental examination
IMAR	–	Inner Mongolia Autonomous Region
LAR	–	land acquisition and resettlement
NO _x	–	nitrogen oxide
O&M	–	operation and maintenance
PIA	–	project implementing agency
PMO	–	project management office
PPMS	–	project performance management system
PPTA	–	project preparatory technical assistance
PRC	–	People's Republic of China
SO ₂	–	sulfur dioxide
TSP	–	total suspended particulates

WEIGHTS AND MEASURES

km	–	kilometer
m	–	meter
m ²	–	square meter
m ³	–	cubic meter
mu	–	666.67 square meters
mg	–	milligram
MW	–	megawatt
ton	–	1,000 kg
µg	–	microgram

NOTE

In this report, "\$" refers to US dollars and “tons” refers to metric tons.

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BASIC DATA

A. Loan Identification

1.	Country	People's Republic of China
2.	Loan Number	2260-PRC
3.	Project Title	Inner Mongolia Autonomous Region Environment Improvement Project
4.	Borrower	People's Republic of China
5.	Executing Agency	Government of Inner Mongolia Autonomous Region (GIMAR)
6.	Amount of Loan	\$120 million
7.	Project Completion Report Number	1664

B. Loan Data

1.	Appraisal	
	– Date Started	17 March 2006
	– Date Completed	03 April 2006
2.	Loan Negotiations	
	– Date Started	21 August 2006
	– Date Completed	23 August 2006
3.	Date of Board Approval	29 September 2006
4.	Date of Loan Agreement	16 May 2007
5.	Date of Loan Effectiveness	
	– In Loan Agreement	14 August 2007
	– Actual	24 September 2007
	– Number of Extensions	1
6.	Closing Date	
	– In Loan Agreement	31 December 2011
	– Actual	21 July 2016
	– Number of Extensions	3
7.	Terms of Loan	
	– Interest Rate	London interbank offered rate (LIBOR)-based
	– Maturity (number of years)	25-year term
	– Grace Period (number of years)	5 years
8.	Terms of Relending (if any)	
	– Interest Rate	LIBOR-based
	– Maturity (number of years)	25-year term
	– Grace Period (number of years)	5 years
	– Second-Step Borrower	GIMAR

9.	Disbursements												
a.	Dates												
	<table><tr><th>Initial Disbursement</th><th>Final Disbursement</th><th>Time Interval</th></tr><tr><td>19 December 2008</td><td>7 June 2016</td><td>90 months</td></tr><tr><td>Effective Date</td><td>Original Closing Date</td><td>Time Interval</td></tr><tr><td>24 September 2007</td><td>31 December 2011</td><td>51 months</td></tr></table>	Initial Disbursement	Final Disbursement	Time Interval	19 December 2008	7 June 2016	90 months	Effective Date	Original Closing Date	Time Interval	24 September 2007	31 December 2011	51 months
Initial Disbursement	Final Disbursement	Time Interval											
19 December 2008	7 June 2016	90 months											
Effective Date	Original Closing Date	Time Interval											
24 September 2007	31 December 2011	51 months											

b. Amount (\$ million)

Category or Subloan ^a	Original Allocation	Last Revised Allocation	Amount Canceled	Net Amount Available	Amount Disbursed	Undisbursed Balance ^b
01	7.450	0.000	0.000	0.000	0.000	0.000
02	99.810	112.920	0.000	112.920	110.770	2.150
03	2.200	1.160	0.000	1.160	1.156	0.004
04	10.540	5.920	0.000	5.920	5.920	0.000
Total	120.000	120.000	0.000	120.000	117.846	2.154

^a 01 = works, 02 = equipment and materials, 03 = consulting services for institutional strengthening and project management support, 04 = interest and commitment charge.

^b The undisbursed balance of \$2,153,432.96 was cancelled at loan closing.

10.	Local Costs (Financed)	
-	Amount (\$)	0
-	Percent of Local Costs	0%
-	Percent of Total Cost	0%

C. Project Data

1. Project Cost (\$ million)

Cost	Appraisal Estimate	Actual
Foreign Exchange Cost	135.25	117.8
Local Currency Cost	195.16	223.1
Total	330.41	340.9

2. Financing Plan (\$ million)

Funding Source	Appraisal		Actual	
	Total (\$ million)	%	Total (\$ million)	%
A. Equity				
Inner Mongolia Western Gas Limited	55.77	16.88	44.82	13.14
Inner Mongolia Saiwaixing HuaZhang Paper Limited	18.84	5.70	10.40	3.05
Wulatehouqi Water Company	3.52	1.07	3.35	0.98
Baiyannur Fuyuan Shiye Group Limited	30.72	9.30	30.47	8.94
Wulatehouqi Huibao Thermal Limited	6.45	1.95	6.71	1.97
Wuhai Thermal Co.	41.51	12.56	13.42	3.94
Inner Mongolia Haosheng Thermal Limited	14.88	4.50	14.11	4.17
Wulatezhongqi Dagong Thermal Limited	3.74	1.13	3.08	0.90
Bayannur Yangguang Energy Group Limited	0	0.00	38.30	11.23
Subtotal	175.43	53.10	164.78	48.29
B. Loan				
Asian Development Bank	120.00	36.32	117.84	34.56
Local Banks	34.97	10.58	58.35	17.11
Subtotal	154.97	46.90	176.19	51.67
Total	330.40	100.00	340.97	100.00

3. Cost Breakdown by Project Component (\$ million)

Component	Appraisal Estimate			Actual		
	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost
I. Base Costs	109.5	148.3	257.8	111.6	207.7	319.3
A. Urban Central Heating Component	57.2	88.3	145.5	71.6	149.8	221.3
A1. Dengkou Central Heating Supply	4.5	5.2	9.7		11.5	11.5
A2. Hangjinhouqi Central Heating Supply	12.6	12.1	24.7	12.1	15.5	27.6
A3. Linhe Central Heating Supply	10.5	11.0	21.5	46.9	57.5	104.4
A4. Wuhai City Central Heating Supply	10.2	36.9	47.1	12.5	14.5	27.0
A5. Wulatehouqi Central Heating Supply	4.2	5.6	9.8		11.7	11.7
A6. Wulateqianqi Central Heating Supply	5.1	5.8	10.9		13.0	13.0
A7. Wulatezhongqi Central Heating Supply	3.1	3.9	7.1		8.4	8.4
A8. Wuyuan Central Heating Supply	7.0	7.7	14.8		17.6	17.6
B. Natural Gas Transmission and Distribution	43.6	45.1	88.8	40.0	53.3	93.3
B1. Chang–Wu–Lin Gas Transmission	18.3	21.1	49.4	16.4	19.2	35.5
B2. Gas Distribution and CNG Station	25.4	24.0	39.4	23.6	34.1	57.7
C. City Wastewater Treatment Component	8.7	14.9	23.6		4.7	4.7
C1. Wulatehouqi Wastewater Treatment	1.9	3.5	5.3		4.7	
C2. Wulateqianqi Wastewater Treatment	6.8	11.5	18.3			
D. Institutional Reform and Corporate Governance Improvement	0.6		0.6	0.3		0.3
Subtotal (I)	110.1	148.3	258.4	111.9	207.7	319.6
II. Contingencies	14.6	19.7	34.4			
III. Financial Charges	10.6	27.1	37.6	5.9	15.4	21.4
Total (I+II+III)	135.3	195.2	330.4	117.8	223.1	341.0

4. Project Schedule

Item	Appraisal Estimate	Actual
Date of Contract with Consultants		
Institutional Strengthening	December 2006	August 2008
Project Implementation Supervision	July 2006	August 2008
Completion of Engineering Designs		January 2011
Civil Works Contract		
Date of Award	June 2008	January 2009
Completion of Work	December 2011	November 2015
Equipment and Supplies		
First Procurement	August 2007	December 2008
Last Procurement	December 2007	May 2014
Completion of Equipment Installation	December 2009	November 2015
Start of Operations		
Completion of Tests and Commissioning		November 2009
Beginning of Startup		October 2010
Completion of Land Acquisition and Resettlement		December 2014

5. Project Performance Report Ratings

Implementation Period	Ratings	
	Development Objectives	Implementation Progress
From 29 September 2006 to 31 August 2007	Satisfactory	Satisfactory
From 01 September 2007 to 31 August 2008	Satisfactory	Highly satisfactory
From 01 September 2008 to 31 December 2010	Satisfactory	Satisfactory
From Q2 2011 to Q3 2016	On Track	

Q = quarter

D. Data on Asian Development Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-Days	Specialization of Members
Loan fact-finding	8–25 November 2005	6	88	a, b, c, d, e, f
Appraisal	17 March–3 April 2006	6	43	a, b, c, d, e, f
Loan negotiations	21–23 August 2006	3	9	b, f, g
Special loan administration	7–9 February 2007	2	6	b, h
Inception	8–14 April 2007	3	17	b, d, e
Procurement/Disbursement	30–31 August 2007	3	6	h, i, j
Review	21–26 September 2008	4	21	b, d, h, k
Review	27 October 2008	1	1	b
Review	25–26 February 2009	1	2	b
Review	10 February 2010	2	2	b, k,
Review	19–21 April 2010	4	12	b, c, e, h
Review	13–15 June 2011	1	3	c
Midterm review	September 18–28 2011	2	19	c, e
Special loan administration	22–23 October 2012	1	2	c
Review	29 July–1 August 2013	6	24	c, d, h, h. i, d
Review	9–13 September 2014	3	13	c, d, h
Review	26–30 January 2015	1	5	c
Project completion review	20–22 April 2016	2	6	c, h

a = principal economist, b = financial specialist, c = energy specialist, d = environment specialist, e = social development specialist, f = counsel, g = programs officer, h = project officer, i = procurement officer, j = controllers officer, k = director, l = project analyst.

I. PROJECT DESCRIPTION

1. The Inner Mongolia Autonomous Region (IMAR) of the Peoples' Republic of China (PRC) has been heavily dependent on coal, which accounted for 92% of primary energy use in 2005. IMAR has considerable coal reserves and generates electricity for export to other provinces. In 2005, IMAR discharged 1.46 million tons of sulfur dioxide (SO₂), representing 5.7% of national emissions, although the population of IMAR was just 1.8% of the national total. Coal burning associated with district heating contributed about 10% of SO₂ emissions in IMAR. The heavy reliance on coal led to urban air pollution, and only 6 of 20 cities in IMAR reached Class II Air Quality Standards in 2005.¹

2. The proportion of the IMAR population living in urban areas increased from 42.2% in 2000 to 47.2% in 2005. District heating coverage expanded as well, from 10% in 2000 to 23% in 2005. Provision of reliable and affordable space heating is a basic need in IMAR due to severe winter conditions, when temperatures can fall to as low as –30°C, with a 7-month heating season. Inadequate coverage of district heating in urban areas resulted in the use of energy inefficient, small inner-city coal-fired boilers and individual household stoves for space heating, which was a major cause of urban air pollution. The influx of people into urban areas also increased municipal wastewater. Only 45% of wastewater in IMAR was treated, and over half of wastewater was discharged untreated into the rivers, resulting in significant pollution. The untreated wastewater discharge caused a disproportionately high annual chemical oxygen demand in IMAR of 297,000 tons in 2005, compared with 116,000 tons in Beijing in 2005.

3. The project aimed to improve air and water quality in targeted cities in IMAR. The project covered Wuhai and Bayanur cities in western IMAR and consisted of (i) an urban district heating system, (ii) natural gas transmission and distribution, (iii) wastewater treatment, and (iv) institutional reform and corporate governance improvement.²

II. EVALUATION OF DESIGN AND IMPLEMENTATION

A. Relevance of Design and Formulation

4. The project design at appraisal was consistent with the development priorities of the PRC government. During the Eleventh Five-Year Plan (2006–2010), the government prioritized sustainable growth while enhancing environment protection, and targeted a 10% reduction of SO₂ emissions and chemical oxygen demand by 2010.³ During this period, the government of IMAR (GIMAR) also prioritized developing a modern and efficient district heating system, spreading the use of natural gas, and constructing wastewater treatment plants. The project was also relevant to the Twelfth Five-Year Plan (2011–2015), which primarily targeted (i) a 16% reduction in energy consumption per unit of gross domestic product (GDP), and (ii) a 17% reduction in carbon dioxide (CO₂) emissions per unit of GDP by 2015.⁴

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

² 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* (Loan 2260-PRC). Manila.

³ Government of the PRC. 2006. *People's Republic of China Eleventh Five-Year Plan* (2006–2010). Beijing.

⁴ Government of the PRC. 2011. *People's Republic of China Twelfth Five-Year Plan* (2011–2015). Beijing.

5. The project was designed to help achieve development priorities (para. 4), and comprised four components: (i) urban district heating supply (component A) to expand district heating systems in the targeted cities by installing large, efficient boilers to facilitate the closure of small, inner city coal-fired boilers; (ii) natural gas transmission and distribution (component B) to develop natural gas supply systems and reduce coal use; (iii) city wastewater treatment to control pollutant discharge (component C); and (iv) institutional reform and corporate governance improvement (component D), focusing mainly on reform of heating tariffs and improvement of billing collection for sustainable delivery of district heating services. The project preparatory technical assistance (TA) helped finalize the project design during August 2005 to July 2006, addressing technical due diligence, social and environment safeguards, financial and economic analyses, procurement package planning, and institutional and policy analyses.

6. The project was aligned with the Asian Development Bank (ADB) country strategy and program (2006–2008) for the PRC, which supported (i) resolution of urban environmental issues (e.g., reducing water pollution and improving air quality); and (ii) infrastructure development, through policy and institutional reform to improve cost recovery and sector governance. The project was also relevant to urban energy efficiency and improvement of the urban environment, which remained priorities in subsequent ADB country partnership strategies.⁵

7. The project was approved on 29 September 2006 and became effective on 24 September 2007. It experienced startup delays due to elaborate on-lending agreements between various levels of the national, provincial and local governments. The delay in formalizing on-lending agreements meant the ADB loan became effective 1 year after approval. The long, harsh winter season makes district heating in IMAR a high priority for local governments, and district heating projects often implemented prior to the impending heating season. The startup delay led to advanced implementation of five of the eight subprojects under component A without utilizing the ADB loan.⁶ Similarly, one wastewater subproject under component C was also implemented without utilizing the ADB loan to meet the discharge reduction requirement of the local environment protection bureau. Another wastewater subproject under component C became obsolete, because the local environment protection bureau forced the wastewater source to stop operating. These changes resulted in \$49.96 million of ADB loan savings.

8. Because of the rapid rise in demand for district heating, on 10 February 2010 the GIMAR requested approval from ADB to use the loan savings to expand the district heating system in Linhe under component A. The proposed expansion fit directly with the design and monitoring framework at appraisal, and ADB approved a major change in scope to accommodate expansion of the district heating system in Linhe on 4 June 2010.

B. Project Outputs

1. Component A: Urban Central Heating Supply

9. As designed at appraisal, component A was to install 766 megawatts (MW) of large, efficient coal-fired boilers; 138 heat exchange stations; and 87.6 kilometers (km) of heat supply pipelines to facilitate the closure of 396 small, inefficient coal-fired boilers for 25.7 million square

⁵ ADB. 2005. *Country Strategy and Program Update (2006–2008)*, People's Republic of China. Manila; 2008. *Country Partnership Strategy (2008–2010)*, People's Republic of China. Manila; 2012. *Country Partnership Strategy (2011–2015)*, People's Republic of China. Manila

⁶ These components were financed instead by the local governments and the project implementing agencies using their own resources. But they were implemented based on the design included at the project appraisal.

meters (m²) of heating area in the targeted townships (Dengkou, Hangjinhouqi, Linhe, Wuhai, Wulatehouqi, Wulateqianqi, Wulatezhongqi, and Wuyuan) to supply cleaner heating services for about 1 million of the urban population.

10. Due to startup delays (para. 7), five subprojects—in Dengkou, Wulatehouqi, Wulateqianqi, Wulatezhongqi and Wuyuan—were implemented without the use of ADB funding. These subprojects were physically completed in 2009. ADB approved a major change in scope in June 2010 to expand the scope of the Linhe subproject (para. 8), which involved construction of 280 MW of heat-only boilers, installation and rehabilitation of 134.3 km of heat transmission pipelines and construction of 100 heat-exchange stations.

11. On completion in 2015, component A involved construction of 773 MW of heating capacity; 224 heat-exchange stations; installation and rehabilitation of 247 km of heat-supply pipelines; and demolition of 431 small, old, inefficient inner-city boilers (Table 1). The enhanced outputs increased the heating area to 37 million m² for about 1.6 million of the urban population.

Table 1: Component A Scope Comparison

Table 1. Component A Scope Comparison									
	Heating Capacity		Heat Exchange		Heat Supply Pipeline		Old Boiler Closure		Funding Source
	(MW)		(No.)		(km)		(No.)		
	Appraisal	Completion	Appraisal	Completion	Appraisal	Completion	Appraisal	Completion	
Dengkou	87	0	11	21	3.0	3.0	39	39	Local Fund
Hangjinhouqi	174	174	31	31	10.6	37.3	11	44	ADB Loan
Linhe	0	280	31	100	36.2	143.7	58	58	ADB Loan
Wuhai	186	0	22	29	10.7	35.9	112	113	ADB Loan
Wulatehouqi	58	58	14	14	9.0	9.0	35	35	Local Fund
Wulateqianqi	87	87	9	9	9.8	9.8	64	64	Local Fund
Wulatezhongqi	58	58	8	8	3.0	3.0	20	21	Local Fund
Wuyuan	116	116	12	12	5.3	5.3	57	57	Local Fund
Total	766	773	138	224	87.6	247.0	396	431	

ADB = Asian Development Bank, km = kilometer, MW = megawatt.

Source: Project Management Office, Government of Inner Mongolia Autonomous Region.

12. **Hangjinhouqi subproject.** The subproject included construction of 58 MW of heating capacity (provided through two boilers) with ADB financing in 2011. Due to a change in urban planning, construction of another 58 MW of heating capacity (one boiler) was delayed until early 2012, and was completed in 2015. In addition, the length of heating pipeline increased to 37.3 km, and the number of small, coal-fired boilers that were demolished increased to 44.

13. **Linhe subproject.** The scope of the subproject was expanded to supply district heating in a new industrial, commercial, and residential area in Linhe (para 10); construction, with ADB financing, was completed in 2014. It involved 70 MW (four boilers) of heating capacity, 143 km of primary and secondary heating pipelines, 100 heat exchange stations, and demolition of 58 small, coal-fired boilers.

14. **Wuhai subproject.** The subproject was completed with ADB financing in 2014. Construction of the heat generation source was cancelled to use a heat supply from the existing combined heat and power plant. The change in heat source location resulted in an increase in the length of the heat supply pipeline to 35.9 km, from 10.5 km at appraisal.

2. Component B: Natural Gas Transmission and Distribution

15. At appraisal, component B was designed to construct (i) 401 km of the Changqing–Wuhai–Linhe primary natural gas pipeline crossing Erdos, Wuhai, and Bayanuur cities, including seven transmission substations and eight valve stations; and (ii) 338 km of secondary natural gas pipelines, including one compressed natural gas (CNG) primary supply station, three CNG satellite filling stations, and four natural gas unloading stations, to annually supply 434.5 million cubic meters (m³) of natural gas and 21 million m³ of CNG for about 1 million urban residents in eight targeted areas (Dengkou, Hangjinhouqi, Linhe, Wuhai, Wulatehouqi, Wulateqianqi, Wulatezonqi, and Wuyuan) by 2010.

16. Component B was completed in 2011 as designed, except (i) length of the Changqing–Wuhai–Linhe primary natural gas pipeline was increased slightly to 426 km, and that of the secondary pipeline to 386 km, as a result of changes made in the final engineering design. In 2016, 451 million m³ of natural gas and 25 million m³ of CNG were supplied, covering an urban population of around 1.28 million in the targeted areas.

3. Component C: City Wastewater Treatment

17. Component C was designed to construct (i) a wastewater treatment plant (6,000 tons per day capacity) and sewage piping network (13.2 km) in Wulatehouqi, and (ii) a wastewater treatment plant (80,000 tons per day capacity) and sewage piping network (40.0 km) with five pumping stations in Wulateqianqi. At appraisal, completion was planned for 2009.

18. Construction of the wastewater treatment plant and associated downstream infrastructure in Wulatehouqi was completed as designed in 2008 without ADB loan financing because of a delay in project startup (para. 7), and the local government's need to complete construction works by 2008. The wastewater treatment plant, sewage piping and pumping stations in Wulateqianqi were cancelled and excluded from the project scope in 2010 the wastewater source—a paper mill factory—was shut down by the local government in 2009, rendering the plant unnecessary.

4. Component D: Institutional Reform and Corporate Governance Improvement

19. Component D comprised (i) institutional strengthening and training, with a primary focus on heat tariff reform and improved tariff collection; (ii) assistance in implementing heating tariff reform and improving corporate governance; and (iii) development of options for private sector participation. A consulting firm was engaged in 2008 to help implement component D,⁷ and carried out (i) interviews and surveys to identify bottlenecks to improving heating tariff revenues and strengthening corporate governance, (ii) workshops and training, and (iii) study tours for GIMAR and project implementing agencies to learn good practices in heating tariff reform and corporate management.

20. In October 2009, GIMAR issued *Guidance on Reinforcement of Heating for Cities and Towns*, which initiated district heating subsector reforms, many of which were directly based on the ADB supported studies, and included: (i) implementing a two-part tariff for energy and capacity charges to fully cover variable and fixed costs, and thus enhance heating supply financial sustainability; (ii) increasing the tariff collection rate; (iii) changing the heat billing mechanism, to gradually shift from floor-based billing to consumption-based billing; (iv) enhancing supply- and demand-side management by improving generation efficiency, reducing transmission and

⁷ Easen International and H&J International.

distribution losses, and installing temperature control devices in buildings; and (v) protecting poor households through tariff discounts or exemptions.⁸

21. The heating subsector reforms have subsequently been implemented and the tariff collection rate has improved from 70% in 2004 to around 96% in 2015. The consumption-based tariff was initiated in Wuhai and Bayanuur on a pilot basis, and will be gradually implemented throughout IMAR's heating subsector. Ongoing reform is also expected to stimulate private sector participation in district heating supply investment and operations in IMAR.

C. Project Costs

22. At appraisal, the total project cost, including contingencies and interest and other loan charges during construction, was estimated at \$330.40 million equivalent—\$135.25 million in foreign exchange costs (41% of the total) and \$195.16 million in local currency costs (59%). Due to a major change in scope in 2010 to accommodate the expanded Linhe district heating subproject (paras. 10 and 13), the estimated total project cost increased to \$376.32 million equivalent, including \$153.05 million in foreign exchange cost (39%) and \$223.27 million in local currency cost (61%). Actual total project cost at completion was \$340.97 million, a 9.3% decrease compared to the estimate accompanying the major change in scope in 2010, but a 3.1% increase from appraisal in 2005.

23. The increase from the appraisal estimate results from (i) the major change in scope to accommodate the expanded Linhe district heating subproject, including 270 MW of new thermal heating capacity; and (ii) the additional length of main and secondary natural gas transmission pipeline, which resulted from changes at the detailed design stage (para. 16). A detailed project cost breakdown is in Appendix 2, with a detailed cost breakdown by project component in Appendix 3.

24. The financing plan at appraisal consisted of (i) an ADB loan of \$120.0 million (36.3%), (ii) equity contributions of \$175.44 million (53.1%), and (iii) domestic borrowings of \$34.97 million (10.6%). The change in the project cost (para. 22) resulted in revision of the financing plan, with increased equity contributions and domestic borrowings. The revised financing plan based on the major change in scope in 2010 consisted of an (i) a ADB loan \$120.00 million (31.9%), (ii) equity contributions of \$214.15 million (56.9%), and (iii) domestic borrowings of \$42.17 million (11.2%). Actual funding included \$117.8 million (34.5%) from an ADB loan, \$164.78 million (48.33%) in equity contributions, and \$58.35 million (17.11%) in domestic borrowing. A detailed breakdown of the financing plan is in Appendix 2.

D. Disbursements

25. Disbursement from the ADB loan was made on 19 December 2008 for the district heating subproject in Wuhai. Contract awards and disbursements were behind the original disbursement schedule because of a delay in project implementation startup (para. 7), but accelerated following ADB approval of the major change in scope and implementation arrangements in 2010. Loan disbursement reached about 90% by 2013, but slower disbursement for some components delayed final disbursement until 7 June 2016 for the district heating subproject in Hangjinhouqi. Disbursement of expenses incurred before the loan closing date was completed during the

⁸ Government of Inner Mongolia Autonomous Region. 2009. *Inner Mongolia Autonomous Region Government's Guidance on Reinforcement of Heating for Cities and Towns*, IMAR Government No.232. Hohhot.

winding-up period within 4 months of the loan closing date. Loan account was closed on 21 July 2016.

26. A total of \$117.85 million (98.21% of the original loan amount) was disbursed. Disbursements for contracts totaled \$111.93 million, while those for interest during construction and commitment fees equaled \$5.92 million. The unused balance of \$2.15 million was canceled at loan closing. ADB approved the use of anticipated loan savings and the reallocation of loan funds among subprojects. Appendix 4 compares the projected and actual disbursements.

E. Project Schedule

27. The loan was approved on 29 September 2006. The loan and project agreements were signed on 16 May 2007 and became effective on 24 September 2007. The startup delays resulting from the multi-layer, multi-component project design and major change in scope (paras. 7 and 8) resulted in extension of the project implementation period, and required three extensions (from 31 December 2011 to 21 January 2016) to loan closing. The projected and actual implementation schedules for each completed component are in Appendix 5.

1. Component A: Urban Central Heating Supply

28. At appraisal, component A was planned to be physically completed in 2009. A major change in scope resulted in initial extension of the loan closing date until 31 December 2013. The district heating subproject was physically completed in October 2014 because of an initial delay in engaging the tendering agency to start procurement. Implementation of the district heating subproject in Wuhai was delayed due to a change in the heat source location, and was completed in December 2014 (para. 14). The original scope of work for the district heating subproject in Hangjinhouqi was partially completed in April 2011; a change in the urban development plan led to a change in the location of a 58 MW (one unit) heat source, and the remainder of the subproject scope was completed in December 2015 (para. 12).

2. Component B: Natural Gas Transmission and Distribution

29. At appraisal, completion of component B was planned for 2010. Startup was delayed but component B was otherwise implemented smoothly. Component B was physically completed in August 2011, and started operation in October 2011.

3. Component C: City Wastewater Treatment

30. Component C comprised two wastewater treatment plants and was to be completed by 2009. The wastewater treatment plant at Wulatehouqi began construction in 2007 and was completed in 2008, without ADB loan financing, while the wastewater subproject in Wulateqianqi was not implemented because the paper mill, which was the source of the wastewater, was closed in 2009 because of poor environmental compliance (paras. 17–18).

4. Component D: Institutional Reform and Corporate Governance Improvement

31. At appraisal, implementation of component D was scheduled to begin in 2006, with completion in 2010. As a result of project startup delays, the consultants who were to help implement the component D were not engaged until November 2008. Institutional reforms and corporate governance improvements were completed in 2010 as planned. However, training and project monitoring were extended until 2015, in parallel with the revised project implementation.

F. Implementation Arrangements

32. GIMAR was the project 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 Reform and Commission, Finance Bureau, and Environment Protection Bureau. The Project Management Office (PMO) was established in 2006 under the IMAR Development and Reform Commission, which was directly responsible for overall project management, coordination, and supervision. The subprojects under components A, B, and C were implemented by various project implementing agencies (PIAs), while component D was administered directly by the PMO.⁹ Each PIA established a project implementation unit that was responsible for the design, construction, and operation of each subproject under the guidance of the executing agency.

33. A change in the implementation arrangements was required because (i) the wastewater subproject in Wulateqianqi was cancelled, (ii) several subprojects under components A and C were implemented without using the ADB loan, and (iii) a new district heating subproject in Linhe was included into the project scope. A change in implementation arrangements and a major change in scope were approved by ADB in 2010, and the Bayannur Yangguang Energy Group became the PIA responsible for the expanded district heating subproject in Linhe.

G. Conditions and Covenants

34. The loan covenants were generally complied with (compliance with covenants in the loan and project agreements is detailed in Appendix 6), including those involving changes in ownership and operation, closure of small coal-fired heating boilers, heating assistance to the poor, implementation of heating reforms, and institutional strengthening. Audited project accounts and audited financial statements were submitted regularly and on time. Quarterly monitoring reports, environment monitoring reports, and land acquisition and resettlement monitoring reports were generally submitted on time.

35. With respect to implementation of heating reforms, the covenants required (i) installation of locking valves in individual apartment units in buildings to improve tariff collection; (ii) installation of radiator control valves in apartment units in buildings to encourage heat conservation; (iii) implementation of a two-part heating tariff structure, with a variable charge based on heat consumption, and an overall tariff level that is cost-reflective and promotes economic efficiency; (iv) installation of heat-measuring devices at the apartment level to support consumption-based billing systems; and (v) conversion to an individual-based payment system. With the assistance of component D, GIMAR issued the heating reform policy in 2009 (paras. 20–21), which enabled implementation of these covenant requirements. The tariff collection rate improved to 96% in 2016, from 70% in 2004.

H. Consultant Recruitment and Procurement

36. To help implement institutional reform and corporate governance improvements, including project management assistance to the PMO (component D), an international consulting firm was

⁹ At appraisal, the PIAs comprised Bayannur Fuyan Shiye Group Limited Co., Inner Mongolia Haosheng Thermal Limited Co., Inner Mongolia Saiwaixing Huazhang Paper Limited Co., Inner Mongolia Western Natural Gas Limited Co., Wuhai Thermal Co., Wulatehouqi Huibao Thermal Limited Co., Wulatehouqi Water Company, and Wulatezongqi Dagong Thermal Limited Co.

engaged with 21 person-months of international consultants inputs, and 129 person-months of national consultant inputs. The consultants were recruited on 8 September 2008 using quality- and cost-based selection in accordance with the ADB Guidelines on the Use of Consultants (2006, as amended from time to time), and were mobilized immediately after the contract was awarded in 2008. The engaged consulting firm provided assistance with (i) institutional strengthening and training, to create an enabling environment for sustainable utility services, with a primary focus on heat tariff reform and tariff collection improvement; (ii) heating tariff reform and corporate governance improvement; and (iii) development of options for private sector participation.

37. At appraisal, the procurement plan comprised 42 contract packages for materials, equipment, and civil works. It was revised due to a major change in scope in 2010, and 26 contract packages for materials and equipment including installation, with a combined value of \$110.77 million, were awarded under the project. The PMO engaged the China Far East Tendering Company as its tendering agent to support preparation of bidding documents and manage the procurement process. Procurement followed ADB's Procurement Guidelines (2004, as amended from time to time). Goods with a contract value of \$1,000,000 or more were procured through international competitive bidding, while goods with a value below \$1,000,000, but not less than \$100,000, were procured through national competitive bidding. The procurement process was delayed on some occasions because of the multi-layered approval process involving county, city, and provincial governments. ADB-financed contract packages are detailed in Appendix 7.

I. Performance of Consultants, Contractors, and Suppliers

38. The performance of the consultants was satisfactory. Engagement of the consulting firms was delayed for 2 years behind the original schedule because of project startup delays, but the consultants promptly helped implement component D (institutional reform and corporate governance improvement), and successfully supported GIMAR to issue the heating reform policy in 2009. The consultants also prepared and implemented a training program, including a domestic study tour to successfully implement heating reforms, enhance corporate governance, and improve project management. The consultants also provided timely assistance to the PMO in project management and monitoring.

39. The performance of contractors and suppliers for civil works, and equipment and material was satisfactory for both ADB-financed contract packages and for contract packages financed using local funds. Domestic design institutes engaged by each PIA carried out the detailed engineering design on time and in accordance with the country construction standards. Civil works, and equipment and material supplies were implemented in accordance with codes, regulations, and contracts. The PIAs found the performance of the design institutes and contractors to be satisfactory. All contractors also followed the safeguard requirements (e.g., regarding environmental management, employment, gender, child labor, and health) as outlined in the covenants.

J. Performance of the Borrower and the Executing Agency

40. 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 GIMAR as the executing agency was generally 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) required coordination among several provincial and local government agencies involved in project implementation. Notwithstanding the change in scope, lengthened implementation

schedule, and enhanced outputs, the executing agency adequately managed the project and guided the PIAs, including complying with covenants and ADB guidelines; mobilizing additional counterpart funding; and initiating institutional reforms and corporate governance improvements, including heating reform. The performance of the PIAs was satisfactory as they delivered the enhanced outputs while flexibly responding to the updating of the urban development plan, which resulted in changes in heating source locations in Hangjinhouqi and Wuhai.

K. Performance of the Asian Development Bank

41. ADB's performance in project administration and management was satisfactory. The PMO assessed that the ADB mission provided strong support to the project, and closely cooperated with the executing agency and the PIAs. ADB staff spent adequate time reviewing physical progress and resolving issues with PMO and PIA staff during implementation. ADB supported smooth implementation through timely approvals of bidding documents and bid evaluation reports. ADB promptly approved the contracts it financed and made the necessary funding disbursements. ADB also approved the requested changes in project scope, implementation arrangements, and loan closing dates in a timely manner. The executing agency and the PIAs have expressed appreciation for ADB's timely actions in resolving project implementation issues.

III. EVALUATION OF PERFORMANCE

A. Relevance

42. The project was *relevant* at appraisal and completion, and was fully aligned with the Eleventh and Twelfth Five-Year plans of the Government of the PRC and GIMAR, in which energy conservation and environmental improvement were priority aspects of the development agenda. It was also consistent with ADB's country strategy and sector priorities. In spite of the project startup delay that led to advanced implementation of several subprojects in component A (urban central heating supply) and C (city wastewater treatment) without ADB loan financing, the project was aligned with its outcome: efficient, safe, and reliable gas, heating supply and wastewater treatment systems that conserve energy and water resources, by accommodating a subproject for 280 MW of expanded district heating in Linhe through a major change in scope (paras. 7 and 8). However, because the project was significantly affected by a change in local government policies—such as the urban development plan, which directly impacted the scope of the subprojects and the implementation schedule, especially in component A—the project modality should have been built upon the medium- and long-term urban development plan, which was closely integrated with development of the district heating system.

43. The project also supported GIMAR in successfully initiating and implementing heating reforms (paras. 20 and 36), which facilitated transformation of the IMAR heating subsector that is more sustainable, open to private sector investment, with reduced energy losses and improved corporate management. The heating reform process also seeks closer coordination across agencies in GIMAR to coordinate heating investments and urban planning. Building on the project, ADB is supporting projects to expand district heating systems in cities in central and eastern

IMAR,¹⁰ and to develop advanced, cleaner district heating systems using wind power, natural gas, and waste heat recovery in Huhhot, the capital of IMAR.¹¹

B. Effectiveness in Achieving Outcome

44. The project achieved its outcome: efficient, safe, and reliable gas and heating supply and wastewater treatment systems that conserve energy and water resource in the project areas. Together with a major change in scope in 2010, the project exceeded most of the intended project outcomes, specifically in components A and B (paras. 9–16).

45. The project provided (i) 451 million m³ of natural gas supply and 25 million m³ of CNG supply, via 426 km of main and 386 km of secondary natural gas transmission pipelines for residential and commercial use for 1.2 million urban residents; (ii) 773 MW of heating supply capacity, 224 units of heat exchange stations, and 396 km of heating pipelines with 37.0 million m² of heating area for 1.6 million urban residents; (iii) closure of 431 small, inefficient coal-fired boilers; and (iv) improved energy efficiency, from 55% to 80%. Daily wastewater capacity was increased by 6,000 tons per day, but 80,000 tons per day less than planned because of cancellation of the wastewater treatment subproject in Wulateqianqi (para. 18). The institutional reforms and corporate governance component (component D) of the project was also implemented as intended, and successfully assisted GIMAR to initiate heating reforms leading to an improvement in (i) the tariff collection rate, from 70% in 2004 to 96% in 2015; and (ii) the financial performance of the district heating supply companies. Most of key intended outcomes and outputs of the project were achieved or exceeded, and the project is rated *effective*.

C. Efficiency in Achieving Outcome and Outputs

46. The project is rated *less than efficient* due to the delay in achieving the overall project outcome and outputs, while the actual project cost was around 9% lower than the revised cost estimate in 2010 (para. 22). The implementation delay was observed mainly in the urban central heating subcomponent (component A). District heating subprojects in Hangjinhouqi, Linhe, and Wuhai faced implementation delays of 4–5 years behind the original implementation schedule due to delayed project implementation startup, a major change in scope to accommodate the expanded district heating subproject in Linhe, and a change in heat source location associated with the updated urban development plan. The subprojects in Dengkou, Wulatehouqi, Wulateqianqi, Wulatezongqi, and Wuyuan completed construction as originally scheduled without using the ADB loan (paras. 7 and 10).

47. The project—which used a stand-alone project loan modality—was composed of multiple subcomponents in scattered locations, with a multilayered project administration structure, including onlending and counter-guarantee arrangements across PIAs and local governments. This posed an inherent challenge to project management, required significant coordination of project proponents, and made project implementation less efficient when responding to immediate implementation needs in several subprojects. It resulted in advanced implementation of five district heating subprojects and one wastewater treatment subproject without the use of ADB loan

¹⁰ 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* (Loan 2658-PRC). Manila.

¹¹ 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.

financing. The lack of coordination between district heating system development and the urban development plan was also a major cause of implementation delays in district heating subprojects, specifically in Hangjinhouqi and Wuhai.

48. **Economic evaluation.** The economic evaluation of the project followed the methodology used at appraisal. The recalculated economic internal rates of return (EIRRs) were 15.8% without environmental benefits, and 23.9% with environmental benefits, for the urban central heating system subcomponent (component A); 16.9% without environmental benefits, and 23.6% with environmental benefits, for the natural gas transmission and distribution subcomponent (component B); and 6.5% without environmental benefits, and 12.1% with environmental benefits for the city wastewater treatment subcomponent (component C). The recalculated EIRR for the entire project was 15.8% without environmental benefits (vs. 17.6% at appraisal), and 23.5% with environmental benefits (vs. 21.7% at appraisal), exceeding the 12% economic opportunity cost of capital. The EIRRs for individual subprojects ranged from 6.5% to 18.5% without environmental benefits, and from 12.1% to 24.7% with environmental benefits. A summary of the EIRR calculation is in Appendix 8.

49. A sensitivity analysis was performed to test the sensitivity of the EIRR to certain changes in parameters. This showed that the recalculated EIRR for the entire project without environmental benefits could decrease to (i) 12.0% if all the economic benefits are reduced by 10%, (ii) 14.6% if the project experiences a cost overrun of 10%, (iii) 13.5% if the operation and maintenance (O&M) costs are increased by 10%, and (iv) 8.5 % under a combination of (i) through (iii). The recalculated EIRR for the entire project with environmental benefits could decrease to (i) 19.6% if all the economic benefits are reduced by 10%, (ii) 21.8% if the subprojects experience a cost overrun of 10%, (iii) 21.5% if the O&M costs are increased by 10%, and (iv) 16.2% under a combination of (i) through (iii). Under these sensitivity scenarios, the project (with environmental benefits) will be economically viable under any of the adverse conditions considered.

50. **Financial evaluation.** The financial internal rate of return (FIRR) was determined for the project using actual investment costs, and a combination of historical and projected data for revenues and costs. The recalculated FIRRs were 9.1% for the urban central heating system subcomponent (component A), 14.4% for the natural gas transmission and distribution subcomponent (component B), and 4.8% for the city wastewater treatment subcomponent (component C). The FIRRs for individual subprojects were 4.8% to 16.9%. The recalculated EIRR for the whole project was 10.5%, compared with 7.7% at appraisal. The FIRRs for the individual subcomponents and the entire project were higher than the weighted average cost of capital (WACC), and all are considered financially viable. The reduction in actual capital cost (in CNY) and favorable full cost-recovery tariffs for district heating and natural gas supply contributed to the increase in the FIRRs for all subprojects under components A and B. FIRR of component C was lower than the original estimate mainly because of the lower wastewater tariffs than estimated at appraisal, but still exceeded the WACC. A summary of the FIRR calculation is in Appendix 9.

51. A sensitivity analysis was performed to test the FIRR's sensitivity to changes in certain parameters. This showed that the recalculated FIRR for the whole project would decrease to (i) 6.8% if all economic benefits are reduced by 10%, (ii) 8.0% if the project experiences a cost overrun of 10%, (iii) 9.1 % if the O&M costs are increased by 10%, and, (iv) 4.9 % under a combination of all three. Under any of these sensitivity scenarios, the project's FIRR exceeds the WACC of 3.3%, and the project is thus deemed financially viable even under adverse conditions. The project is sensitive to declines in revenue, however, and continuous tariff adjustment is essential to ensure financial sustainability.

D. Preliminary Assessment of Sustainability

52. The project is rated *likely sustainable*. All subprojects are operating well and have achieved their performance parameters. All subprojects will be sustainable with increasing demand and improved policies supporting sustainable operations. Enhanced energy conservation and environmental improvement remain priorities in the PRC's Thirteenth Five-Year Plan, and this is expected to continue because of the increasing urban population and growing concern over deteriorating air and water quality.¹² Further infrastructure investments in district heating supply, natural gas supply, and wastewater treatment are essential to respond to the increased demand, combined with rapidly expanding urban areas in the cities targeted by the project. The district heating subprojects that were completed in 2009 without ADB loan financing added 395 MW of new heating capacity and 300 km of heating pipelines to cover 9.8 million m² of additional heating area. Similarly, the wastewater treatment subproject in Wulatehouqi, which was completed in 2008 without ADB loan financing, expanded treatment capacity by 20,000 m³ per day. The heating reforms (para. 45) built a foundation for sustainable transformation of the district heating subsector, and ongoing implementation of the reforms will help ensure a continued supply of sustainable and reliable heating services by district heating subprojects.

E. Impact

1. Environmental Impact

53. The project is classified as environment category B (sensitive), in accordance with the ADB environmental categorization.¹³ The domestic environmental impact assessment reports for all subprojects under components A, B, and C were prepared in 2005, and approved by the Environment Protection Bureau of IMAR in 2006. The summary initial environmental examination was prepared in accordance with the ADB Environment Policy (2002) and submitted to ADB in 2006. A Supplementary Initial Environmental Examination was prepared in accordance with the ADB Safeguard Policy Statement (2009) and submitted to ADB in 2010, which took into account the major change in scope in 2010 that accommodated the expanded district heating subproject in Linhe, and the domestic environmental impact assessment report approval by the IMAR Environment Protection Bureau in 2009.

54. The project management office, established in the GIMAR Development and Reform Commission, was responsible for managing, coordinating, and supervising implementation of the environmental management plan (EMP). Each PIA established an environmental management unit (EMU) responsible for EMP implementation and monitoring during subproject construction and operation. The PMO designated environmental staff to coordinate with each EMU, undertake environmental management of subprojects, and oversee EMP implementation and monitoring for all subprojects, with consultant assistance. EMP submissions were frequently delayed, but confirmed that key environmental impacts (including soil erosion and contamination, wastewater disposal, and dust generation during construction) were addressed in accordance with mitigation measures in the EMP. Mitigation measures in the EMP during operation for components A, B, and C—such as dry sludge disposal, compliance with the boiler emission standard, and natural gas leakage detection—were also addressed (Appendix 10). As required under national laws and regulations, all subprojects in components A, B, and C were reviewed through the environment

¹² State Council of the People's Republic of China. 2016. *Outline of the Thirteenth Five-Year Plan for National Economic and Social Development of the People's Republic of China*. Beijing.

¹³ The project remained classified as category B for the environment following the major change in scope in 2010.

protection completion audit by the IMAR provincial and municipal environmental protection bureaus during 2009–2016.

55. The project's development impact is considered *satisfactory* as it achieved its intended impact of an improved environment resulting from a reduction in atmospheric and water pollution. The project is delivering substantial environment benefits through avoided annual net emissions from components A and B: 1,071,964 tons of CO₂ (787,243 tons at appraisal); 3,164 tons of NO_x (2,718 tons at appraisal); 20,036 tons of SO₂ (17,570 tons at appraisal); and 23,958 tons of total suspended particulates (TSP) (21,547 tons at appraisal). The environmental benefits of the city wastewater subproject (component C) that is treating 6,000 tons per day of wastewater include: avoided annual discharge of 985 tons of chemical oxygen demand, 400 tons of biological oxygen demand, 530 tons of suspended solids, 62 tons of ammoniacal nitrogen, 86 tons of total nitrogen, and 6 tons of total phosphorous.

2. Social Impact

56. The project was classified as category B for involuntary resettlement and C for indigenous peoples. A land acquisition and resettlement plan was prepared by the IMAR Environmental Improvement Project Management Office in March 2006 in accordance with the ADB Involuntary Resettlement Policy (1995), and was updated in May 2010 due to the major change in scope. The project involved 684.38 *mu* of permanent land acquisition and 1,154.48 *mu* of temporary land occupation without resettlement and house demolition.¹⁴ 161 people were affected by permanent land acquisition, and 324 by temporary land occupation. The total cost of land acquisition was CNY55.74 million, or CNY25.9 million higher than the original estimate, but below the CNY56.29 million estimated in 2010 in conjunction with the major change in scope. The cost increase resulted mainly from the significant increase in the compensation rate for permanent land acquisition. Land acquisition for the project was implemented in accordance with the PRC's laws and regulations and the land acquisition and resettlement plan. No complaints were received from the affected people.

57. The project also involved demolition of 431 old, small and inefficient inner-city boilers to improve ambient urban air quality, which affected 800 boiler workers. Reemployment of the affected boiler workers was arranged by each project implementing agency upon subproject completion; 280 were retained in the project implementing agencies, and 520 were reemployed without changes in the level of their wages and benefits. No complaints were received from the affected boiler workers. Details on land acquisition and labor reemployment are in Appendix 11.

58. The project benefited about 2.8 million urban inhabitants, including 46,129 poor households, by reducing air pollution through cleaner district heating and natural gas supply. The project supported GIMAR in preparation and implementation of heating reforms, including a pro-poor tariff design and an assistance program that provided a free heating connection and 50%–100% tariff reduction to ensure an affordable heating supply for the poor.¹⁵

¹⁴ A *mu* is a Chinese unit of measurement (1 *mu* = 666.67 m²).

¹⁵ Disabled and the elderly covered under the social protection program are eligible for a 100% discount in their heating tariff.

IV. OVERALL ASSESSMENT AND RECOMMENDATIONS

A. Overall Assessment

59. The project faced startup delays due to elaborate on-lending agreements among various levels of the national, provincial, and local governments. It led to the advanced implementation of several subprojects without ADB loan funding, and resulted in a major change in scope and implementation arrangements. The loose integration the district heating investment planning and urban development plan also led to a delay in achieving the outcome and outputs. However, the project remained relevant to the five-year development plans of both the PRC and GIMAR governments, and ADB sector policies and strategies. The project also is also deemed *effective*, as it achieved its main outcomes and outputs. As a result of the major change in scope, the project exceeded most of outcome and output targets. (Appendix 1)

60. The project is considered *likely sustainable* because of growing infrastructure investment needs and continued priority given by the government to energy conservation and environmental improvement. More importantly, heating tariff reform—supported through the institutional reform and corporate governance subcomponent (component D)—created a foundation to transform heating project sustainability. Building on the project, ADB is supporting two projects to help expand district heating systems in IMAR (para. 43). Thus, despite a delay in achieving the outcomes, the project is rated *successful* (Appendix 12).

B. Lessons

61. Choice of project modality, scope, and implementation arrangements should be carefully assessed and deliberately considered at project preparation. Project management faced challenges beginning with initial implementation as the project comprised multiple subcomponents scattered across many locations, resulting in a multilayered project administrative structure. Combined with a requirement to conclude on-lending agreements backed by stringent counter-guarantee arrangements across the PIAs and local governments, the required coordination among relevant local government agencies was significant. It resulted in (i) limited flexibility to respond to immediate implementation needs; and (ii) delays, which resulted in advanced implementation of several subproject without the use of ADB loan financing. A flexible approach that allowed individual subprojects to become effective when individual requirements were met would have avoided this situation.

62. Urban development plans should be thoroughly reviewed and assessed to identify potential risks at project preparation and thereby minimize subsequent changes in scope, and attendant implementation delays. The district heating subproject faced a change in heat source location, which affected both the original scope of works and implementation schedule. It was caused by the limited coordination between the urban development plan and heating supply investment planning. Heating reforms are expected to include tightened integration of district heating investment and urban development planning.

63. A strong project steering committee with close coordination across relevant local government agencies is essential for smooth project implementation. The project structure—with multiple subcomponents in scattered locations and a multi-layer project administrative structure—required strong leadership of the project leading group, which served to guide project implementation.

C. Recommendations

1. Project Related

64. **Future monitoring.** GIMAR should continue to monitor (i) the operational status of all subprojects, and (ii) the implementation status of heating reform. These will provide valuable lessons for the two ADB-financed district heating projects now ongoing in IMAR (para 43).

65. **Further actions or follow-up.** ADB is the largest donor active in district heating development in IMAR. A heating subsector-specific evaluation that builds on the outcome, outputs, and lessons from this and the two ongoing ADB projects is recommended to identify necessary actions and recommendations to enhance subsector sustainability and reduce emissions, while meeting growing demand for heating.¹⁶

2. General

66. The project modality and scope should be carefully considered during project preparation. The simple stand-alone project loan modality is less advantageous when implementing a multi-component project that involves a wide range of subsectors and project proponents, 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 and results-based lending—should be considered. Alternatively, the project scope should be well focused to minimize the complexity of project management.

67. Urban development plans should be carefully assessed in preparation of any district heating project. The relevance and effectiveness of the district heating project design (heat source, generation capacity, and transmission and distribution) depend entirely on urban zoning, which is linked to commercial and public building construction planning, industrial complex development, and population growth projections.

¹⁶ 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; ADB. 2015. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for Qingdao Smart Low Carbon District Energy* (Loan 3358-PRC). Manila.

DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets/Indicators at Appraisal	Performance Targets/Indicators at Major Change in Scope ^a	Actual Performance
Impact Environmental improvement resulting from a reduction in atmospheric and water pollution	<p>Annual emission reduction of 787,243 t of CO₂, 17,570 t of SO₂, 2,718 t of NO_x, and 21,547 t of TSP in the project area</p> <p>Annual discharge reduction of 14,126 t of COD, 5,738 t of BOD, 7,600 t of suspended solids, 898 t of NH₃-N, 1,234 t of total nitrogen, and 88 t of total phosphorous in the project area</p> <p>Improved 35,200 poor households benefit from the gas and central heating supply connection and tariff discounts starting 2010</p>	<p>Annual emission reduction of 1,071,694 t of CO₂, 17,570 t of SO₂, 2,718 t of NO_x, and 21,547 t of TSP in the project area</p> <p>Annual discharge reduction of 14,126 t of COD, 5,738 t of BOD, 7,600 t of suspended solids, 898 t of NH₃-N, 1,234 t of total nitrogen, and 88 t of total phosphorous in the project area</p> <p>Improved 35,200 poor households benefit from the gas and central heating supply connection and tariff discounts starting 2013</p>	<p>Annual emission reduction of 1,071,694 t of CO₂, 20,036 t of SO₂, 3,164 t of NO_x, and 23,958 t of TSP in the project area in 2016</p> <p>Avoided annual discharge of 985 t of COD, 400 t of BOD, 530 t of suspended solids, 62 t of NH₃-N, 86 t of total nitrogen, and 6 t of total phosphorous in the project area in 2016</p> <p>46,129 poor households benefit from the gas and central heating supply connection and tariff discounts in 2016</p>
Outcome Efficient, safe, and reliable gas and heating supply and wastewater treatment systems that conserve energy and water resources in the project areas	<p>Reliable gas services to about 1 million urban population, with annual supply capacity of 434.5 m³ of natural gas and 21.25 million m³ of CNG for residential, commercial, and industrial purposes in the project areas by 2010</p> <p>Reliable central heating services to about 1 million urban population, with a coverage area of 25.776 million m² and 766 MW heating supply capacity by 2009</p> <p>Closure of 396 small inefficient coal-fired boilers and an average of 20% efficiency improvement in heating supply by 2009</p> <p>More than 85% of the household coal-fired stoves for heating and/or cooking substituted by central heating and/or gas supply by 2010</p> <p>784 workers affected by the closure of 396 small boilers will be reemployed</p>	<p>Reliable gas services to about 1 million urban population, with annual supply capacity of 434.5 m³ of natural gas and 21.25 million m³ of CNG for residential, commercial, and industrial purposes in the project areas by 2011</p> <p>Reliable central heating services to about 1.6 million urban population, with a coverage area of 37 million m² and 1,106 MW heating supply capacity by 2013</p> <p>Closure of 422 small inefficient coal-fired boilers and an average of 20% efficiency improvement in heating supply by 2013</p> <p>More than 85% of the household coal-fired stoves for heating and/or cooking substituted by central heating and/or gas supply by 2013</p> <p>960 workers affected by the closure of 396 small boilers will be reemployed</p>	<p>Reliable gas services provided to about 1.28 million urban residents, with an annual supply of 451 m³ of natural gas and 25 million m³ of CNG for residential, commercial, and industrial purposes in the project areas in 2011</p> <p>Reliable central heating services provided to about 1.6 million urban residents, with a coverage area of 37 million m² and 773 MW heating supply capacity in 2015</p> <p>Closure of 431 small, inefficient coal-fired boilers, with an average heating supply efficiency improvement of 20% in 2015</p> <p>Around 93% of household coal-fired stoves used for heating and/or cooking replaced by central heating and/or gas supply in 2015</p> <p>800 workers affected by the closure of 422 small boilers were reemployed</p>

Design Summary	Performance Targets/Indicators at Appraisal	Performance Targets/Indicators at Major Change in Scope ^a	Actual Performance
	<p>773.4 mu of land acquired permanently and 9,801.8 mu occupied temporarily, affecting 133 people permanently and 177 people temporarily by 2009</p> <p>Daily wastewater treatment capacity increased by 86,000 m³ in Wulateqianti and Wulatehouqi by 2009</p> <p>Treated water meets the national discharge standard and the 30 million t of the treated grey water recyclable annually</p> <p>Energy efficiency improves from 58% to 80% (by 22%) and energy conserved annually equivalent to 540,000 t of standard coal by 2010</p>	<p>822 mu of land acquired permanently and 10,296 mu occupied temporarily, affecting 133 people permanently and 1776 people temporarily by 2011</p> <p>Daily wastewater treatment capacity increased by 6,000 m³ in Wulatehouqi by 2010</p> <p>Avoided 80,000 m³/day of wastewater discharge from pollutant chemical plant in Wulateqianqi</p> <p>Treated water meets the national discharge standard and the 2.25 million t of the treated grey water recyclable annually</p> <p>Energy efficiency improves from 58% to 80% (by 22%) and energy conserved annually equivalent to 711,000 t of standard coal by 2013.</p>	<p>684 mu of land permanently acquired, and 11,154 mu occupied temporarily, permanently affecting 161 people, and temporarily affecting 324 people</p> <p>Daily wastewater treatment capacity increased by 6,000 m³ in Wulatehouqi in 2008</p> <p>Avoided 80,000 m³/day of wastewater discharge from pollutant chemical plant in Wulateqianqi</p> <p>Treated water met the national discharge standard, with 2.25 million t of treated grey water recycled annually</p> <p>Energy efficiency improved from 58% to 80% (by 22 percentage points); the energy conserved annually was equivalent to 711,000 t of standard coal in 2015</p>
Outputs			
<p>1. Improved central heating systems in the project areas</p> <p>2. Provision of gas transmission and distribution systems in the project areas</p> <p>3. Enhanced wastewater treatment capacity in the project areas</p> <p>4. Institutional strengthening and capacity building</p>	<p>A well-functioning central heating supply system in 8 project areas with 88 km of heating pipeline, 21 boilers, and 138 heating exchange stations by 2009; closure of 396 small coal fired boilers by 2009</p> <p>Construction of a 401 km gas transmission trunk pipeline from Changqing to Linhe, including 7 transmission and 8 valve stations, and 338 km urban gas distribution pipeline in 8 project areas including 1 CNG primary supply station, 3 CNG satellite filling stations, and 4 gas uploading stations by 2010</p>	<p>A well-functioning central heating supply system in 8 project areas with 231 km of heating pipeline, 22 boilers, and 238 heating exchange stations by 2009; closure of 422 small coal-fired boilers by 2013</p> <p>Construction of a 401 km gas transmission trunk pipeline from Changqing to Linhe, including 7 transmission and 8 valve stations, and 338 km urban gas distribution pipeline in 8 project areas including 1 CNG primary supply station, 3 CNG satellite filling stations, and 4 gas uploading stations by 2011</p>	<p>A well-functioning central heating supply system was installed in 8 project areas, with 247 km of heating pipeline, 22 boilers, and 224 heating exchange stations by 2009; 422 small coal fired boilers were closed in 2015</p> <p>The following were achieved in 2011: construction of a 426 km gas transmission trunk pipeline from Changqing to Linhe, including 7 transmission and 8 valve stations, and an 386 km urban gas distribution pipeline in 8 project areas including 1 CNG primary supply station, 3 CNG</p>

Design Summary	Performance Targets/Indicators at Appraisal	Performance Targets/Indicators at Major Change in Scope ^a	Actual Performance
	<p>Construction of 2 wastewater treatment plants, a 53 km sewer transmission pipeline, and 5 pumping stations by 2009</p> <p>An implementation plan on institutional reform and corporate governance fully implemented by PIAs</p>	<p>Construction of wastewater treatment plant, a 13 km sewer transmission pipeline by 2010</p> <p>An implementation plan on institutional reform and corporate governance fully implemented</p>	<p>satellite filling stations, and 4 gas uploading stations in 2011</p> <p>Wastewater treatment plant and a 13 km sewer transmission pipeline were constructed in 2008</p> <p>The implementation plan on institutional reform and corporate governance was fully implemented</p>
Activities	Inputs:		
Civil Works, Materials, Equipment, Consulting services, Land acquisition, Closure of small boilers	<p>Project Cost: \$330.40 million</p> <p>ADB: \$120.0 million Local Banks: \$34.97 million PIAs: 175.43 million</p>	<p>Project Cost: \$376.32 million</p> <p>ADB: \$120.0 million Local Banks: \$42.17 million PIAs: \$256.32 million</p>	<p>Project Cost: \$340.97 million</p> <p>ADB: \$117.84 million Local Banks: \$58.35 million PIAs: 164.78 million</p>

ADB = Asian Development Bank, BOD = biochemical oxygen demand, CNG = compressed natural gas, COD = chemical oxygen demand, CO₂ = carbon dioxide, km = kilometer, m³ = cubic meters, MW = megawatt, NH₃-N = ammonia nitrogen, NO_x = nitrogen oxide, PIA = project implementing agency, SO₂ = sulfur dioxide, t = ton, TSP = total suspended particulates.

^a Major Change in Project Scope and Implementation Arrangements, Reallocation of Loan Proceeds, and Extension of Loan Closing Date were approved on 14 June 2010.

PROJECT COST BREAKDOWN BY PROJECT COMPONENT AND FINANCING PLAN
(\$ million)

Component	Appraisal Estimate			Change in Scope			Actual		
	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost
I. Base Costs	109.5	148.3	257.8	139.2	189.1	328.4	111.6	207.7	319.3
A.Urban Central Heating Component	57.2	88.3	145.5	93.8	140.5	234.3	71.6	149.8	221.3
A1.Dengkou Central Heating Supply	4.5	5.2	9.7	4.5	5.2	9.7		11.5	11.5
A2.Hangjinhouqi Central Heating Supply	12.6	12.1	24.7	12.6	12.1	24.7	12.1	15.5	27.6
A3.Linhe Central Heating Supply	10.5	11.0	21.5	47.4	62.8	110.3	46.9	57.5	104.4
A4.Wuhai City Central Heating Supply	10.2	36.9	47.1	10.2	36.9	47.1	12.5	14.5	27.0
A5.Wulatehouqi Central Heating Supply	4.2	5.6	9.8	4.1	5.7	9.8		11.7	11.7
A6.Wulateqianqi Central Heating Supply	5.1	5.8	10.9	5.0	5.9	10.9		13.0	13.0
A7.Wulatezhongqi Central Heating Supply	3.1	3.9	7.1	3.1	4.0	7.1		8.4	8.4
A8.Wuyuan Central Heating Supply	7.0	7.7	14.8	6.9	7.8	14.8		17.6	17.6
B.Natural Gas Transmission and Distribution	43.6	45.1	88.8	43.6	45.1	88.8	40.0	53.3	93.3
B1.Chang–Wu–Lin Gas Transmission	18.3	21.1	49.4	18.3	21.1	49.4	16.4	19.2	35.5
B2.Gas Distribution and CNG Station	25.4	24.0	39.4	25.4	24.0	39.4	23.6	34.1	57.7
C.City Wastewater Treatment Component	8.7	14.9	23.6	1.8	3.5	5.3		4.7	4.7
C1.Wulatehouqi Wastewater Treatment	1.9	3.5	5.3	1.8	3.5	5.3		4.7	
C2.Wulateqianqi Wastewater Treatment	6.8	11.5	18.3						
D. Institutional Reform and Corporate Governance	0.6		0.6	0.6		0.6	0.3		0.3
Subtotal (I)	110.1	148.3	258.4	139.8	189.1	329.0	111.9	207.7	319.6
II. Contingencies	14.6	19.7	34.4	2.0	3.0	5.0			
III. Financial Charges	10.6	27.1	37.6	11.3	31.2	42.4	5.9	15.4	21.4
Total (I +II + III)	135.3	195.2	330.4	153.1	223.3	376.4	117.8	223.1	341.0

CNG = compressed natural gas.

Source: Project Management Office.

PROJECT COST BREAKDOWN BY PROJECT COMPONENT AND FINANCING PLAN
(\$ million)

Funding Source	Appraisal		Change in Scope		Actual	
	Total (\$million)	%	Total (\$million)	%	Total (\$million)	%
A. Equity						
Inner Mongolia Western Gas Limited	55.77	16.88	55.77	14.82	44.82	13.14
Inner Mongolia Saiwaixing HuaZhang Paper Limited	18.84	5.70	18.84	5.01	10.40	3.05
Wulatehouqi Water Company	3.52	1.07	3.52	0.94	3.35	0.98
Baiyannur Fuyuan Shiye Group Limited	30.72	9.30	30.72	8.16	30.47	8.94
Wulatehouqi Huibao Thermal Limited	6.45	1.95	6.45	1.71	6.71	1.97
Wuhai Thermal Co.	41.51	12.56	41.51	11.03	13.42	3.94
Inner Mongolia Haosheng Thermal Limited	14.88	4.50	14.88	3.95	14.23	4.17
Wulatezhongqi Dagong Thermal Limited	3.74	1.13	3.74	0.99	3.08	0.90
Bayannur Yangguang Energy Group Limited	0.00	0.00	38.72	10.29	38.30	11.23
Subtotal	175.43	53.09	214.15	56.90	164.78	48.32
B. Loan						
Asian Development Bank	120.00	36.32	120.00	31.89	117.84	34.56
Local Banks	34.97	10.58	42.17	11.21	58.35	17.11
	154.97	46.90	162.17	43.09	176.19	51.67
	330.40	100%	376.32	100%	340.97	100%

Source: Project management office.

DETAILED COST BREAKDOWN BY PROJECT COMPONENT

Component	Appraised			Major Change in Scope			Actual		
	Foreign Exchange	Local currency	Total Cost	Foreign Exchange	Local currency	Total Cost	Foreign Exchange	Local currency	Total Cost
A.Urban Central Heating Supply	57.16	88.31	145.47	93.75	140.50	234.25	71.57	149.77	221.34
1.Dengkou Central Heating Supply									
a.Equipment	3.68	1.68	5.36	3.68	1.68	5.36		6.40	6.40
b.Civil Works	0.74	3.54	4.28	0.74	3.54	4.28		5.11	5.11
c.Project Management	0.07		0.07	0.07		0.07			
Subtotal component A1	4.49	5.22	9.71	4.49	5.22	9.71		11.52	11.52
2.Hangjinhouqi Central Heating Supply									
a.Equipment	12.41	2.36	14.77	12.41	2.36	14.77	11.82	6.03	17.85
b.Civil Works		9.75	9.75		9.75	9.75		9.41	9.41
c.Project Management	0.17		0.17	0.17		0.17	0.32	0.04	0.36
Subtotal component A2	12.58	12.11	24.69	12.58	12.11	24.69	12.14	15.47	27.61
3.Linhe County Central Heating Supply									
a.Equipment	10.29	0.57	10.86	46.76	11.69	58.46	46.23	8.84	55.07
b.Civil Works	0.10	10.38	10.48	0.00	39.94	39.94		41.85	41.85
c.Project Management	0.15		0.15	0.66	11.20	14.61	0.66	6.82	7.48
Subtotal component A3	10.54	10.95	21.49	47.42	62.83	110.25	46.89	57.51	104.40
4.Wuhai City Central Heating Supply									
a.Equipment	10.00	21.88	31.88	10.00	21.88	31.88	12.25	0.16	12.41
b.Civil Works	0.00	15.04	15.04	0.00	15.04	15.04		14.29	14.29
c.Project Management	0.17		0.17	0.17		0.17	0.29	0.04	0.33
Subtotal component A4	10.17	36.92	47.09	10.17	36.92	47.09	12.54	14.49	27.03
5.Wulatehouqi Central Heating Supply									
a.Equipment	4.00	2.30	6.30	4.00	2.30	6.30		7.53	7.53
b.Civil Works	0.10	3.33	3.43	0.10	3.34	3.44		4.11	4.11
c.Project Management	0.07		0.07	0.00	0.06	0.06		0.07	0.07
Subtotal component A5	4.17	5.63	9.80	4.10	5.70	9.80		11.71	11.71
6.Wulatezhongqi Central Heating Supply									
a.Equipment	3.07	1.02	4.09	3.07	1.02	4.09		4.89	4.89
b.Civil Works	0.00	2.92	2.92	0.00	2.92	2.92		3.49	3.49
c.Project Management	0.05		0.05	0.00	0.05	0.05		0.06	0.06
Subtotal component A6	3.12	3.94	7.06	3.07	3.99	7.06		8.43	8.43
7.Wuyuan Co.Central Heating Supply									
a.Equipment	6.02	2.28	8.30	6.02	2.28	8.30		9.92	9.92
b.Civil Works	0.92	5.43	6.35	0.92	5.43	6.35		7.59	7.59
c.Project Management	0.10		0.10	0.00	0.11	0.11		0.13	0.13
Subtotal component A7	7.04	7.71	14.75	6.94	7.82	14.76		17.63	17.63
8.Wulateqianqi Central Heating Supply									
a.Equipment	4.33	2.08	6.41	4.33	2.08	6.41		7.66	7.66
b.Civil Works	0.65	3.75	4.40	0.65	3.75	4.40		5.26	5.26
c.Project Management	0.07		0.07	0.00	0.08	0.08		0.10	0.10
Subtotal component A8	5.05	5.83	10.88	4.98	5.91	10.89		13.01	13.01

DETAILED COST BREAKDOWN BY PROJECT COMPONENT

Component	Appraised			Major Change in Scope			Actual		
	Foreign Exchange	Local currency	Total Cost	Foreign Exchange	Local currency	Total Cost	Foreign Exchange	Local currency	Total Cost
			0.00						
B.Natural Gas Transimission and Distribut	43.64	45.12 ✓	88.76	43.64	45.12 ✓	88.76	40.01	53.25	93.26
1.Gas Distribution and CNG Station									
a.Equipment	17.68	4.69	22.37	17.68	4.69	22.37	16.12	0.16	16.28
b.Civil Works	0.35	16.45	16.80	0.35	16.45	16.80		11.50	11.50
c.Project Management	0.26		0.26	0.26		0.26	0.26	7.48	7.74
Subtotal component B1	18.29	21.14 ✓	39.43	18.29	21.14 ✓	39.43	16.38	19.15	35.53
2.Chang-Wu-Lin Gas Transmission									
a.Equipment	24.97	7.59	32.56	24.97	7.59	32.56	23.29	23.10	46.39
b.Civil Works	0.04	16.39	16.43	0.04	16.39	16.43		0.28	0.28
c.Project Management	0.34		0.34	0.34		0.34	0.34	10.72	11.06
Subtotal component B2	25.35	23.98 ✓	49.33	25.35	23.98 ✓	49.33	23.63	34.10	57.73
			0.00						
C.City Wastewater Treatment	8.67	14.91 ✓	23.58	1.81	3.49 ✓	5.30	0.00	4.66	4.66
1.Wulatehouqi Wastewater Treatment			0.00			0.00			
a.Equipment	0.94	0.00	0.94	0.94	0.00	0.94		1.12	1.12
b.Civil Works	0.87	3.46	4.33	0.87	3.46	4.33		3.34	3.34
c.Project Management	0.04		0.04	0.00	0.03	0.03		0.19	0.19
Subtotal component C1	1.85	3.46 ✓	5.31	1.81	3.49	5.30		4.66	4.66
2.Wulateqianqi Wastewater Treatment			0.00			0.00			
a.Equipment	4.82	2.50	7.32						
b.Civil Works	1.89	8.95	10.84						
c.Project Management	0.11		0.11						
Subtotal component C2	6.82	11.45 ✓	18.27	0.00	0.00	0.00			
			0.00						
D.Institutional Strengthening	0.60	0.00	0.60	0.60	0.00	0.60	0.34		0.34
E.Contingencies	14.64	19.74	34.38	2.00	3.00	5.00			
Physical	11.01	14.84	25.85	1.00	1.00	2.00			
Price	3.63	4.90	8.53	1.00	2.00	3.00			
			0.00						
F. Finance Charges during Construction	10.55	27.07	37.62	11.25	31.16	42.41	5.92	15.45	21.37
Total Project Cost	135.26	195.15 ✓	330.41	153.05	223.27	376.32 ✓	117.84	223.13	340.97

CNG = compressed natural gas

Source: Project management office.

PROJECTED AND ACTUAL LOAN DISBURSEMENT



(\$ million)		
Year	Disbursement	
	Projected^a	Actual
2008	0.000	0.983
2009	0.000	0.479
2010	12.736	11.273
2011	62.495	62.495
2012	9.796	9.796
2013	23.864	23.865
2014	5.582	5.582
2015	2.810	2.810
2016	2.717	0.564
Total	120.000	117.847

^a Figures shown are cumulative.
Source: Asian Development Bank.

PROJECT IMPLEMENTATION SCHEDULE

[illegible]

Source: Project management office.

 Schedule
 Actual implementation

STATUS OF COMPLIANCE WITH LOAN COVENANTS

Provision	Reference	Compliance Status
<u>Project Executing Agency</u> 1. GIMAR shall be the Project Executing Agency responsible for overall implementation of the Project. 2. A project management office (PMO) will be responsible for managing, coordinating, and supervising implementation of all project subcomponents.	LA Schedule 5, para. 1, para. 2	Complied with.
<u>Project Implementation Agencies</u> 3. The Project subcomponents will be implemented by each concerned project implementing agency (PIA). The following PIAs shall be responsible for day-to-day implementation of the relevant part of the Project as follows: (i) Bayannur Fuyuan Shiye Group Limited Co. shall be responsible for implementation of Component A in each of (a) Dengkou and (b) Wuyuan; (ii) Inner Mongolia Haosheng Thermal Limited Co. shall be responsible for implementation of Component A in Hangjinhouqi; (iii) Inner Mongolia Saiwaixing Huazhang Paper Limited Co. shall be responsible for implementation of (a) Component A and (b) Component C, both in Wulateqianqi; (iv) Inner Mongolia Western Natural Gas Limited Co. shall be responsible for implementation of Component B; (v) Wuhai Thermal Co. shall be responsible for implementation of Component A in Wuhai; (vi) Wutalehouqi Huibao Thermal Limited Co. shall be responsible for implementation of Component A in Wulatehouqi; (vii) Wulatehouqi Water Co. shall be responsible for implementation of Component C in Wulatehouqi; (viii) Wulatezhongqi Dagong Thermal Limited Co. shall be responsible for implementation of Component A in Wulatezhongqi; and, (ix) Bayannur Yangguang Energy Group Co. shall be responsible for implementation of Component A in Linhe District. 4. Each PIA will establish a project implementation office to be directly responsible for design, construction, and operation of its subcomponents.	LA, Schedule 5, para. 3	Complied with. PIAs (ii), (iv), (v), and (ix) implemented subprojects using ADB loan funding. The remaining PIAs implemented without ADB loan financing.
<u>Counterpart Funding</u> 5. The Borrower shall ensure, and shall cause GIMAR to ensure, that all necessary financing (other than from the Loan proceeds) including cash injection and equity contributions 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, the Borrower shall cause GIMAR to provide prompt	LA, Schedule 5, para. 5	Complied with. Counterpart funding was arranged in a timely manner.

Provision	Reference	Compliance Status
and adequate funds as may be necessary for successful implementation of the Project.		
<u>Change in Ownership and Operation</u> 6. In the event (a) of any change in ownership of the Project facilities or (b) any sale, transfer or assignment of shares or interest or other change of control in any PIA is anticipated, the Borrower shall, and shall cause that GIMAR and the concerned PIA to, consult with ADB at least six months prior to the implementation of such change. The Borrower shall, and shall cause GIMAR to, ensure that such change be carried out in a lawful and transparent matter.	LA, Schedule 5, para. 6	Complied with. A change in scope and implementation arrangements was approved by ADB in 2010 to accommodate the expanded district heating subproject in Linhe, and remove the wastewater subproject in Wulateqiaiqi.
<u>Implementation of Heating Tariff Reforms</u> 7. The Borrower shall through GIMAR cause the PIAs to progressively implement at the city level key heating tariff reforms including: (a) installation of lock valves in individual apartment units in buildings to improve tariff collection; (b) installation of radiator control valves in apartment units in buildings to encourage heat conservation; (c) implementation of two-part heating tariff structure that the variable charge shall be based on heat consumption; the overall heating tariff level should be cost-reflective and promote economic efficiency; (d) installation of heat measuring devices at apartment level to support consumption-based billing systems; and (e) conversion from enterprise-based tariff payment system to individual-based payment system.	LA, Schedule 5, para. 7	Complied with. Heating reform that addresses all key heating tariff reforms in the loan covenants was initiated in 2009 and is being implemented.
<u>Project Midterm Review</u> 8. A midterm review of the project shall be undertaken two years after the effective date. Such review shall cover 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, evaluate development, resettlement, environment, poverty impact, and compliance with assurance in the Project Agreement. 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.	LA, Schedule 5 para 8	Complied with in general. Due to a major change in scope in 2010, the midterm review was conducted in September 2011.
<u>Counterpart Funding</u> 9. GIMAR shall ensure that all necessary financing (other than from the loan proceeds) including cash injection and equity contributions 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 may be necessary for successful implementation of the Project.	PA. Schedule, para 1	Complied with. Counterpart funding was arranged in a timely manner.

Provision	Reference	Compliance Status
<p><u>Change in Ownership and Operation</u></p> <p>10. In the event (a) of any change in ownership of the Project facilities or (b) any sale, transfer or assignment of shares or interest or other change of control in any PIA is anticipated, GIMAR shall, and shall cause the concerned PIA to ensure that such change be carried out in a lawful and transparent matter.</p>	PA, Schedule, para. 2	Complied with. A change in scope and implementation arrangements was approved by ADB in 2010 to accommodate the expanded district heating subproject in Linhe, and remove the wastewater subproject in Wulateqiaiqi.
<p><u>Closure of Small Coal-fired Heating Boilers</u></p> <p>11. GIMAR shall ensure that the PIAs complete the closure of 396 small coal-fired heat boilers identified for closure under the Project by 31 December 2009. The demolishing of boilers shall be carried out in accordance with all applicable PRC environmental and safety standards. In accordance with ADB's Social Protection Strategy, GIMAR shall cause the PIAs to ensure that all workers affected by the closure of the small coal-fired heat boilers under the Project are reemployed in a timely manner and in accordance with the reemployment action plan so that they will be at least as well off as they would have been in the absence of the Project.</p>	PA, Schedule, para. 3	Complied with. Due to the change in scope, the number of small coal fired boiler that were closed increased from 322, with a total of 422 small coal-fired heat boilers closed by 2014. All affected boiler workers were either given new positions as boiler workers, or reemployed in other jobs, with no change in the level of their wages and benefits.
<p><u>Construction Quality</u></p> <p>12. GIMAR shall ensure that technical specification of the design of the Project facilities, and construction supervision, quality control and contract management are performed in accordance with national standards and internationally acceptable practice.</p>	PA, Schedule, para. 4	Complied with. The domestic design institute, PIAs, and PMO ensured compliance with national standards, which are equivalent to international practice.
<p><u>Implementation of Heating Tariff Reforms</u></p> <p>13. GIMAR shall cause the PIAs to progressively implement at the city level key heating tariff reforms including: (a) installation of lock valves in individual apartment units in buildings to improve tariff collection; (b) installation of radiator control valves in apartment units in buildings to encourage heat conservation; (c) implementation of two-part heating tariff structure that the variable charge shall be based on heat consumption; the overall heating tariff level should be cost-reflective and promote economic efficiency; (d) installation of heat measuring devices at apartment level to support consumption-based billing systems; and (e) conversion from enterprise-based tariff payment system to individual-based payment system.</p>	PA, Schedule, para. 5	Complied with. Heating reform that addresses all key heating tariff reforms in the loan covenants was initiated in 2009 and is being implemented.

Provision	Reference	Compliance Status
<u>Heating Assistance to the Poor</u> 14. GIMAR shall ensure that the PIAs implement the pro-poor programs that provide heating tariff discounts to the poor based on the cost savings from efficiency improvement under the Project. GIMAR shall ensure that the government-funded heating assistance programs to assist the poor and those with incomes marginally higher than the poverty level to pay heating bills are established in the Project area.	PA, Schedule, para. 6	Complied with. This was addressed in the heating reform policy in 2009.
<u>Financial Performance of the PIAs</u> 15. In each fiscal year commencing from fiscal year 2007, GIMAR shall ensure that PIAs maintain a debt-service coverage ratio of at least 1.4 times; and a current ratio of greater than 1:1 by 2010 and thereafter, and a debt-equity ratio of not greater than 70:30.	PA, Schedule, para. 7	Complied with.
<u>Institutional Strengthening</u> 14. GIMAR shall ensure that the PIAs implement, in accordance with the implementation plan agreed upon between the GIMAR and ADB, the agreed upon recommendations for financial and institutional strengthening made by the consultants under Component D of the Project, in particular with regard to improving cost accounting and financial management and reporting, corporate governance, budgeting, management administration, and staff incentive schemes.	PA, Schedule, para. 8	Complied with. Institutional strengthening activities were implemented.
<u>Environment</u> 15. GIMAR shall ensure that the PIAs implement the Project in accordance with national and local government environmental laws, regulations, procedures, guidelines, the ADB <i>Environment Policy</i> , 2002, and the EIA. The GIMAR shall, and shall cause the PIAs to, ensure that any adverse environmental impacts from the construction and operation of the Project will be minimized, by implementing the mitigation measures in the EMP and environmental monitoring plan. Environmental monitoring reports shall be submitted to ADB twice annually during construction and annually for 2 years during the operational period. The EMP (mitigation measures, monitoring plan and institutional arrangement) shall be updated during the engineering design stage, and will be incorporated in the bidding documents and civil works contracts.	PA, Schedule, para. 9	Complied with, although monitoring report submissions were delayed at times. The EMP was updated at the design stage and incorporated into the bidding documents.
<u>Land Acquisition and Resettlement</u> 16. GIMAR shall through the Municipal Governments and County Governments cause PIAs to (a) implement the RP in accordance with its terms, (b) ensure that all land and rights-of-way required by the Project are made available in a timely manner, (c) ensure that the provisions of the RP, including compensation and entitlements for affected persons (AP), will be implemented in accordance with all applicable Borrower's laws and regulations, and ADB's <i>Policy on Involuntary Resettlement</i> , 1995, (d) ensure all affected people are provided adequate information and regularly consulted in advance of signing household compensation agreements, (e) ensure timely provision of counterpart funds for land acquisition and resettlement activities, (f) meet any obligations	PA, Schedule, para. 10	Complied with. Land acquisition was implemented in compliance with the resettlement plan.

Provision	Reference	Compliance Status
<p>in excess of the RP budget estimate (g) ensure that the AP will be at least as well off as they would have been in the absence of the Project, and (h) ensure that the RP will be updated on completion of the detailed measurement survey and submitted to ADB for review and approval. GIMAR shall ensure that PIAs notify ADB in advance of any significant changes, update the RP as necessary, and submit to ADB such updated RPs. GIMAR shall cause the PIAs to ensure that civil works contractors' specifications include requirements to comply with the RP and entitlements for permanent and temporary impacts to the AP, and will supervise the Project contractors to ensure compliance with requirements of RP, applicable law and ADB's <i>Policy on Involuntary Resettlement, 1995</i>. GIMAR shall, and shall cause the PIAs to, keep ADB informed of the progress of implementation of the RP through the quarterly progress reports and through two reports on achievement of resettlement objectives to be submitted immediately upon completion of the resettlement plan and one year thereafter. GIMAR shall engage an independent domestic agency to (a) monitor the implementation of the RP including the extent to which adverse social impacts have been compensated for, (b) provide inputs for the quarterly progress reports on the implementation of the RP, and (c) prepare an evaluation report of the resettlement one year after completion. GIMAR shall, and shall cause the PIAs to, ensure that the payment of compensation and all resettlement assistance prior to APs being dispossessed of their assets and external monitoring reports will be submitted to ADB.</p>		
<p><u>Gender and Development</u> 17. GIMAR shall ensure that the PIAs follow the principles of the ADB's <i>Policy on Gender and Development, 1998</i> 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, which are included in the Social Development Action Plan.</p>	PA, Schedule, para. 11	Complied with.
<p><u>Health and Social Risks</u> 18. 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 civil works contracts, and compliance shall be strictly monitored by the GIMAR and the PIAs.</p>	PA, Schedule, para. 12	Complied with.
<p><u>Labor and Employment</u> 19. GIMAR shall, and shall cause the PIAs to, ensure that Project contractors: (a) are encouraged to use local labor and local materials in Project works; (b) provide equal pay to men and women for work of equal type; (c) provide safe working conditions for both male and female workers, (d) maximize employment for the affected persons with equal access to women, including</p>	PA, Schedule, para. 14	Complied with.

Provision	Reference	Compliance Status
disadvantaged women, (e) comply with applicable labor laws, and (f) abstain from child labor in construction, operation and maintenance activities on Project facilities.		
<u>Anticorruption measures</u> 20. GIMAR shall, and shall cause the PIAs to: (i) undertake necessary measures to create and sustain a corruption-free environment, (ii) ensure that Borrower's anticorruption laws and regulations and ADB's Anticorruption Policy, 1998, 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, (iii) facilitate in ADB's exercise of its right to investigate, directly or through its agents, any alleged corrupt, fraudulent, collusive or coercive practices relating to the Project, (iv) conduct periodic inspections on the Project contractor's activities related to fund withdrawals and settlements, and (v) ensure that all contracts financed by ADB in connection with the Project include provisions specifying the right of ADB to audit and examine the records and accounts of the PIAs and all contractors, suppliers, consultants and other service providers as they relate to the Project. GIMAR shall also (i) involve full-time officials from the Finance Bureau of IMAR in the supervision of bidding, construction, and operations; and (ii) carry out periodic inspections of the contractors' activities related to fund withdrawals and settlements.	PA, Schedule, para. 15	Complied with.
<u>Monitoring and Evaluation</u> 21. GIMAR shall monitor and evaluate Project impacts, with assistance of the consultants engaged under the Project, as specified in the project performance management system (PPMS) developed for the Project and agreed to by GIMAR, to ensure that the Project facilities are managed effectively and the benefits, particularly to the poor, are maximized. GIMAR shall (i) engage consultants for monitoring and evaluation by December 2006, (ii) facilitate the data collection from local governments, including local statistics offices, to measure the indicators in the PPMS during Project implementation, at completion, and biennially, for 5 years thereafter, with the frequency as specified in the PPMS; and (iii) submit to ADB the reports summarizing the key findings.	PA, Schedule, para. 16	Complied with.
<u>Project Midterm Review</u> 22. A midterm review of the project shall be undertaken two years after the Effective Date. Such review shall cover 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, evaluate development, resettlement, environment, poverty impact, and compliance with assurance in the Project Agreement. 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.	PA, Schedule, para. 17	Complied with in general. Due to a major change in scope in 2010, the midterm review was conducted in September 2011.

Provision	Reference	Compliance Status
24. Section 2.01. (a) GIMAR shall, and shall cause the PIAs to, carry out the Project with due diligence and efficiency, and in conformity with sound administrative, financial, engineering, environmental and, where applicable, heating supply, gas transmission and distribution, and wastewater treatment practices. (b) In the carrying out of the Project and operation of the Project facilities, GIMAR shall, and shall cause the PIAs to, perform all obligations set forth in the Loan Agreement to the extent that they are applicable to GIMAR and the PIAs and all obligations set forth in the Schedule to this Project Agreement.	PA Article II, Particular Covenants	Complied with.
25. Section 2.02. GIMAR shall, and shall cause the PIAs to, make available, promptly as needed, the funds, facilities, services, equipment, land and other resources which are required, in addition to the proceeds of the Loan, for the carrying out of the Project.	PA Article II, Particular Covenants	Complied with.
26. Section 2.03. (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. (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.	PA Article II, Particular Covenants	Complied with.
27. Section 2.04. 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.	PA Article II, Particular Covenants	Complied with.
28. Section 2.05. (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 the Project facilities to such extent and against such risks and in such amounts as shall be consistent with sound practice. (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 and shall cause the PIAs to undertake 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.	PA Article II, Particular Covenants	Complied with.

Provision	Reference	Compliance Status
29. Section 2.06. 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 Article II, Particular Covenants	Complied with.
30. Section 2.07. (a) ADB and GIMAR shall cooperate fully to ensure that the purposes of the Loan will be accomplished. (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 of the Onlending Agreements, or the accomplishment of the purposes of the Loan. (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.	PA Article II, Particular Covenants	Complied with.
31. Section 2.08. (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 and 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. (b) Without limiting the generality of the foregoing, GIMAR shall furnish to ADB quarterly reports on the execution of the Project during the construction period and reports on the operation and management of the Project facilities. 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 quarter under review, steps taken or proposed to be taken to remedy these problems, and proposed program of activities and expected progress during the following quarter. (c) Promptly after physical completion of the Project, but in any event not later than three (3) 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.	PA Article II, Particular Covenants	Complied with.
32. Section 2.09. (a) GIMAR shall maintain separate accounts for the Project and shall cause the PIAs to maintain separate accounts for their respective Components or subcomponents. 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	PA Article II, Particular Covenants	Complied with.

Provision	Reference	Compliance Status
<p>applied, by external 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 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. (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 the concerned PIA shall otherwise agree.</p>		
<p>33. Section 2.10. 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 to the extent applicable to the Project, and any relevant records and documents.</p>	<p>PA Article II, Particular Covenants</p>	<p>Complied with.</p>
<p>34. Section 2.11. (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>PA Article II, Particular Covenants</p>	<p>Complied with.</p>
<p>35. Section 2.12. 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.</p>	<p>PA Article II, Particular Covenants</p>	<p>Complied with.</p>
<p>36. Section 2.13. 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.</p>	<p>PA Article II, Particular Covenants</p>	<p>Complied with.</p>
<p>37. Section 2.14. Except as ADB may otherwise agree, GIMAR shall duly perform all its 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</p>	<p>PA Article II,</p>	<p>Complied with.</p>

Provision	Reference	Compliance Status
assigning, amending, abrogating or waiving any rights or obligations of the parties under any such agreement.	Particular Covenants	
38. Section 2.15. GIMAR shall, and shall cause the concerned PIA to, promptly notify ADB of any proposal to amend, suspend or repeal any provision of the PIA's Charter and shall afford ADB an adequate opportunity to comment on such proposal prior to taking any action thereon.	PA Article II, Particular Covenants	Complied with

ADB = Asian Development Bank, AIDS = acquired immune deficiency syndrome, AP = affected person, EIA = environmental impact assessment, EMP = environmental management plan, GIMAR = government of Inner Mongolia Autonomous Region, HIV = human immunodeficiency virus, PA = project agreement, PMO = project management office, PPMS = project performance management system, PRC = People's Republic of China, RP = resettlement plan.

ADB-FINANCED CONTRACT PACKAGES

Contract Description	PCSS #	Mode of Procurement	Date of Contract	Contract Amount \$('000)
A1. Wuhai DHS Subcomponent				
Sleeve Pipes and Tubes	0003	ICB	30 Dec 2008	2708.6
Instrument & Control of Heat Exchange Stations	0025	ICB	15 Oct 2012	4,989.8
Pre-fabricated insulation pipe and fittings	0026	ICB	12 May 2014	4,554.4
Subtotal				12,252.9
A2. Hangjinhouqi DHS Subcomponent				
Instrument & Control of Heat Exchange Stations	0024	ICB	29 Jun 2012	783.0
Water Pumps, valves, plate-type heat exchanger	0014	ICB	15 Aug 2010	1,705.5
Boilers and Auxiliary	0018	ICB	1 Jun 2011	5150.7
Insulated Pipes, Fittings and Compensators	0006	ICB	1 Aug 2010	4,180.0
Subtotal				11,819.2
A3. Linhe DHS Subcomponent				
Main Pipeline and Fittings for Saibei Street and Jinchuan Road	0007	ICB	15 Sep 2010	8,017.3
Main Pipeline and Fittings for Shuofang Road and Hetao Street	0008	ICB	15 Sep 2010	7,682.7
Pre-insulated Pipe and Fittings for Old Pipeline Network Construction	0015	ICB	14 Feb 2011	4,560.0
Newly Built and Reconstruction of Centralized Heat Supply Pipeline Network	0016	ICB	14 Feb 2011	6,080.0
Equipment	0017	NCB	14 Feb 2011	722.8
Newly built and rebuilt central heat supply project valves and filter	0019	ICB	31 Aug 2012	1367.5
Full Automatic Heat Exchanging Unit Equipment	0020	ICB	31 Aug 2012	7,074.4
Water Softener and Soft Water Tank	0021	ICB	31 Aug 2012	1,359.0
Branch Pipelines and Fittings, and Heat Exchanging Stations Materials	0022	ICB	31 Aug 2012	5,244.4
Electrical Equipment and Dispatching Control System	0023	ICB	31 Aug 2012	4,149.0
Subtotal				46,257.1
B1. Chang-Wu-Lin Gas Transmission Subcomponent				
Spiral Submerged Arc Welded Steel Pipe	0004	ICB	1 Jun 2010	13,235.4
Spiral Submerged Arc Welded Steel Pipe	0005	ICB	1 Jun 2010	9,087.8
Equipment	0013	ICB	18 Mar 2011	3,786.4
B2. Gas Distribution and CNG Station Subcomponent				
Equipment	0010	ICB	18 Mar 2011	4,016.6
Equipment	0011	ICB	18 Mar 2011	3,796.6
Pipes and Fittings	0012	ICB	18 Mar 2011	6,518.2
Subtotal				40,441.0
C. Institutional Reforms and Corporate Governance Improvement				
Consulting services for institutional strengthening	0001	QCBS	11 Aug 2008	315.1
Consulting services for project implementation supervision	0002	QCBS	11 Aug 2008	317.1
Project management expenses	0009			524.1
Subtotal				1,156.3
Total				111,926.6

ADB = Asian Development Bank, CNG = compressed natural gas, DHS = district heating supply, ICB = international competitive bidding, NCB = national competitive bidding, PCSS = procurement contract summary sheet, QCBS = quality- and cost-based selection.

Source: Asian Development Bank.

ECONOMIC REEVALUATION

1. The project aimed to improve air and water quality in targeted cities in Inner Mongolia Autonomous Region (IMAR). The project covered Wuhai and Bayanuur cities in western IMAR, and consisted of (i) component A: urban central heating supply, (ii) component B: natural gas transmission and distribution, (iii) component C: city wastewater treatment, and (iv) component D: institutional reform and corporate governance improvement. Economic reevaluation of the project was conducted in accordance with Asian Development Bank (ADB) guidelines.¹

A. General Assumptions for Economic Analysis

2. Economic reevaluation reassessed the economic internal rates of return (EIRRs) of components A, B, and C, and results were compared with the estimates at appraisal. Project costs and benefits were reviewed based on information provided by the executing and implementing agencies. The economic feasibility was evaluated by comparing with- and without-project scenarios. The without-project scenario made the following assumptions: (i) existing and future space heating demand will be met by small inner-city coal-fired boilers (component A); (ii) existing and future energy demand for residential, commercial, and industrial use will be met through the use of coal (component B); and (iii) untreated wastewater will be continuously discharged into the river (component C). The reevaluation was conducted for the project lifespan for 25 years plus the actual implementation period of each subproject. The residual value at the end of the project life was assumed to be zero. All prices and costs were expressed in 2016 prices and in the domestic currency using the world price numeraire. The analysis was carried out using the standard conversion factor of 0.987 for shadow pricing of non-tradable goods and services, 1.00 for tradable goods and services, and a shadow wage rate factor of 0.67 for unskilled labor.²

B. Economic Costs

3. The financial capital costs were converted to the relevant economic values after deducting taxes, subsidies, and price contingencies, and then applying the respective conversion factors as specified in the general assumptions. The capital costs of the project included actual costs related to civil works, materials, equipment, and the other associated costs. These costs occurred during the construction of each subproject in components A, B, and C.³ The operation and maintenance (O&M) costs were assumed to remain constant in real terms, and comprise costs for fuel and related input purchases, electricity, water, salaries, overhead, and administrative expenses. The O&M costs occur throughout the life of each subproject.

C. Economic Benefits

4. The economic benefits of the project include (i) revenues from district heating, natural gas transmission and distribution, and wastewater treatment—calculated by willingness to pay for district heating, natural gas supply services, and wastewater treatment services—as incremental benefits; (ii) savings in coal use from increased heating generation efficiency and demolition of small, inner city energy-inefficient coal-fired boilers, and replacement of coal with natural gas use as a non-incremental benefit; and (iii) environmental benefits, which are reflected in (a) the net

¹ ADB. 1997 and 2017. *Guidelines for the Economic Analysis of Projects*. Manila.

² These conversion factors have been used consistently for recently approved energy projects in neighboring provinces in the PRC, such as the Shanxi Energy Efficiency and Environment Improvement Project (ADB. 2014. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Low Carbon District Heating Project in Huhhot in Inner Mongolia Autonomous Region*. Manila).

³ Costs occurred for implementation in component D were included in the economic reevaluation for the entire project.

reduction of environmental costs associated with energy efficiency gains from replacement of inefficient small coal-fired boilers with energy efficient district heating systems (428,089 tons of annual coal savings from component A); (b) gains stemming from conversion from coal use to natural gas (217,509 tons of annual coal savings from component B); and (c) a reduction in untreated wastewater discharge into the river (2.19 million tons of annual treated wastewater discharge from component C).⁴ The environmental benefits are estimated using the avoided annual net emissions associated with components A, B, and C—namely: 1,071,964 tons of carbon dioxide, 2,718 tons of nitrogen oxides, 17,570 tons of sulfur dioxide, 21,547 tons of total suspended particulates, and 104,635 tons of coal ash—multiplied by the unit environmental cost.⁵ The environmental benefits of the city wastewater subproject, which treats 6,000 tons of wastewater per day, include an avoided annual discharge of 985 tons of chemical oxygen demand, 400 tons of biological oxygen demand, 530 tons of suspended solid, 62 tons of ammoniacal nitrogen, 86 tons of total nitrogen, and 6 tons of total phosphorous.⁶

D. Economic Internal Rate of Return

5. The EIRR of each subproject is recalculated with and without the environment benefits. The recalculated EIRR for the whole project, and each subproject (comprising components A, B, and C) is in Table A8.1.

Table A8.1: Comparison of Economic Internal Rate of Return

Subcomponents/Subprojects	Appraisal		Completion	
	Without Environment Benefit (%)	With Environment Benefit (%)	Without Environment Benefit (%)	With Environment Benefit (%)
Component A: Urban Central Heating System	15.0	19.7	15.8	23.9
Dengkou Central Heating Supply	22.1	26.4	15.4	25.9
Wuyuan Central Heating Supply	15.8	19.3	12.6	22.3
Linhe Central Heating Supply	10.0	14.0	18.5	24.2
Wuhai Central Heating Supply	11.0	15.0	17.1	23.8
Hangjinhouqi Central Heating Supply	12.8	17.9	13.0	24.7
Wulatehou Central Heating Supply	16.5	21.8	12.9	21.3
Wulatezhong Central Heating Supply	14.3	20.1	12.8	24.3
Wulateqian Central Heating Supply	17.9	23.7	13.3	24.2
Component B: Natural Gas Transmission and Distribution	18.1	19.9	16.9	23.6
Chang–Wu–Lin Gas Transmission	15.8	19.3	16.5	24.7
Gas Distribution and Station	20.4	20.4	17.6	21.7
Component C: City Wastewater Treatment	19.2	21.7	6.5	12.1
Wulatehou Wastewater Treatment	25.9	40.0	6.5	12.1
Wulateqian Wastewater Treatment	12.5	21.5		
The Overall Project	17.6	21.4	15.8	23.5

Source: Project management office, and Asian Development Bank estimates.

⁴ Willingness to pay for heating was estimated at CNY24 per square meter of district heating area; CNY2.4 per cubic meter (m³) for natural gas supply, including CNY0.54 for natural gas transmission; and CNY2.73 per m³ of treated wastewater.

⁵ Current emission charges were used for sulfur dioxide (CNY1,600 per ton), nitrogen oxides (CNY631 per ton), and particulate matter (CNY235 per ton); carbon dioxide emissions were calculated at \$36.3 (CNY 238) per ton (increasing at 2% per year).

⁶ Market prices are unavailable for water pollutant emissions; the reevaluation used the penalty charge for chemical oxygen demand (CNY1,675 per ton) and ammoniacal nitrogen (CNY1,750 per ton) to estimate the environmental benefit.

6. The recalculated EIRR for the entire project was 15.8% without environmental benefits, and 23.5% with environmental benefits. The EIRR for the urban central heating component (component A) was 15.8% without environmental benefits, and 23.9% with environmental benefits. The EIRR for natural gas transmission and distribution (component B) was 16.9% without environmental benefits, and 23.6% with environmental benefits. The EIRR for the city wastewater treatment component (component C) was 6.5% without environmental benefits, and 12.1% with environmental benefits. Because of the substantial environmental benefits, the EIRRs for all subprojects with environmental benefits were assessed to be above the 12% of economic opportunity cost of capital. The economic benefits and costs of the entire project, with and without environmental benefits, is in Table A8.2.

Table A8.2: Economic Internal Rate of Return for the Overall Project (CNY million)

	Economic Benefit	Environment Benefit	Total Cost	Net Economic Benefit	Net Environment Benefit
2007			307.81	(307.81)	(307.81)
2008			269.92	(269.92)	(269.92)
2009	5.98	7.88	160.18	(154.20)	(152.30)
2010	329.11	392.99	442.60	(113.49)	(49.60)
2011	582.27	686.06	1,004.09	(421.82)	(318.03)
2012	613.04	748.68	586.92	26.11	161.76
2013	622.04	758.71	801.76	(179.72)	(43.06)
2014	623.04	762.20	606.79	16.25	155.41
2015	1,057.33	1,318.47	727.99	329.34	590.49
2016	1,189.61	1,453.21	700.59	489.02	752.62
2017	1,189.61	1,458.13	698.36	491.25	759.77
2018	1,189.61	1,463.15	698.36	491.25	764.80
2019	1,189.61	1,468.28	698.36	491.25	769.92
2020	1,189.61	1,473.50	698.36	491.25	775.14
2021	1,189.61	1,478.83	698.36	491.25	780.47
2022	1,189.61	1,484.27	698.36	491.25	785.91
2023	1,189.61	1,489.81	698.36	491.25	791.45
2024	1,189.61	1,495.47	698.36	491.25	797.11
2025	1,189.61	1,501.24	698.36	491.25	802.88
2026	1,189.61	1,507.12	698.36	491.25	808.76
2027	1,189.61	1,513.12	698.36	491.25	814.76
2028	1,189.61	1,519.24	698.36	491.25	820.89
2029	1,189.61	1,525.49	698.36	491.25	827.13
2030	1,189.61	1,531.86	698.36	491.25	833.50
2031	1,189.61	1,538.36	698.36	491.25	840.00
2032	1,189.61	1,544.98	698.36	491.25	846.62
2033	1,189.61	1,551.74	698.36	491.25	853.38
2034	1,183.63	1,550.75	695.49	488.14	855.27
2035	860.50	1,135.63	444.97	415.53	690.66
2036	860.50	1,140.90	444.97	415.53	695.93
2037	434.29	612.36	169.90	264.38	442.46
2038	434.29	615.82	169.90	264.38	445.91
2039	434.29	619.34	169.90	264.38	449.44
ENPV without Environment Benefit			500.61		
ENPV with Environment Benefit			1,700.34		
EIRR without Environment Benefit			15.85%		
EIRR with Environment Benefit			23.55%		

() = negative, CNY = Chinese Yuan, EIRR = economic internal rate of return, ENPV = economic net present value.

Source: Project management office, and Asian Development Bank estimates.

E. Sensitivity Analysis

7. Sensitivity analysis was performed to test the EIRR's sensitivity to changes in various parameters (Table A8.3). The recalculated EIRR for the entire project without environmental benefits decreased to (i) 12.0% when all economic benefits are reduced by 10%, (ii) 14.6% if the project experiences a cost overrun of 10%, (iii) 13.5 % if the O&M costs are increased by 10%, and (iv) 8.5% if all are combined. The recalculated EIRR for the entire project with environmental benefits decreased to (i) 19.6% when all the economic benefits are reduced by 10%, (ii) 21.8% if the subprojects experience a cost overrun of 10%, (iii) 21.5% if the O&M costs are increased by 10%, and (iv) 16.2% if all are combined. Under these sensitivity scenarios, the project with environment benefits will be economically viable under all of the tested adverse conditions. All components (except component C) were also assessed to be economically viable under all adverse conditions when considered with environmental benefits.

Table A8.3: Sensitivity Analysis of the Economic Internal Rate of Return

	Whole Project		Component A Urban Central Heating System		Component B Natural Gas Transmission and Distribution		Component C: City Wastewater Treatment	
	Without Environment	With Environment	Without Environment	With Environment	Without Environment	With Environment	Without Environment	With Environment
	Benefit	Benefit	Benefit	Benefit	Benefit	Benefit	Benefit	Benefit
Base Case	17.7	20.4	17.9	20.9	18.1	19.7	6.8	12.0
(i) Sensitivity 1: Capital Cost Overrun 10%	16.2	18.8	16.5	19.4	16.2	17.7	5.8	10.8
(ii) Sensitivity 2: Benefit Decrease 10%	13.6	16.3	13.9	16.8	13.4	15.0	4.7	9.9
(iii) Sensitivity 3: O&M Cost Overrun 10%	15.3	18.1	15.4	18.6	15.7	17.4	5.8	11.3
(v) Sensitivity 4: Combined (i), (ii), and (iii)	9.9	12.6	10.3	13.2	9.1	10.8	2.8	7.9

O&M = operation and maintenance.

Source: Project management office, and Asian Development Bank estimates.

FINANCIAL REEVALUATION

1. The project aimed to improve air and water quality in targeted cities in the Inner Mongolia Autonomous Region (IMAR). The project covered Wuhai and Bayanuur cities in western IMAR, and consisted of (i) component A: urban central heating supply, (ii) component B: natural gas transmission and distribution, (iii) component C: city wastewater treatment, and (iv) component D: institutional reform and corporate governance improvement. Component D involved capacity building support for the executing and implementing agencies, and was excluded from the financial reevaluation.

2. The analysis was performed in accordance with Asian Development Bank (ADB) guidelines.¹ All actual costs and prices are in constant 2015 currency values. The financial internal rate of return (FIRR) was derived using incremental annual cash flows throughout the 25-year lifespan of each subproject. The financial analysis model compared each subproject's FIRR with the weighted average cost of capital (WACC). Sensitivity analyses were conducted to assess the impact of various adverse conditions.

A. Key Assumptions

3. Capital costs are based on the actual project investments including civil works, equipment and materials, project administration, and associated costs. Revenues were calculated based on the actual and projected sales of heating supply, natural gas transmission and distribution, and wastewater treatment, using 2016 tariff levels. Operational costs include fuel, electricity, wages and benefits, maintenance and repair, and other sales and management expenses. Net cash flows from the subprojects are determined after allowing for corporate income taxes (25% of pre-tax profit). The WACC was calculated after-tax in real terms using the actual capital mix and costs of funds. The real interest costs of loan funds were considered based on the actual cost of loan funds from ADB and domestic banks. The cost of equity is assumed at 8.0%.

B. Financial Indicators

4. Results of the financial analysis for whole project and each subproject under components A, B, and C are in Table A9.1. All subprojects are above the WACC, and deemed financially viable.

Table A9.1: Projected Financial Indicators

Subcomponents/Subprojects	Appraisal		Completion	
	FIRR (%)	WACC (%)	FIRR (%)	WACC (%)
Component A: Urban Central Heating System	7.6	4.0	9.1	3.5
Dengkou Central Heating Supply	6.7	4.0	7.7	3.1
Wuyuan Central Heating Supply	7.6	4.0	8.9	2.9
Linhe Central Heating Supply	7.1	4.0	8.4	2.9
Wuhai Central Heating Supply	8.4	4.4	9.9	3.3
Hangjinhouqi Central Heating Supply	7.3	3.6	10.9	3.3
Wulatehou Central Heating Supply	8.2	4.0	8.5	3.4
Wulatezhong Central Heating Supply	7.5	3.5	9.9	3.2
Wulateqian Central Heating Supply	7.6	4.0	8.1	3.1

¹ ADB. 2005. *Financial Management and Analysis of Projects*. Manila.

Subcomponents/Subprojects	Appraisal		Completion	
	FIRR (%)	WACC (%)	FIRR (%)	WACC (%)
Component B: Natural Gas Transmission and Distribution	7.9	3.7	14.4	2.9
Chang–Wu–Lin Gas Transmission	7.9	3.7	16.9	3.1
Gas Distribution and Station	7.9	3.6	10.0	2.5
Component C: City Wastewater Treatment	7.1	3.5	4.8	2.7
Wulatehouqi Wastewater Treatment	6.7	4.0	4.8	2.7
Wulateqian Wastewater Treatment	7.3	3.3	0.0	0.0
The Overall Project	7.7	3.9	10.5	3.3

FIRR = financial internal rate of return; WACC = weighted average cost of capital.

Source: Project management office and Asian Development Bank estimates.

5. The recalculated FIRR for the project is 10.5%, compared with 7.7% at appraisal. The reduction in capital costs and favorable full cost-recovery tariffs contributed to increasing the FIRRs in all subprojects under components A and B. The FIRR for the Wulatehouqi wastewater treatment subproject is lower than the original estimate mainly because of the lower wastewater tariff than estimated at appraisal, but still exceeds the WACC. The Wulateqinqi wastewater treatment subproject was canceled in 2010, and is excluded from the financial reevaluation. Net cash flow for the whole project and each subcomponent are in Table A9.2.

Table A9.2: Consolidated Cash Flows for the Overall Project (CNY million)

Year	Capital Costs	O&M Costs	Revenue	Cash Flow		
				Net Cash Flow before tax	Income Tax	Net Cash Flow after tax
2007	313.47	0.00	0.00	(317.73)	0.00	(317.73)
2008	289.02	0.00	0.00	(295.15)	0.00	(295.77)
2009	162.53	0.00	0.00	(204.77)	0.00	(204.77)
2010	197.77	242.80	236.25	(48.41)	3.25	(51.66)
2011	746.99	377.96	474.19	(401.07)	3.84	(404.91)
2012	99.23	447.77	531.03	(104.26)	10.95	(115.21)
2013	315.96	437.24	593.01	(366.06)	16.43	(382.49)
2014	119.03	441.12	654.67	27.32	19.80	7.52
2015	69.82	657.90	991.76	264.04	45.19	218.85
2016	2.25	667.95	1008.51	338.31	31.29	307.02
2017	0.00	679.47	1028.55	349.08	28.97	320.11
2018	0.00	688.46	1045.28	356.82	29.14	327.68
2019	0.00	697.45	1065.32	367.87	29.70	338.17
2031	0.00	707.87	1075.63	367.77	30.47	337.29
2032	0.00	707.87	1075.63	367.77	30.55	337.22
2033	0.00	707.87	1075.63	367.77	32.63	335.14
2034	0.00	704.94	1068.98	364.05	32.63	331.42
2035	0.00	449.31	748.56	299.25	24.41	274.84
2036	0.00	286.09	458.25	172.16	24.41	147.76
2037	0.00	173.37	314.58	141.21	20.60	120.62
2038	0.00	173.37	314.58	141.21	20.60	120.62
2039	0.00	173.37	314.58	141.21	20.60	120.62
WACC						
3.31%						
					FNPV	2,357.4
					FIRR	10.5%

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

Source: project management office and Asian Development Bank estimates.

C. Sensitivity Analysis

6. Sensitivity analysis was performed to test the FIRR's sensitivity to certain changes in parameters. The sensitivity analysis focused on four variables: (i) project costs increase by 10%; (ii) revenue decreases by 10%; (iii) O&M costs increase by 10%; (iv) implementation is delayed by 1 year; and (v) a combination of all variables. The sensitivity analysis results for the overall project are shown in Table A9.3.

7. The whole project and each project subcomponent are assessed robust in each adverse condition except all combined sensitivity case, and FIRRs in general are above the WACC. Among sensitivity cases, all components are relatively sensitive to a decline in revenues.

Table A9.3: Sensitivity Analysis of Financial Internal Rates of Return (%)

	Whole Project		Component A Urban Central Heating System		Component B Natural Gas Transmission and Distribution		Component C City Wastewater Treatment	
	Appraisal	Completion	Appraisal	Completion	Appraisal	Completion	Appraisal	Completion
Base Case	7.7	10.5	7.6	9.1	7.9	14.4	7.1	4.8
(i) Sensitivity 1: Capital Cost Overrun 10%	6.6	8.0	6.6	6.4	6.8	12.5	6.1	3.9
(ii) Sensitivity 2: Revenue Decrease 10%	5.2	6.8	4.9	5.8	5.3	9.7	4.7	3.0
(iii) Sensitivity 3: O&M Cost Overrun 10%	6.7	9.1	6.5	7.3	7.4	13.6	6.6	4.8
(iv) Sensitivity 4: Implementation Delay 1 Year	7.3	10.4	7.3	9.0	7.7	14.3	6.1	4.6
(v) Sensitivity 5: Combined (i), (ii), (iii), and (iv)	2.9	4.9	2.8	3.2	3.3	9.2	1.3	2.0
WACC	3.9	3.3	4.0	3.5	3.7	2.9	3.5	2.7

O&M = operation and maintenance, WACC = weighted average cost of capital.

Note: Sensitivity indicator is the ratio of percentage change in the financial internal rate of return divided by the percentage change in the given parameter.

Source: Project management office and Asian Development Bank estimates.

ENVIRONMENTAL IMPACT ASSESSMENT

A. Introduction

1. The project completed construction of (i) urban central heating supply (component A), comprising construction of 773 megawatts (MW) of heat generation capacity, 224 heat exchange stations, 247 kilometers (km) of heat supply pipeline, and closure of 431 small inner-city boilers during 2009 to 2015; (ii) natural gas transmission and distribution (component B), comprising construction of 426 km of the Changqing–Wuhai–Linhe natural gas primary pipeline and 338 km of natural gas secondary pipelines across Erdos, Wuhai, and Bayanur cities, including associated transmission substations and valve stations; a compressed natural gas (CNG) primary supply station; CNG satellite filling stations; and natural gas unloading stations in 2007; and (iii) city wastewater treatment (component C), comprising 6,000 tons per day of wastewater treatment capacity in Wulatehouqi, in 2008.

2. The project is classified as category B (sensitive) for the environment in accordance with the Asian Development Bank (ADB) environmental categorization.¹ Domestic environmental impact assessment reports were prepared in 2005 for all subprojects under components A, B, and C, and approved by the Environment Protection Bureau of the Inner Mongolia Autonomous Region (IMAR) in 2006. The summary initial environmental examination (SIEE) was prepared in accordance with the ADB Environment Policy (2002) and submitted to ADB in 2006. In response to a major change in scope in 2010 to accommodate the expanded district heating subproject in Linhe, and approval of the domestic environmental impact assessment report by IMAR Environment Protection Bureau in 2009, a supplementary initial environmental examination was prepared in accordance with the ADB Safeguard Policy Statement (2009) and submitted to ADB in 2010.² As required under national laws and regulations of the People's Republic of China (PRC), all subprojects in components A, B, and C were reviewed through the environment protection completion audit by the IMAR provincial and municipal environmental protection bureaus during 2010 to 2016. The demolition of boilers was carried out in accordance with the applicable environmental and safety standards of the PRC.

B. Institutional Setup and Environmental Management

3. The government of IMAR (GIMAR) 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 GIMAR 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 (EMU) responsible for implementation and monitoring of the EMP during subproject construction and operation. The PMO designated environmental staff to coordinate with each EMU, conduct environmental management of subprojects, and oversee EMP implementation and monitoring for all subprojects, with assistance from the consultant engaged under the institutional reform and corporate governance improvement component (component D).

¹ The project remained classified as category B for the environment following the major change in scope in 2010.

² A total of 975 affected people were involved during preparation and implementation of SIEE. Public hearings were also held separately in each subproject site to receive opinions.

4. During the construction phase, all contractors kept daily and weekly environmental records, and prepared environmental monitoring reports that were submitted to the PIAs. 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. The PMO submitted EMPs to ADB twice per year during construction, and once per year for 2 years following completion of construction.

C. Environmental Impacts and Mitigation Measures Undertaken

5. 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 A10.1 presents the implementation status of mitigation measures during construction and operation.

Table A10.1: Environmental impacts, mitigation measures, and implementation status

Issue	Major Impacts, Mitigation Measures and Monitoring Frequency	Responsible party and compliance status
Construction Phase		
Soil erosion	<p>Temporary soil stockpiles were covered, stockpile trenches recompacted, sediment fences installed to minimize sediment runoff, and disturbed surfaces revegetated to minimize erosion.</p> <p>Implementation of soil erosion mitigation measures was monitored by the EMU and construction supervision companies.</p>	<p>Contractor, PMO, EMU, and construction supervision companies</p> <p>Fully complied with.</p>
Soil contamination by hazardous waste and materials, including hydrocarbons	<p>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.</p> <p>Implementation of soil erosion mitigation measures was monitored by the EMU and construction supervision companies.</p>	<p>Contractor, EMU, construction supervision companies, and local EPB.</p> <p>Fully complied with.</p>
Water	<p>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.</p> <p>Implementation of soil erosion mitigation measures was monitored by the EMU and construction supervision companies.</p>	<p>Contractor, EMU, construction supervision companies, and local EPB</p> <p>Fully complied with.</p>
Air quality	<p>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 Class II air quality standard (GB3095-1996).</p> <p>Implementation of air quality mitigation measures was monitored by the EMU, construction supervision companies, and the local EPBs.</p>	<p>Contractor, EMU, construction supervision companies, and local EPBs.</p> <p>Fully complied with.</p>

Noise	<p>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.</p> <p>Implementation of air quality mitigation measures monitored by EMU, construction supervision companies, and local EPBs.</p>	<p>Local EPBs, EMU, and supervision company.</p> <p>Fully complied with.</p>
Flora (Impact on <i>Tetraena mongolica Maxim</i> in the WENNR)	<p>Specific mitigation measures included (i) limiting the construction corridor to 9 m in width (including trenching activities and access roads); (ii) providing an environmental training program for all construction workers regarding environmental management issues relating to protected species; (iii) taking special precautions to prevent fires during construction; (iv) revegetating compacted trenches, including removal and preservation of <i>Tetraena mongolica Maxim</i> plants, if encountered, and replanting after completion of pipeline-laying activities; and (v) burying the pipeline 2 m below ground.</p>	<p>Local EPBs and WENNR Authority.</p> <p>Around 15 km of the pipeline section was located inside the experimental zone of the WENNR, where infrastructure facilities such as a highway and railways already existed. Environment mitigation measures for this 15 km of pipeline route were approved and monitored by local EPBs, and the WENNR Authority.</p>
Operation phase		
Wastewater Treatment Plants	<p>The plant site is more than 300 m away from residential areas, and ventilation for the sludge dewatering room—including tree planting around the plant—was implemented to minimize the emission of odors from the plant in accordance with Technical Specification of Wastewater Engineering for Town and Villages (CJJ 123/124-2008).</p> <p>For dry sludge disposal, the plant complied with the Technical Specification of Sludge Treatment for the Wastewater Treatment (CJJ 131-2008), and operational manuals were prepared and implemented for proper sludge disposal.</p> <p>To ensure the treatment quality of wastewater used for irrigation and agricultural lands, the plant complied with Technical Specification for Operation, Maintenance, and Safety for Municipal Wastewater Treatment Plants (CJJ 60-2011), and met the water quality standards for scenic environments (GB/T 18921-2002).</p> <p>Discharged wastewater quality needs to be regularly monitored.</p>	<p>EMU and local EPBs.</p> <p>Fully complied with.</p>
District Heating	<p>The heat source plants were completed with (i) above 100 m of high stacks to minimize direct impacts on adjacent areas, (ii) electro precipitators with 95% efficiency, and (iii) flue gas desulfurization with more than 85% efficiency.</p> <p>Each subproject under component A 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.</p> <p>Each subproject under component A prepared and is implementing an operations manual that includes spraying water on coal and fly-ash, and covering coalyards to minimize airborne dust dispersion. Wastewater is used for water spraying.</p>	<p>EMU and local EPB mitigation measures were also applicable to the expanded district heating subproject in Linhe.</p> <p>Fully complied with.</p> <p>Stack height of the constructed heat plants was 100–120 m, with electro precipitators from 95% to 98%, and flue gas desulfurization from 85%</p>

	<p>The heat source plants under component A fully complied with the Emission Standards for Coal-Fired, Oil-Fired, and Gas-Fired Boilers (GB 13271-2001).</p> <p>Hourly emission monitoring from each heat source plant is required. Currently all heat source plants under component A are equipped with emission monitoring devices that are also connected to the environment monitoring system of local EPBs.</p>	<p>to 87%.</p> <p>Reported annual emission from the constructed heat plants were 432–451 mg/m³ of SO₂, 46.8–48.2 mg/m³ of PM, and 398–406 mg/m³ of NO_x. These were below the government and the World Bank standard maximum emission values.</p>
Natural Gas Transmission and Distribution	<p>Domestic wastewater from natural gas stations is being treated with station-specific septic tanks and used for watering trees and grass, and for road spraying.</p> <p>Natural gas transmission and distribution systems under component B were fully equipped with gas leakage monitoring devices for early detection and warning. Regular daily inspection for transmission and distribution routes is being implemented.</p> <p>Quarterly revegetation inspection along the pipeline route has been carried out since 2012.</p>	<p>EMU</p> <p>Fully complied with. Reported discharges from the wastewater treatment plant were 35–46 mg/l of BOD, 90–110 mg/l of COD, and 49–50 mg/l of SS. These were below maximum emission values in both the government and the World Bank standard.</p>

BOD = biochemical oxygen demand, COD = chemical oxygen demand, EMU = environment management unit, EPB = environment protection bureau, km = kilometer, m = meter, mg/m³ = milligram per cubic meter, mg/l = milligram per liter, NO_x = nitrogen oxide, PM = particulate matter, PMO = project management office, SO₂ = sulfur dioxide, SS = suspended solids, WENNR = Western Erdos National Natural Reserve.

Source: Inner Mongolia Autonomous Region Environment Improvement Project Management Office.

6. All project components were constructed and are operated in accordance with the EMP. Emissions of total suspended particulates (TSP), sulfur dioxide (SO₂), and nitrogen oxide (NO_x) from newly installed boilers under component A were measured and verified by local EPBs, and the results met Emission Standards for Coal-Fired, Oil-Fired, and Gas-Fired Boilers (GB 13271-2001), and the World Bank standard.³ 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. Discharged treated water from the wastewater treatment plant under component C was also measured and verified by the local EPBs, and the results met the water quality standard for scenic environmental use (GB/T 18921-2002) and the World Bank Standard (footnote 3). The water quality of the discharged treated water has been monitored at the outlet gate of the plant since 2009—with 35–46 milligrams per liter (mg/l) of biological oxygen demand (BOD), 90–110 mg/l of chemical oxygen demand (COD), and 49–50 mg/l of suspended solids—which meets the water quality standard for paddy irrigation and vegetable cultivation uses under GB/T 18921-2002.

D. Environmental Benefits

7. The project delivers substantial environment benefits through avoided annual net emissions associated with component A, B, and C, specifically 1,071,964 tons of carbon dioxide, 2,718 tons of NO_x, 17,570 tons of SO₂, and 21,547 tons of TSP, and 104,635 tons of coal ash from components A and B. Environmental benefit of the city wastewater subproject (component C), which treats 6,000 tons of wastewater per day, includes an avoided annual discharge of 985

³ World Bank. 1998. *Pollution Prevention and Abatement Handbook*. Washington, DC.

tons of COD, 400 tons of BOD, 530 tons of suspended solids, 62 tons of ammoniacal nitrogen, 86 tons of total nitrogen, and 6.1 tons of total phosphorous.

8. At appraisal, the project area in Bayanuur and Wuhai cities fell between categories II and III in terms of ambient air quality standards.⁴ The air pollutants were mainly SO₂ and TSP, caused by numerous small, inner-city coal-fired boilers. Ambient air quality data for project site locations from site-specific monitoring stations and adjacent monitoring stations during 2006 to 2016 are in Table A10.2; all targeted cities and townships have recorded improved ambient air quality since 2006, and met category II ambient air quality standards in 2016.

Table A10.2: Ambient Air Quality in the Project Areas
(annual average, mg/m³)

Air Quality Standard		Appraisal		After physical completion			
Class II	Class III	Pollutant	2006	2010	2012	2014	2016
Wuhai							
0.06	0.10	SO ₂	0.15	0.13	0.07	0.06	0.05
0.20	0.30	TSP	0.36	0.30	0.27	0.13	0.18
0.05	0.30	NOx	0.31	0.18	0.10	0.03	0.02
Hangjinhouqi							
Class II	Class III	Pollutant	2006	2010	2012	2014	2016
0.06	0.10	SO ₂	0.12	0.11	0.10	0.08	0.06
0.20	0.30	TSP	0.34	0.30	0.26	0.20	0.18
0.05	0.30	NOx	0.26	0.18	0.10	0.04	0.03
Linhe							
Class II	Class III	Pollutant	2006	2010	2012	2014	2016
0.06	0.10	SO ₂	0.09	0.11	0.10	0.05	0.04
0.20	0.30	TSP	0.17	0.21	0.20	0.18	0.18
0.05	0.30	NOx	0.04	0.06	0.05	0.02	0.02
Wulateqianqi							
Class II	Class III	Pollutant	2006	2010	2012	2014	2016
0.06	0.10	SO ₂	0.05	0.05	0.04	0.05	0.04
0.20	0.30	TSP	0.19	0.17	0.14	0.19	0.13
0.05	0.30	NOx	0.02	0.01	0.02	0.03	0.02
Class II	Class III	Pollutant	2006	2010	2012	2014	2016
0.06	0.10	SO ₂	0.05	0.04	0.05	0.03	0.03
0.20	0.30	TSP	0.12	0.11	0.12	0.09	0.10
0.05	0.30	NOx	0.03	0.04	0.05	0.02	0.03
Wulatezhongqi							
Class II	Class III	Pollutant	2006	2010	2012	2014	2016
0.06	0.10	SO ₂	0.06	0.05	0.04	0.03	0.04
0.20	0.30	PM	0.21	0.19	0.17	0.17	0.15
0.05	0.30	NOx	0.06	0.06	0.04	0.04	0.02

⁴ As provided under the PRC's Ambient Air Quality Standards GB 3095-1996, class I standards apply to specially protected areas (e.g., natural conservation areas, scenic spots, and historical sites); class II standards apply to residential areas, mixed commercial-residential areas, and cultural, industrial, and rural areas; and class III standards apply to special industrial areas. Annual daily average concentrations are as follows: (i) class I: TSP: 80 mg/m³; SO₂: 20 mg/m³; NOx: 50 mg/m³; (ii) class II: TSP: 200 mg/m³; SO₂: 60 mg/m³; and NOx: 50 mg/m³; and (iii) Class III: TSP: 300 mg/m³; SO₂: 100 mg/m³; and NOx: 100 mg/m³. All targeted cities and townships met Category II ambient air quality standards, even under the new Ambient Air Quality Standard GB 3095-2012 (TSP: 200 mg/m³; SO₂: 60 mg/m³; and NOx: 40 mg/m³).

Air Quality Standard			Appraisal	After physical completion			
Class II	Class III	Pollutant	2006	2010	2012	2014	2016
Wuyuan							
Class II	Class III	Pollutant	2006	2010	2012	2014	2016
0.06	0.10	SO ₂	0.05	0.04	0.04	0.03	0.03
0.20	0.30	PM	0.13	0.11	0.11	0.10	0.09
0.05	0.30	NO _x	0.05	0.04	0.05	0.02	0.03
Denkou							
Class II	Class III	Pollutant	2006	2010	2012	2014	2016
0.06	0.10	SO ₂	0.08	0.06	0.06	0.04	0.05
0.20	0.30	PM	0.21	0.17	0.17	0.17	0.11
0.05	0.30	NO _x	0.09	0.06	0.04	0.04	0.02

mg/m³ = milligram per cubic meter, NO_x = nitrogen oxide, SO₂ = sulfur dioxide, PM = particulate matter

Source: Inner Mongolia Autonomous Region Environment Protection Bureau.

8. Air quality in the project targeted cities (Bayanuur and Wuhai) has improved relative to the air pollution index. In 2005 air quality in Bayanuur was rated as good or excellent on 256 days, and in Wuhai on 91 days, by 2015 this increased to 303 days in Bayanuur, and 228 days in Wuhai.⁵

9. Surface water quality of Yellow River tributaries, which include the wastewater subproject site of Wulatehoqi, have improved significantly. Following subproject completion, biological oxygen demand decreased to 42.1 mg per liter in 2010 from 61.2 mg per liter in 2005, and chemical oxygen demand to 96.3 mg per liter in 2010 from 170.7 mg in 2005.

E. Conclusion

10. The project met the initial objectives and delivered substantial environmental benefits to improve ambient air and water quality in targeted areas of the PRC's IMAR. Environmental management and associated mitigation measures were properly implemented during construction and operation. Environment monitoring was implemented by the PMO EMU and each PIA EMU. No environmental complaints were received during the construction and operation stages of all subprojects under components A, B, and C. ADB is supporting additional projects to expand district heating systems in targeted cities in central and eastern IMAR,⁶ and constructing cleaner advanced district heating systems using wind power, natural gas, and waste heat recovery in Huhhot (capital of IMAR).⁷ In combination with the three subprojects, these will further enhance ambient air quality improvements in the region.

⁵ The index assesses atmospheric pollutants: SO₂, nitrogen dioxide, suspended particles, carbon monoxide, and ozone. A value of 0–50 is considered excellent and 51–100 is considered good, with no negative health impacts.

⁶ ADB. 2010. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Peoples' Republic of China for the Inner Mongolia Autonomous Region Environment Improvement Project Phase II* (Loan 2658-PRC) Manila.

⁷ ADB. 2014. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Peoples' Republic of China for Low Carbon District Heating Project in Huhhot in Inner Mongolia Autonomous Region* (Loan 3218-PRC). Manila.

IMPLEMENTATION OF LAND ACQUISITION PLAN AND RESETTELMENT PLAN AND OTHER SOCIAL BENEFITS

A. Project Description

1. The project aimed to improve air and water quality in targeted cities in the Inner Mongolia Autonomous Region (IMAR). The project covered Wuhai and Bayanuur cities in western IMAR, and consisted of (i) component A: urban central heating supply, (ii) component B: natural gas transmission and distribution, (iii) component C: city wastewater treatment, and (iv) component D: institutional reform and corporate governance improvement.

2. At appraisal the design for component A called for installation of 766 megawatts (MW) of large efficient coal-fired boilers, 138 heat exchange stations, and 87.6 kilometers (km) of heat supply pipelines to facilitate closure of 396 small, inefficient coal-fired boilers for 25.7 million square meters (m²) of heating area in the targeted townships (Dengkou, Hangjinhouqi, Linhe, Wuhai, Wulatehouqi, Wulateqianqi, Wulatezhongqi, and Wuyuan) to supply cleaner heating services for an urban population of about 1 million.

3. Due to project implementation delays, five subprojects—in Dengkou, Wulatehouqi, Wulateqianqi, Wulatezhongqi and Wuyuan—were implemented without using ADB loan funding, to meet immediate heating demands in these townships. These subprojects were physically completed in 2010. ADB also approved a major change in scope in June 2010 to expand the scope of the subproject in Linhe, which involved (as designed) construction of 280 MW of heat-only-boilers, installation of 76.0 km of primary heat transmission pipelines, rehabilitation of 67.4 km of secondary heat pipeline, and construction of 100 heat exchange stations. Upon completion of component A in 2015, the project had constructed a total of 773 MW of heating capacity and 224 heat exchange stations, installed and rehabilitated 247 km of heat supply pipelines, and demolished 431 old, small, inefficient inner-city boilers.

4. Component B was designed to construct (i) 401 km of the Changqing–Wuhai–Linhe natural gas primary pipeline across Erdos, Wuhai, and Bayanuur cities, including seven transmission substations and eight valve stations; and (ii) 338 km of natural gas secondary pipelines including one compressed natural gas (CNG) primary supply station, three CNG satellite filling stations, and four natural gas unloading stations, to annually supply 434.5 million cubic meters (m³) of natural gas and 21 million m³ of CNG, to an urban population of about 1 million people. Component B was completed in 2011 as designed, except the length of the Changqing–Wuhai–Linhe natural gas primary pipeline was increased to 426 km, and that of the secondary pipeline to 386 km, as a result of changes made during the final engineering design.

5. Component C was designed to construct (i) a wastewater treatment plant (6,000 ton per day capacity) and 13.2 km of sewage piping network in Wulatehouqi; and (ii) a wastewater treatment plant (8,000 ton per day capacity) and 40.0 km of sewage piping network, with five pumping stations, in Wulateqianqi. The wastewater treatment plant with associated downstream infrastructure in Wulatehouqi was constructed as designed in 2008 without using ADB loan financing because of a delay in project startup, and local government requirements that the subproject be completed by 2008. The Wulateqianqi wastewater treatment plant, including the sewage piping and pumping stations, was cancelled and deleted from the project scope in 2010 because the paper mill (the wastewater source) was shut down in 2009 by order of the local government.

6. A land acquisition and resettlement plan (LARP) for the project was prepared in 2006 and revised in 2010 as a result of the major change in scope (para 3). The original LARP called for (i) permanent acquisition of 773 *mu* of collective and state-owned land, and (ii) temporary occupation of 9,801 *mu* of collective and state-owned land.¹ An estimated 133 persons were estimated to be affected by permanent land acquisition and 176 persons by temporary land acquisition, but no resettlement was anticipated. Total land acquisition cost—including compensation cost, monitoring and evaluation costs, tax and fees, and contingencies—was estimated at CNY26.49 million in 2006. The planned land acquisition impact by component, as estimated in 2006, is summarized in Table A11.1.

Table A11.1: Planned Land Acquisition in 2006 (Original)

	Permanent		Temporary		Affected People	
	State-Owned	Collective	State-Owned	Collective	Permanent	Temporary
Urban Central Heating Supply	344.9	160.0	642.8	49.8	20.0	166.0
Natural Gas Transmission and Distribution	101.4	51.7	7,788.5	1,113.7	102.0	10.0
City Wastewater Treatment	81.7	33.8	202.0	5.0	11.0	0.0
Total	527.9	245.5	8,633.3	1,168.5	133.0	176.0

Source: Inner Mongolia Autonomous Region project management unit. 2006. Resettlement Planning Document <https://www.adb.org/projects/documents/inner-mongolia-autonomous-region-environmental>

7. Changes in scope to accommodate the expanded district heating subproject in Linhe in 2010 (para. 3) required the following additional land acquisition: permanent acquisition of 124 *mu* of unused collective land, and temporarily acquisition of 684 *mu* of state-owned land, with no resettlement anticipated. Additional land acquisition costs, including compensation costs, monitoring and evaluation costs, tax and fees, and contingencies was estimated at CNY29.80 million in 2010. The planned land acquisition by component is summarized in Table A11.2.

Table A11.2: Planned Land Acquisition in 2010 (Change in Scope)

	Permanent		Temporary		Affected People	
	State-Owned	Collective	State-Owned	Collective	Permanent	Temporary
Urban Central Heating Supply	368.9	259.2	1,326.8	16.0	40.0	286.0
Natural Gas Transmission and Distribution	101.4	51.7	7,788.5	1,113.7	102.0	10.0
City Wastewater Treatment	6.7	33.8	17.0	5.0	11.0	0.0
Total	476.9	344.7	9,132.3	1,134.7	153.0	296.0

B. Land Acquisition Planning, Impact, and Budget

7. The LARP was prepared by IMAR Environmental Improvement Project Management Office in March 2006 in accordance with the Asian Development Bank (ADB) Involuntary Resettlement Policy (1995), and updated in May 2010 due to the major change in scope (para. 3). A comparison of planned and actual land acquisition is in Table A11.3.

8. In comparison with the permanent land acquisition estimated in 2010, the actual permanent land acquisition was 684.38 *mu*, 137.18 *mu* less than the planned 821.56 *mu*. This resulted because of (i) cancellation of heat generation plant construction in district heating subprojects in Denkou and Wuhai, which used the existing combined heat and power plants as a heat source instead; and (ii) cancellation of wastewater treatment plant construction in Wulateqianqi. An increase in natural gas transmission and distribution line length resulted in 33.3 *mu* of permanent land acquisition.

¹ A *mu* is a Chinese unit of measurement (1 *mu* = 666.67 square meters).

9. The actual temporary land acquisition was 11,154.48 *mu*, 887.42 *mu* more than the 2010 estimate of 10,267.06 *mu*. This resulted from an increase in the transmission and distribution pipeline length in the urban district heating-supply component, and in the natural gas transmission and distribution component (paras. 3 and 4). Cancellation of the wastewater treatment subproject in Wulateqianqi reduced temporary land acquisition under the wastewater treatment component significantly, from 207 *mu* to 22 *mu*.

Table A11.3: Comparison between Planned and Actual Land Acquisition

Component	Permanent Land Acquisition (<i>mu</i>)				Temporary Land Acquisition (<i>mu</i>)			
	Change				Change			
	Original (A)	in Scope (B)	Actual (C)	Difference (B-C)	Original (A)	in Scope (B)	Actual (C)	Difference (B-C)
Urban Central Heating Supply	504.9	628.1	457.6	(170.5)	692.6	1,342.8	1,450.2	107.4
Natural Gas Transmission and Distribution	153.1	153.1	186.4	33.3	8,902.3	8,902.3	9,682.3	780.0
City Wastewater Treatment	115.4	40.4	40.4		207.0	22.0	22.0	0.0
Total	773.4	821.6	684.4	(137.2)	9,801.9	10,267.1	11,154.5	887.4

() = negative

^a A *mu* is a Chinese unit of measurement (1 *mu* = 666.67 square meters).

Source: Project management office, Inner Mongolia Autonomous Region.

10. In comparison with the affected people estimated at the major change in scope in 2010, the population affected by permanent land acquisition totaled 161 people, 8 more than the estimated 153 people. The people affected by temporary land occupation totaled 324, 28 more than the estimated 296 people. The comparison between planned and actual affected people is summarized in Table A11.4.

11. The total cultivated land acquired was 160.00 *mu*, out of the total permanent land acquisition of 684.38 *mu*. The remaining 524.38 *mu* of land acquired was unused land and the government owned land. The impact of the loss of cultivated land vs. the total cultivated land of affected villages (21,979.38 *mu*) was not significant, as the total loss of cultivated land represents 0.72% of the total area of cultivated land. The impact of temporary land acquisition was marginal, because (i) the period of land occupation was 9–18 months, (ii) compensation for temporary land occupation was paid as agreed, and (iii) the occupied land was restored in its original condition by contractors under the guidance of the project implementing agencies (PIAs).

Table A11.4: Planned and Actual Affected People

Component	Number of People Affected by Permanent Land Acquisition				Number of People Affected by Temporary Land Acquisition (<i>mu</i>)			
	Change				Change			
	Original (A)	in Scope (B)	Actual (C)	Difference (B-C)	Original (A)	in Scope (B)	Actual (C)	Difference (B-C)
Urban Central Heating Supply	20	40	32	-8	166	286	309	23
Natural Gas Transmission and Distribution	102	102	118	16	10	10	15	5
City Wastewater Treatment	11	11	11	11	0	0	0	0
Total	133	153	161	8	176	296	324	28

() = negative

^a A *mu* is a Chinese unit of measurement (1 *mu* = 666.67 square meters).

Source: Project Management Office, Inner Mongolia Autonomous Region.

12. Total cost of land acquisition was CNY55.74 million, which was CNY25.9 million higher than the original estimate but barely within CNY56.29 million of the revised land acquisition cost at the time of a major change in scope in 2010, despite the decrease in permanent land acquisition (which was 13% less than originally estimated, and 21% lower than the revised land acquisition plan at the time of a major change in scope in 2010). This is mainly due to the significant increase in compensation rates for permanent land acquisition that occurred during the delayed

implementation of the urban district heating component and natural gas transmission and distribution component. The compensation rate for permanent land acquisition under the delayed subprojects increased to CNY54,075 per *mu*, from an initially planned rate of CNY39,716 per *mu*.

C. Resettlement Management, Supervision, and Monitoring

13. Land acquisition for the project was implemented in accordance with the laws and regulations issued by the state and provincial councils under the Land Administration Law. The Project Leading Group, established by the government of IMAR (GIMAR) had overall responsibility for ensuring land acquisition was implemented in accordance with the LARP. The project management office (PMO) was established in the Development and Reform Commission of GIMAR, and was responsible for managing, coordinating, and supervising LARP implementation. Each PIA and the resettlement offices under the municipal and county governments were responsible for LARP implementation and monitoring. The PMO designated staff to coordinate with PIAs and the resettlement offices to ensure smooth LARP implementation. The PMO also engaged an independent external monitor to supervise LARP implementation, under the institutional reform and corporate governance improvement component (component D). Assessment of the external monitor was incorporated into the semi-annual monitoring report.

D. Information Disclosure, Consultation, and Participation

14. The institutions implementing the LARP (para. 13) used consultative and participatory processes in LARP planning, implementation, and monitoring. All affected people were fully informed about the project and land acquisition policies, compensation measures, grievance procedures, and legal rights. PIAs and local government resettlement offices held consultation meetings with community leaders and affected households during the preparation of the feasibility study and the LARP, and during LARP implementation. A land acquisition booklet was also distributed to the affected people.

E. Grievance Redress Mechanism

15. A grievance mechanism was established in the PMO, and each PIA and local government resettlement office stipulated procedures for the transparent and efficient redress of grievances. Affected people with problems or grievances regarding land acquisition and compensation could appeal through their local government resettlement office as detailed in the LARP. No complaints from affected people or nongovernment organizations were reported during project implementation or following completion.

F. Income Restoration, Rehabilitation, and Job Creation

16. **People affected by land acquisition.** According to the sample household survey conducted by the PMO, the living conditions and livelihoods of the affected households improved. The average annual household income per affected household was around CNY47,063 in 2013, as compared to CNY30,181 in 2006, and no affected households reported a decline in household income. The project created around 13,200 person-years of employment opportunities, and the affected population was given employment opportunities as construction laborers during the project construction.

17. **Labor retrenchment.** The urban central heating component (component A) constructed 773 MW of heating capacity and 224 heat exchange stations, and installed 247 km of heat supply pipelines, which enabled demolition of 431 old, small, inefficient inner-city boilers, with the goal of

improving urban ambient air quality. However, 800 workers were affected by the closure of the small boilers. Reemployment of the affected boiler workers was arranged by each PIA upon completion of each subproject under component A, and the results are summarized in Table A11.5. A total of 280 of boiler workers were placed into the PIA of each subproject, while the PIAs arranged external reemployment for 520 boiler workers, with no changes in the level of their wages and benefits. To date, the PIAs and PMO have received no complaints from the retrenched boiler workers.

Table A11.5: Placement and Reemployment of Affected Boiler Workers

	Affected Boiler Workers (no.)	Workers Placed in Project Implementing Agencies (no.)	Workers reemployed outside (no.)	Average Wages of Reemployed Workers^a (CNY)
Dengkou	97	26	71	3,500
Hangjinhouqi	34	34	0	
Linhe	147	41	106	3,651
Wuhai	70	37	33	2,791
Wulatehouqi	40	20	20	4,000
Wulateqianqi	76	20	56	4,000
Wulatezhonqi	136	42	94	3,300
Wuyuan	200	60	140	4,500
Total	800	280	520	

^a Monthly average wages for the boiler workers who were reemployed outside of project implementing agencies.
Source: Project management office, Government of Inner Mongolia Autonomous Region.

18. **Gender and development.** The project benefited women through fuel switching (from coal to natural gas) and a change in heating (from household stoves to district heating systems), which avoided indoor air pollution. Local women's associations were involved in the public hearings prior to the implementation of each subproject to provide their opinions. In compliance with applicable labor law in the PRC, preference was given to women for employment opportunities during project construction, and the project ensured that (i) men and women received equal pay for work of equal type; (ii) working conditions were safe, for both male and female workers; and (iii) affected persons were given priority for employment, with equal access to women.

19. **Health and social risks.** The PIAs, together with the local government authorities, required that contractors employed under the project disseminated information to those employed during project implementation on the risks of sexually-transmitted diseases, including HIV/AIDS, through health and safety programs. This requirement was also incorporated into the bidding documents to ensure strict compliance. The PIAs, contractors and local public health bureaus conducted the occupational safety program for workers and disseminated information on the risks of sexually transmitted diseases, including HIV/AIDS.

G. Conclusions

20. Overall, the project avoided significant land acquisition impacts by minimizing permanent land acquisition, and avoiding resettlement and house demolition. Land acquisition was successfully implemented and there were no complaints from the affected people. There was a high degree of involvement by the affected people throughout planning, implementation, and monitoring of land acquisition. Affected boiler workers were also successfully placed in the PIAs

or reemployed without changing the level of their wages and benefits, with no complaints received to date from the retrenched boiler workers.

QUANTITATIVE ASSESSMENT OF OVERALL PROJECT PERFORMANCE

Criterion	Weight (%)	Assessment^a	Rating (0-3)	Weighted Rating
Relevance	25	Relevant	2	0.50
Effectiveness	25	Effective	2	0.50
Efficiency	25	Less than Efficient	1	0.25
Sustainability	25	Likely Sustainable	2	0.50
Overall Rating		Successful		1.75

^a Project ratings are calculated as follows, based on the overall weighted rating: (i) ≥ 2.50 = Highly successful; (ii) < 2.50 and ≥ 1.75 = successful; (iii) < 1.75 and ≥ 0.75 = less than successful; and < 0.75 = unsuccessful.