



Completion Report

Project Number: 28388
Loan Number: 1715
September 2006

People's Republic of China: Shanxi Environment Improvement Project

Asian Development Bank

CURRENCY EQUIVALENTS

Currency Unit – yuan (CNY)

		At Appraisal (2 November 1999)	At Project Completion (17 March 2006)
CNY1.00	=	\$0.1208	\$0.1244
\$1.00	=	CNY8.2779	CNY8.0390

ABBREVIATIONS

ADB	–	Asian Development Bank
DDHC	–	Datong District Heating Company
DDHP	–	Datong District Heating Plant
EIRR	–	economic internal rate of return
EPB	–	environmental protection bureau
FIRR	–	financial internal rate of return
ICB	–	international competitive bidding
MBI	–	market-based instrument
MOF	–	Ministry of Finance
NO _x	–	nitrogen oxide
NO ₂	–	nitrogen dioxide
PIA	–	project implementing agency
PRC	–	People's Republic of China
SO ₂	–	sulfur dioxide
SPG	–	Shanxi Provincial Government
SYGC	–	Shanxi Yangquan Gas Company
TA	–	technical assistance
TCGC	–	Taiyuan Coal Gasification Company
TCGP	–	Taiyuan Coal Gasification Plant
TCR	–	technical assistance completion report
TSP	–	total suspended particulates
YGDC	–	Yangquan Gas Distribution Company
YGDP	–	Yangquan Gas Distribution Plant

WEIGHTS AND MEASURES

ha	–	hectare
km	–	kilometer
m ²	–	square meter
m ³	–	cubic meter
t	–	metric ton
t/y	–	metric tons per year

NOTE

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

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BASIC DATA

A. Loan Identification

1.	Country	People's Republic of China
2.	Loan Number	1715-PRC
3.	Project Title	Shanxi Environment Improvement Project
4.	Borrower	People's Republic of China
5.	Executing Agency	Shanxi Provincial Government
6.	Amount of Loan	\$102.0 million
7.	Project Completion Report	PCR: PRC 940

B. Loan Data

1.	Appraisal	
	– Date Started	5 July 1999
	– Date Completed	19 July 1999
2.	Loan Negotiations	
	– Date Started	2 November 1999
	– Date Completed	4 November 1999
3.	Date of Board Approval	7 December 1999
4.	Date of Loan Agreement	27 November 2000
5.	Date of Loan Effectiveness	
	– In Loan Agreement	27 February 2001
	– Actual	25 May 2001
	– Number of Extensions	1
6.	Closing Date	
	– In Loan Agreement	30 June 2004
	– Actual	2 December 2005
	– Number of Extensions	1
7.	Terms of Loan	
	– Interest Rate	LIBOR-based variable lending rate for US dollars
	– Maturity (years)	20
	– Grace Period (years)	4
8.	Terms of Relending	
	– Interest Rate	LIBOR-based variable lending rate for US dollars
	– Maturity (years)	20
	– Grace Period (years)	4
	– Second-Step Borrower	Shanxi Provincial Government
9.	Terms of Onlending	
	– Interest Rate	LIBOR-based variable lending rate for US dollars
	– Maturity (years)	20
	– Grace Period (years)	4
	– Third-Step Borrowers	Subproject 1: Taiyuan Coal Gasification Company Subproject 2: Datong District Heating Company Subproject 3: Shanxi Yangquan Gas Company

LIBOR = London Interbank Offered Rate.

10. Disbursements

a. Dates

Initial Disbursement	Final Disbursement	Time Interval
15 November 2001	2 December 2005	48 months
Effective Date	Original Closing Date	Time Interval
25 May 2001	30 June 2004	36 months

b. Amount (\$ million)

Category or Subloan	Original Allocation	Last Revised Allocation	Amount Canceled	Amount Disbursed
Civil Works	8.22	0.53	(0.10)	0.64
Machinery and Equipment	70.54	95.07	0.88	94.19
Human Resource Development	1.27	0.37	0.19	0.17
Consulting Services (Institutional Development)	0.30	0.00	0.00	0.00
Engineering Services	2.38	0.00	0.00	0.00
Unallocated	9.15	0.00	0.00	0.00
IDC	10.14	6.03	1.98	4.04
Total	102.00	102.00	2.96	99.04

IDC= interest during construction.

11. Local Costs (Asian Development Bank-Financed)

- Amount (\$)	0
- Percentage of Local Costs	0
- Percentage of Total Cost	0

C. Project Data

1. Project Cost (\$ million)

Cost	Appraisal Estimate	Actual
Foreign Exchange Cost	102.00	99.04
Local Currency Cost	81.00	83.00
Total	183.00	182.04

2. Financing Plan (\$ million)

Cost	Appraisal Estimate			Actual		
	Foreign	Local	Total	Foreign	Local	Total
Implementation Costs						
Borrower-Financed	0.00	54.04	54.04	0.00	74.88	74.88
ADB-Financed	91.86	0.00	91.86	95.00	0.00	95.00
Other External Financing	0.00	23.04	23.04	0.00	6.71	6.71
Subtotal	91.86	77.08	168.94	95.00	81.59	176.59
IDC Costs						
Borrower-Financed	0.00	3.92	3.92	0.00	1.41	1.41
ADB-Financed	10.14	0.00	10.14	4.04	0.00	4.04
Other External Financing	0.00	0.00	0.00	0.00	0.00	0.00
Subtotal	10.14	3.92	14.06	4.04	1.41	5.45
Total	102.00	81.00	183.00	99.04	83.00	182.04

ADB = Asian Development Bank, IDC = interest during construction.

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

Component	Appraisal Estimate			Actual		
	Foreign	Local	Total	Foreign	Local	Total
A. Base Cost						
Land Acquisition	0.00	4.39	4.39	0.00	0.99	0.99
Site Preparation	0.00	3.98	3.98	0.00	9.30	9.30
Engineering and Design Including License Fees	2.38	5.34	7.72	0.00	1.17	1.17
Equipment and Materials	60.36	12.60	72.96	94.19	5.30	99.49
Auxiliary Equipment and Materials	10.18	2.63	12.81	0.00	0.00	0.00
Domestic Transport	0	1.31	1.31	0.00	0.00	0.00
Construction and Erection Including Civil Works	8.22	33.95	42.17	0.64	55.37	56.01
Consulting Service	0.30	3.01	3.31	0.00	0.16	0.16
Human Resource Development	.56	.62	1.18	0.17	0.07	0.24
Commissioning and Start-Up	0.00	0.87	0.87	0.00	0.00	0.00
Energy and Environmental Management	0.00	0.98	0.98	0.00	0.00	0.00
Project Management	0.71	1.10	1.81	0.00	9.23	9.23
Subtotal (A)	82.71	70.78	153.49	95.00	81.59	176.59
B. Contingencies						
Physical	4.17	3.43	7.60	0.00	0.00	0.00
Price	4.98	2.87	7.85	0.00	0.00	0.00
Subtotal (B)	9.15	6.30	15.45	0.00	0.00	0.00
C. Interest During Construction	10.14	3.92	14.06	4.04	1.41	5.45
Total	102.00	81.00	183.00	99.04	83.00	182.04

4. Project Schedule

Milestone	Appraisal Estimate	Actual
Preliminary Design		
Part A	December 1999	July 2000
Part B	December 1999	March 2001
Part C	December 1999	July 2003
Bid Document Preparation		
Part A	September 2000	November 2003
Part B	June 2000	June 2002
Part C	September 2000	April 2003
Detailed Engineering		
Part A	June 2001	June 2002
Part B	December 2000	March 2005
Part C	March 2001	October 2003
Equipment Procurement		
Part A	June 2002	January 2004
Part B	September 2001	June 2002
Part C	April 2002	June 2004
Land Acquisition		
Part A	September 1999	March 2001
Part B	December 2000	December 2001
Part C	March 2000	December 2002
Site Preparation		
Part A	April 2000	November 2001
Part B	March 2001	September 2005
Part C	June 2000	December 2002
Civil Works		
Part A	September 2002	January 2004
Part B	September 2002	November 2005
Part C	September 2001	December 2003
Installation		
Part A	April 2003	March 2004
Part B	December 2002	November 2005
Part C	June 2002	June 2005
Testing, Start-Up, and Commissioning		
Part A	August 2003	April 2004
Part B	December 2002	October 2004
Part C	January 2003	January 2006
Commercial Operation		
Part A	December 2003	June 2005
Part B	December 2003	December 2005
Part C	December 2003	December 2006

5. Project Performance Report Ratings

Implementation Period	Ratings	
	Development Objectives	Implementation Progress
From December 1999 to April 2000	S	S
From May 2000 to October 2000	S	U
From November 2000 to November 2000 ^a	S	S
From December 2000 to December 2000	PS	U
From December 2000 to December 2000 ^a	S	S
From January 2001 to May 2001	PS	U
From June 2001 to July 2001	PS	S
From August 2001 December 2005	S	S

PS = partly satisfactory, S = satisfactory, U = unsatisfactory.

^a Adjusted rating following loan signing. Unsatisfactory ratings were due to delays in loan signing and loan effectiveness.

D. Data on Asian Development Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-Days	Specialization of Members ^a
Fact-Finding	15–28 April 1999	5	65	a,b,c,d,e,
Appraisal	5–19 July 1999	6	84	a,b,d,e,g,f
Inception	24–28 July 2000	2	8	a,h
Review 1	15–18 March 2001	3	12	a,c,g,i
Review 2	21–16 October 2001	2	10	c,h
Review 3	27–30 November 2002	3	9	c,h,j
Review 4	14–17 December 2003	2	6	j,k
Review 5	11–18 August 2004	3	21	j,k,l
Review 6	12–18 May 2005	2	12	k,l
Project Completion Review	6–14 March 2006	4	29	j,l,m,n

^a a – senior project engineer, b – senior financial analyst, c – senior economist for environment, d – social development specialist, e – economist (environment), f – senior environment specialist, g – counsel, h – assistant project analyst, i – assistant procurement specialist, j – environment specialist, k – associate project analyst, l – energy specialist (finance), m – project officer, n – staff consultant.

I. PROJECT DESCRIPTION

1. The People's Republic of China's (PRC) heavy dependence on coal to meet energy and industry requirements has degraded the environment severely in major cities. The country's rapid economic growth and industrialization since the early 1990s has exacerbated the situation. In Shanxi province, the situation was more acute. A poor inland province in central PRC, Shanxi is one of the country's major coal-producing areas. Its capital, Taiyuan, had the worst air quality in PRC and ranked among the 10 most polluted cities in the world.¹ Two other cities in Shanxi—Datong and Yangquan—were also among the cities with the worst air quality in PRC and in the world. The levels of harmful emissions from heavy industries, as well as household stoves, boilers, and commercial furnaces that burn coal, were 2–3 times the national standards. The release of coalbed methane into the atmosphere as a greenhouse gas, instead of using it as an energy source, compounded the problem in Yangquan. As the producer of about one third of PRC's coal, Shanxi also uses coal as its primary energy source.

2. Recognizing the need to address the growing environmental concerns, the Government developed a comprehensive environmental protection plan.² The plan covered 52 major cities, focusing on abatement measures for the targeted urban industrial and household sectors that are using large amounts of coal and are energy inefficient. These measures included developing policies on resource pricing, enforcing regulations, implementing control measures, and developing least-cost energy-efficient manufacturing technologies. The Asian Development Bank (ADB) supported the Government's initiatives through loans and technical assistance (TA), focusing on capacity building and institutional strengthening of implementing agencies. ADB also assisted the formulation of legislation for environmental monitoring and protection.

3. The Shanxi Provincial Government (SPG), through the Shanxi Environmental Protection Bureau (EPB), developed an environmental improvement plan,³ and enacted environmental laws and regulations in line with the national policy framework. SPG developed a system for environmental monitoring, including operating rules, personnel, and equipment to implement its short-term and long-term strategies. The primary objectives of the environmental protection strategy⁴ were to

- (i) control air pollution by using clean energy, developing centralized heating, relocating industry, and developing clean production technologies;
- (ii) control water pollution by treating and protecting water sources;
- (iii) control waste by developing waste regulations, adopting incentives for pollution prevention and comprehensive reuse, and developing an integrated waste management plan; and
- (iv) strengthen the legal system and environment management program.

4. The short-term strategy focused on establishing a more effective monitoring and supervision system to ensure that major cities in the province reach Class II or Class III ambient air quality standards⁵, and controlling pollution emitted by the local enterprises. The long-term

¹ World Bank. 1997. *Clear Water, Blue Skies: China's Environment in the New Century*. Washington, D.C.

² The PRC's plans for urban environmental improvement were outlined in the country's program for comprehensive renovation of the urban environment.

³ For short term (2000) and long term (2010).

⁴ ADB. 1999. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan and Technical Assistance Grant to the People's Republic of China for the Shanxi Environment Improvement Project*. Manila.

⁵ Ambient Air Quality Standards GB 3095- 1996. Class I standards apply to specially protected areas such as natural conservation areas, scenic spots and historical sites. Class II standards apply to residential areas, mixed commercial/ residential areas, cultural, industrial, and rural areas. Class III standards apply to special industrial areas.

strategy aimed to reach and maintain Class I air quality standards throughout the province. Meeting these objectives required undertaking comprehensive control projects, such as (i) expanding the gas distribution systems, (ii) establishing central heating systems, and (iii) controlling coalbed methane emissions by installing methane capture infrastructure. These facilities were to reduce air pollution by replacing coal burning in open, low-efficiency household stoves, as well as in low-efficiency boilers and furnaces. Local and provincial governments, and sometimes the national Government, funded most of the investments in the projects. At the same time, SPG identified industrial point source control projects, which the enterprises self-financed. Systems for the proper transport and handling of coal also were to be developed and implemented. Environmental quality targets were established and included in the plan, with corresponding budget expenditures. Loan 1715- PRC: Shanxi Environment Improvement Project (the Project) supported the high-priority components of the comprehensive environmental improvement plan of Shanxi province.

5. The main objective of the Project was to improve the ambient air quality of three main cities in Shanxi Province—Taiyuan, Datong and Yangquan—by (i) supporting market-oriented price reforms, (ii) strengthening environmental protection agencies' capabilities in sustainable environmental management and enforcement of compliance with national environmental standards, and (iii) financing part of the investments required to expand district heating and gas distribution systems to reduce direct coal burning and improve energy efficiency. The project scope covered (i) a coal gasification and gas distribution system in Taiyuan, (ii) a district heating system in Datong, (iii) a coalbed methane gas storage and distribution system in Yangquan, and (iv) capacity building for concerned agencies.

6. Market-oriented pricing was promoted to encourage environment-friendly behavior, and appropriate tariffs were incorporated for urban services needed to sustain improvements to the environment. The construction of infrastructure to address Shanxi's requirement for a clean environment was strategically important for the PRC to support and sustain its rapidly growing economy. It was particularly important for Shanxi, as the country's top coal producer. The Project aimed to support economic growth in Shanxi that was sustainable, efficient, and environmentally desirable. This was the sixth⁶ ADB-funded project to support the Government's environmental protection efforts.

7. As designed, the Project had four components:

- (i) **Taiyuan Coal Gasification Plant (TCGP).** This component involved the construction of a new coke oven gas manufacturing plant with a capacity of

⁶ The other five projects were:

- (i) ADB. 1992. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of China for the Qingdao Environmental Improvement Project*. Manila. (Loan 1205-PRC, for \$103 million, approved on 10 December).
- (ii) ADB. 1993. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of China for the Tangshan and Chengde Environment Improvement Project*. Manila. (Loan 1270-PRC, for \$140 million, approved on 25 November).
- (iii) ADB. 1994. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of China for the Beijing Environment Improvement Project*. Manila. (Loan 1336-PRC, for \$157 million, approved on 29 November).
- (iv) ADB. 1996. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of China for the Anhui Environmental Improvement Project for Industrial Pollution Abatement*. Manila. (Loan 1491-PRC, for \$112 million, approved on 26 November).
- (v) ADB. 1997. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of China for the Xi'an-Xianyang-Tongchuan Environment Improvement Project*. Manila. (Loan 1543-PRC, for \$156 million, approved on 24 September).

504,000 cubic meters (m³) of coal gas⁷ per day (175 million m³ per year) and 930,000 metric tons (t) of coke⁸ per year, and the associated storage and distribution network. The gas will replace coal for industrial, commercial, and residential uses.

- (ii) **Datong District Heating Plant (DDHP).** This component involved the construction of two peak load boilers with capacities of 80 t per hour and 120 t per hour, and the associated district heating transmission network. The plant will supply 3.4 million gigajoules of heat to 5.1 million square meters (m²) of residential and commercial floor space.
- (iii) **Yangquan Gas Distribution Plant (YGDP).** This entailed the installation of a system for recovering 272,000 m³ of methane gas daily (94 million m³ per year) from a coal mine, and construction of the associated storage and distribution network. It will replace coal for industrial, commercial, and residential use.
- (iv) **Institutional Development and Project Management.** This component involved investments to support and strengthen the capabilities of the provincial executing organizations, project implementing agencies (PIAs), and related bureaus in project, institutional, and financial management; procurement and construction supervision; and environmental policy making and monitoring capabilities.

8. ADB approved a loan of \$102 million from its ordinary capital resources on 7 December 1999. The Loan Agreement was signed on 27 November 2000, and the loan became effective on 25 May 2001. Initially, the loan was classified under ADB's pool-based, single currency lending facility. With the implementation of the lending facility based on the London Interbank Offered Rate, the loan was converted to this new facility on 31 July 2002. At the Government's request, the loan was extended by 1 year, with a revised closing date of 30 June 2005. The loan actually closed on 2 December 2005 following the final disbursement. The net loan amount was \$99.0 million. Principal repayment started in May 2004, and \$6.3 million had been repaid as of 30 June 2006.

9. A summary of major events during implementation is in Appendix 1.

II. EVALUATION OF DESIGN AND IMPLEMENTATION

A. Relevance of Design and Formulation

10. At appraisal, ADB's country operational strategy for the PRC focused on three objectives: (i) improving economic efficiency in a sustainable manner, (ii) reducing poverty by promoting growth in the poorer interior provinces to achieve balanced regional development, and (iii) improving the environment and conserving natural resources (footnote 4). The strategy supported PRC's programs to prevent urban pollution, and to encourage investments in industries and areas that promote energy conservation and environmental protection. Under ADB's policy agenda, state-owned enterprises were to adopt market-oriented reforms aimed at removing price distortions, strengthening competition, and increasing their autonomy. ADB's assistance in improving the environment in the three severely polluted cities, as a means of supporting environment-friendly economic growth in Shanxi, was relevant to the Government's

⁷ Coal gas is a fuel produced by heating coal in the absence of air. It consists mainly of methane, carbon monoxide, hydrogen, and nitrogen, and is more environment friendly than directly burning coal.

⁸ Coke is produced by roasting coal in ovens at very high temperature. This removes gases and leaves almost pure carbon material used in smelting copper and other ores.

programs and consistent with ADB's strategy at appraisal and now. With Shanxi's active economic development since the 1990s, its economy has grown phenomenally. From 1999 to 2004, Shanxi's gross domestic product doubled,⁹ representing double-digit annual growth. The resulting air pollution in Shanxi required an integrated plan for a clean environment. The assistance provided under the Project was instrumental in implementing that plan.

11. The Project was designed to reduce air pollution by replacing coal with gas, decreasing coal use, and lowering greenhouse gas emissions through the capture of methane gas. In addition to the environmental benefits, the Project was designed to improve energy efficiency and reduce energy costs. Capacity building of environmental agencies also was considered appropriately in the Project's design.

12. The consultant's report under the project preparatory TA¹⁰ approved by ADB confirmed the feasibility and the environmental benefits of the project components, and recommended their implementation. Project facilities were designed adequately. The basic technical designs in the approved feasibility studies were used, though they were modified to allow more efficient use of resources and to accommodate other changes made during project implementation. The TCGP subproject was implemented as designed without any major change. For DDHP, the two peaking boilers that were included in the original scope were canceled in response to the construction of the Datong Pingwang combined heat and power plant, which has two 200-megawatt turbines. The plant recovers waste heat from steam turbines, providing a far more efficient means of producing heat. The feasibility study for the change in project design was approved in 2004. The funds originally allocated for the peaking boilers were used to procure additional pipes to extend the heating area coverage. The change in scope created greater heating efficiency and increased beneficiaries. The original design for YGDP also underwent a minor change that increased the capacity of one of the three gas holders from 20,000 m³ to 50,000 m³, the same capacity as the other two gas holders.

B. Project Outputs

13. The three subprojects have been completed and are operating satisfactorily. TCGP's plant facilities are operating at full capacity, and are able to provide the target volume of 175 million m³ of gas per year. The plant also produces 930,000 t of coke per year, as well as many chemical by-products. Plant has been used consistently at 100% capacity, compared to 80% as originally envisaged. The PIA did not report any major operational problems since commissioning. The plant has passed the compliance tests conducted by different national departments—e.g., environmental, safety, and security—and has been certified to operate within PRC's standards. The PIA attributes the success of the subproject to (i) appropriate technical design, (ii) strict construction management and qualified technical personnel, (iii) good cooperation with suppliers and contractors, (iv) adequate counterpart funds, (v) and timely action and support from ADB.

14. TCGP's gas distribution subsidiary undertook the other components included in the original scope, which were financed with counterpart funding. Thirty regulating stations and two gas holders were rehabilitated and 36 kilometers (km) of gas distribution pipelines were laid out. In addition, the environmental safeguards were enhanced for the old coal gasification facility, which is certified as complying with PRC's environmental emission standards.

⁹ National Bureau of Statistics. 2005. *China Statistical Yearbook*. People's Republic of China: China Statistics Press.

¹⁰ ADB. 1997. *Technical Assistance to the People's Republic of China for the Shanxi Environmental Improvement Project*. Manila (TA 2901- PRC).

15. The Taiyuan EPB estimates that 485 small coal-fired industrial and commercial boilers were closed down as a direct consequence of the implementation of the TCGP subproject, resulting in about 392,000 t of annual coal savings in 2005. This has reduced significantly air emissions, as discussed in Section III.

16. For DDHP, 104 km of pipeline and 75 heat exchange stations were installed—about double the original scope of 60 km of heat transmission pipeline and 37 heat exchange stations. The heating area likewise increased to 6.6 million m² from the original scope of 5.1 million m². In the original design, two peaking boilers for heat generation were to be built. However, the construction of the Datong Pingwang combined heat and power plant, with a capacity of 400 megawatts, made the two peaking boilers unnecessary. ADB approved a minor change in project scope to allow the PIA to reallocate loan funds and procure materials needed to expand the heating coverage area. Following the completion of 81.4 km of heat transmission pipelines and 55 heat exchange stations, the subproject started supplying heat during the 2004–2005 winter season. The remainder was completed in time for the winter season of 2005–2006. All project facilities now are operational and able to supply heat to about 225,000 residential, 16,700 industrial, and 943 commercial consumers. The subproject is estimated to have displaced about 325,000 t of coal in 2005, significantly reducing air emissions (Section III).

17. For YGDP, the target outputs included in the original scope were achieved within or ahead of schedule. As envisaged at appraisal, 131 km of gas distribution pipelines were laid out, with the final section completed in September 2004. Five gas holders were constructed, three financed by the ADB loan and two by city government funds. In addition, 38 regulating stations (compared to 39 envisaged at appraisal) and three control stations were completed, all funded by the ADB loan. The capacity of one of the gas holders, originally designed to hold 20,000 m³ of methane gas, was enlarged to 50,000 m³. Thus, all the gas holders now have the same capacity. Using the existing coal mine gas extraction system, the Project will be able to supply 94 million m³ of methane gas to users. Previously, this gas was vented into the atmosphere. Capacity utilization, which is now 77%, is expected to reach 100% in 2007. Project beneficiaries include 64,395 households, 174 commercial establishments, and 8 industrial companies, as well as 280 others. The Yangquan EPB estimates that 753 small heating boilers and commercial stoves were closed due to the subproject, saving about 76,000 t of coal in 2005 and reducing air emissions significantly (Section III).

18. For all components, staff were trained sufficiently. Similarly, training and study tours provided under complementary TAs were completed successfully. These interventions were useful in improving the technical and management skills of the implementing and environmental agencies.

C. Project Costs

19. At appraisal, the Project was estimated to cost the equivalent of \$183.0 million, including contingencies, and interest and other loan charges during construction. This estimate consisted of \$102.0 million in foreign exchange costs (56% of the total) and the equivalent of \$81.0 million in local currency costs (44% of the total). The actual project cost was \$182.0 million, which was in line with the appraisal estimates. Foreign exchange costs of \$99.0 million were about 3% lower than envisaged at appraisal, while local currency costs of \$83.0 million were 2% higher. Loan savings from some components were reallocated to other components to expand their scope and improve their efficiency. Lower-than-expected prices from international competitive bidding (ICB), as well as foreign exchange rate gains, accounted for the savings in foreign costs of TCGP. The increase in foreign costs for DDHP was due to the longer pipelines and additional

heat exchange stations, which offset the cost of the excluded boilers. Higher costs for civil works associated with the change in scope increased local costs for YGDP.

20. The financing plan at appraisal comprised an ADB loan for \$102.0 million (56%), equity contributions from the provincial and municipal governments of \$58.0 million (32%), and local borrowings of \$23.0 million (12%). Actual funding came from ADB (\$99.0 million, or 54%), equity and customers' deposits (\$76.3 million, or 42%), and domestic loans (\$6.7 million, or 4%). Deposits collected from customers allowed lower local borrowings.

21. Project costs and financing plans are in Appendix 2. A detailed cost breakdown by project component is in Appendix 3.

D. Disbursements

22. Disbursements from the ADB loan began in November 2001, with an initial drawdown of \$0.3 million for liquidation of advance payments (imprest funds). Although contract awards and disbursements were delayed initially, they picked up after loan effectiveness. Disbursements were highest during the second year of project construction (2003), when most of the pipes were laid and most of the major equipment installed. The final disbursement was in December 2005 for the last payment on the contract for the insulated pipes and fittings. The loan was closed on 2 December 2005, following disbursements totaling \$99.04 million (or 97% of the original loan amount). Disbursements for contracts totaled \$92.75 million, while those for interest during construction and commitment fees amounted to \$6.29 million. The unused balance of \$2.96 million was canceled. ADB approved the use of anticipated loan savings and reallocation of loan funds among subprojects. Disbursements were made mainly through letters of credit and direct payments. Appendix 4 compares projected and actual disbursements.

E. Project Schedule

23. The Loan Agreement was signed about 1 year after loan approval, and the loan became effective 6 months later, due to the late approval of the project feasibility studies by the then State Development Planning Commission¹¹. Problems arranging local financing caused the delay. The problem eventually was addressed (para. 29), and the Project was implemented smoothly after loan effectiveness. Appendix 5 shows projected and actual implementation schedules for each completed component.

24. TCGP was completed several months ahead of the projected 4-year implementation period. The completion target, which originally was the end of 2003, was adjusted to mid-2005 due to the 18-month delay in awarding the contract. The first coke battery unit was commissioned on 30 April 2004, and reached design capacity in 6 weeks. The second coke battery unit was commissioned on 26 August 2004, and reached design capacity within 2 weeks.

25. Construction of DDHP was delayed due to the change in scope (para. 16). Nevertheless, a major portion of the subproject (81.4 km of heat transmission pipelines and 55 heat exchange stations) was completed in time for the 2004–2005 winter season. The remainder was completed in time for the winter season of 2005–2006.

26. For YGDP, the final section of the pipes was completed in September 2004. The Beijiao storage station was commissioned in June 2004, while the Wukuang storage station was commissioned in January 2006. The Songjiazhuang station was tested and accepted in January 2006, and was put in commercial operation in May 2006.

¹¹ This state agency later became the National Development and Reform Commission.

F. Implementation Arrangements

27. As envisaged at appraisal, SPG was designated as the Executing Agency and a project monitoring office (PMO) was created. Separate PIAs were named for each subproject: Taiyuan Coal Gasification Company (TCGC)¹² was responsible for implementing TCGP; Datong District Heating Company (DDHC) was responsible for implementing DDHP; and Shanxi Yangquan Gas Company (SYGC) was responsible for implementing YGDP.

28. The PIAs established a well-staffed project management team for the engineering and construction, and provided the appropriate organization and procedures for the implementation and initial operation of the facilities. International consultants financed under the loan, along with domestic design agencies, provided technical consulting services. They also assisted the PIAs in reviewing the design, preparing tender documents, and constructing facilities. Appendix 6 shows the organizational setup of the PIAs.

29. After domestic banks withdrew their commitment, TCGC's parent company created a new subsidiary, Shanxi Shenzhou Coking Company, Ltd., and raised equity through the public listing of its shares (40%) to address the local funding issue for the Project. TCGC's parent company continues to hold the remaining 60% of the shares. The share listing is viewed as a progressive step because of the private sector influence on management.

30. SYGC was created to handle the responsibilities of the PIA during implementation of the YGDP subproject. Upon completion, the project facilities will be turned over to the three existing gas companies—Yangquan City Gas Company (YCGC), Pingding Gas Company, and Jiaoqu Gas Company—which will be responsible for operating the Project. YCGC, which has been operating since 1988, supplies gas to the city and is the biggest company. The other two companies, established in 2001, supply gas to the suburban areas.

31. The PIAs procured all ADB-financed components for the Project with the assistance of a tendering company. Local contractors constructed the civil works and installed the equipment, while the equipment suppliers supervised installation and commissioning of equipment procured through ICB. Issues encountered during project implementation (e.g., requirements accompanying the changes in scope and funds reallocation) were resolved with the assistance of ADB staff.

G. Conditions and Covenants

32. The loan covenants generally were complied with. The exceptions were the covenants on tariffs, which were only partially complied with, and the financial covenants for TCGC and YCGC. SPG still subsidizes the operations of YCGC, which continues to lose money from operations due to the limited tariff adjustment. For DDHC, although audited financial statements on the results of its commercial operations are not available yet, initial operating results appear favorable. Full compliance with the covenant requires removal of the subsidy, and approval of heating tariff and gas tariffs that would allow full cost recovery. SPG and DDHC were advised of the completion of the TA on Pro-Poor Urban Heating Tariff Reforms,¹³ which could provide

¹² TCGC is structured as an independent profit center under the parent company.

¹³ ADB. 2001. *Technical Assistance to the People's Republic of China for Pro-Poor Urban Heating Tariff Reforms*. Manila. (TA 3673-PRC, for \$850,000, approved on 19 June). The TA aimed to help the Government reform the heating sector and promote sustainable heating supply in PRC's urban centers by (i) formulating national guidelines for a pro-poor heating tariff, and (ii) establishing an effective heating tariff collection mechanism.

useful measures for addressing viability and social issues common to heating companies in PRC.

33. Audited project accounts and audited financial statements were submitted regularly and mostly on time. Appendix 7 summarizes the financial performance of TCGC, DDHC, and YGDC. Appendix 8 shows the status of compliance with the covenants in the Loan Agreement.

H. Related Technical Assistance

34. The Government of Japan also extended an advisory TA¹⁴ grant to help SPG develop an air pollution permit trading system, and to modify the existing pollution levy system to ensure the sustainability of environmental improvement measures. The objectives of the TA were to (i) enhance the use of market-based instruments for air quality management in Shanxi, and (ii) strengthen the institutional capabilities of the provincial agencies to facilitate their implementation.

35. The technical assistance completion report (TCR) for the advisory TA was prepared in May 2005 (Appendix 9). Taiyuan EPB continues to implement the sulfur dioxide (SO₂) emissions trading mechanism developed under the TA. Taiyuan EPB reported that 21 (11 at the time of the TCR) of the 26 enterprises participating in the program have installed the online monitoring system. Seven monitoring stations have been installed within the city to measure ambient air quality. Eighteen new transactions (two at the time of the TCR), for 602 t of SO₂, were completed; and six more (for 200 t) are being negotiated at the time of the project completion review mission. However, some problems persist in the implementation of the SO₂ emissions trading mechanism that prevent its active implementation. These relate mostly to the low penalties, which do not provide sufficient incentives for participants to trade. Taiyuan EPB is exploring ways to address the issue.

I. Consultant Recruitment and Procurement

36. TCGC hired an international consulting firm to assist with the review of technical design, preparation of bid documents and bid evaluation, and supervision of some aspects of construction and equipment installation. The international consultants were engaged in accordance with ADB's *Guidelines on the Use of Consultants*. The PIA used domestic design institutes for the engineering design of the Project and a research institute for the environmental impact assessment.

37. The Project awarded 74 contract packages for materials, equipment supply, and installation, with a combined value of \$93.0 million. ADB's loan also funded international consultants' services and training. Procurement followed ADB's *Guidelines for Procurement*. Equipment with a contract value of \$500,000 or more was procured following ICB procedures, while equipment with a value below \$500,000, but not less than \$50,000, was procured using international shopping procedures. The ICB procedures produced lower-than-expected bids, which allowed TCGC to lower its foreign exchange costs. Appendix 10 shows the ADB-financed contract packages.

¹⁴ ADB. 1999. *Technical Assistance to the People's Republic of China for the Shanxi Air Quality Improvement*. Manila. (TA 3325-PRC, for \$700,000, approved on 7 December).

J. Performance of Consultants, Contractors, and Suppliers

38. The performance of the international and national consultants was satisfactory. The consulting services, which were carried out in accordance with their terms of reference, contributed to the successful implementation of the Project.

39. The subprojects were implemented largely as designed, with some modifications (para. 16), and the installed facilities are operating satisfactorily. The PIAs expressed satisfaction with the performance of the equipment supplied by the manufacturers as it is operating as designed with no major problems. The quality of construction completed by civil works contractors and installers is also satisfactory.

K. Performance of the Borrower and the Executing Agency

40. As the Borrower, the performance of the Ministry of Finance (MOF) was satisfactory, as was the performance of SPG as the Executing Agency. Although loan effectiveness and the subsidiary Loan Agreement for relending loan proceeds to the PIAs came 1 year after loan approval (para. 23), project implementation went smoothly after that. MOF's supervision and monitoring of the Project did not require significant staff time, as the PIAs assumed the major responsibilities for project implementation. ADB review missions briefed MOF regularly on the Project's progress and implementation issues. The performance of SPG and the PIAs was generally satisfactory, and project was implemented systematically. However, an extension was necessary due to the change in scope for DDHP and the expansion in the coverage area.

L. Performance of the Asian Development Bank

41. ADB's performance in monitoring the Project was satisfactory. Regular project review missions, as well as frequent consultations and briefings with MOF, demonstrated ADB's efforts in monitoring the progress of project implementation. ADB fielded six regular review missions, and ADB staff spent adequate time reviewing physical progress and resolving issues with the PIAs' staff, during implementation. ADB promptly approved the contracts it financed, as well as the necessary disbursements of funds. Further, ADB approved in a timely manner the requested change in project scope and the reallocation of loan proceeds. SPG and the PIAs expressed appreciation for the timely action of ADB in resolving project implementation issues.

III. EVALUATION OF PERFORMANCE

A. Relevance

42. The Project was assessed as highly relevant. The Project was consistent with the priorities of ADB and the Government at the time of appraisal, and helped to improve the environment in Shanxi province. Shanxi is a poor inland province with a nominal gross domestic product per capita of CNY9,120 in 2004—equivalent to 75% of the national average. Shanxi ranks 17th among PRC's 31 provinces in that category. As a producer of about one third of PRC's coal requirements, Shanxi's air quality is among the worst in the country. Four of the 10 most polluted cities in PRC¹⁵ are in Shanxi Province. It has many typical examples of major pollution problems, which highlight the need to address environmental concerns in urban centers.

¹⁵ Four of the 10 most polluted cities in PRC are in Shanxi: Linfen (first), Yanqguan (second), Datong (third), and Xianyang (eighth), based on a State Environmental Protection Administration report.

43. SPG's plan is to continue to improve the environment of the province. The provincial and local governments have lined up programs and projects to reduce pollution.¹⁶ ADB is supporting environmental improvement activities in the energy sector in Shanxi Province and in PRC generally. In Shanxi, ADB is supporting the capture and utilization of coalbed methane.¹⁷ Since 1992, ADB has processed 14 loans (worth \$1.9 billion) designed to improve environmental conditions in PRC's energy sector.

B. Effectiveness in Achieving Outcome

44. The Project was highly effective in achieving its outcome. The Project achieved its objective of improving the environment in Taiyuan, Datong, and Yangquan by helping the cities meet part of their energy requirements through desirable and safe environmental investments and practices. The Project also helped establish a more conducive environment for sustainable economic growth.

C. Efficiency in Achieving Outcome and Outputs

45. The Project was efficient in achieving its outcome and outputs. The three subprojects were implemented efficiently, without any major cost overruns and within the construction schedule. Project facilities were constructed, installed, and commissioned with few problems. The changes made during implementation allowed wider coverage and more beneficiaries to be served. The organizational setup, management, and approval processes of the SPG and PIAs were responsive to the Project's requirements. ICB saved money. Counterpart funds were adequate and provided in a timely manner, albeit after an initial delay.

1. Financial Evaluation

46. The financial internal rate of return (FIRR) for the Project was determined using actual investment costs, and a combination of historical and projected data for revenues and costs. The Project's expected capital costs during commercial operations, which are minimal, already are considered in the maintenance costs. Revenues and expenditures are in constant 2005 prices, and exclude depreciation and interest. The recalculated FIRRs were 10.5% for TCGP, compared with an appraisal estimate of 9.2%; 8.1% for DDHP, compared with 8.7% at appraisal; and 6.9% for YGDP, versus 10.3% at appraisal. These rates are higher than the weighted average costs of capital of 4.4% for TCGP, 4.3% for DDHP, and 4.3% for YGDP. The higher recalculated FIRR for TCGP resulted from lower capital costs and higher prices of outputs than assumed at appraisal. The financial benefit from the high price of coke effectively cross-subsidizes the low coal gas tariff. On the other hand, lower tariffs than anticipated accounted for the decline in FIRRs for DDHP and YGDP. For YGDP, the added revenues from the capture of methane gas, which was being vented into the atmosphere before the Project, accrues to the coal mining company. These incremental revenues were not included as a financial benefit of the Project, because the coal mining company financed the investment for the gas recovery system separately. Therefore, it was not part of the project cost. If the incremental financial benefit were considered in the analysis, the FIRR of YGDP would increase significantly. A summary of the FIRR calculation is in Appendix 11.

¹⁶ One of the projects involves the expansion of the DDHP subproject with funds coming from the Japan Bank for International Cooperation.

¹⁷ ADB. 2004. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of China for the Coal Mine Methane Development Project*. Manila. (Loan 2146-PRC, for \$117.4 million, approved on 20 December). By applying the latest technologies, this project covers all aspects of effective and efficient coal mine methane and coalbed methane production, capture, and use.

2. Economic Evaluation

47. The economic evaluation of the Project followed the methodology used at appraisal. The actual investment costs and related benefits of the project scope were included. Taxes and duties on equipment and other items were excluded. Financial costs were converted to their economic values at 2005 constant prices. Tradable goods were valued at their border prices, including transport and handling costs. Nontradable goods and services were converted into economic costs by applying the applicable specific and standard conversion factors.¹⁸ The economic benefits of each subproject were determined. The prevailing economic price of coal to domestic consumers was used in the calculations. Operating costs were based on actual and assumed data obtained from the subprojects, and adjusted to their economic values.

48. The recalculated economic internal rates of return (EIRR) were 14.5% for TCGP, compared with 23.9% at appraisal; 19.0% for DDHP, compared with 14.1% at appraisal; and 16.1% for YGDP, compared with 26.6% at appraisal. The recalculated EIRRs exceeded ADB's 12.0% hurdle rate for economic opportunity cost of capital. The recalculated EIRRs varied from appraisal estimates due to (i) lower-than-anticipated coal gas tariff for TCGC, (ii) higher efficiency of heat source and expanded project scope for DDHP, and (iii) lower gas tariff for YGDP. The EIRRs would rise if the value of the economic benefits from environmental improvements were included.¹⁹ Aside from reducing pollution, other economic benefits include making areas available for development that had been occupied by district boiler houses, and lowering operations and maintenance costs due to the removal of small boilers. Other benefits not quantified at appraisal or at project completion include the removal of waste residues, and reduced tolls on coal transport and handling due to lower coal volume. A summary of the EIRR calculation is in Appendix 12.

D. Preliminary Assessment of Sustainability

49. The Project is likely to be sustainable. District heating and gas supply are two essential public services. The demand for these services in urban areas is expected to multiply as the public becomes increasingly aware of the need for a cleaner environment. The operating parameters of the subprojects suggest that they are sustainable. The operating facilities were designed and installed properly, and function well. The PIAs possess the institutional capability and expertise required to manage and operate the facilities effectively and efficiently. For TCGC, the demand and price of coke have been rising for the past 3 years. If the price of coke remains at the current level, the internal cross-subsidy provided will relieve the pressure to increase the coal gas tariff as the company remains profitable. However, YCGC's operation continues to be subsidized, and adequate tariffs have not been approved and implemented. The incremental financial benefit from the capture of methane gas effectively has been channeled to the coal mine company, providing an incentive to undertake similar environmental projects. The need to establish a heating tariff that is sufficient to allow full cost recovery also should be addressed for DDHP.

50. Despite the concern over adequate heating and gas tariffs, projected net revenue flows for each component are positive, and actual FIRRs remain above the weighted average cost of capital. Actual EIRRs are also above the 12% minimum for the economic opportunity cost of capital. Higher heating and gas tariffs will improve the sustainability of the subprojects. As the

¹⁸ The conversion factors used in this evaluation are 1.10 for civil works, 1.10 for local machinery, and 0.93 for others.

¹⁹ An attempt to estimate the local and global environmental benefits derived from the Project (following the benefits transfer method described in ADB, 1996. *Economic Evaluation of Environmental Impacts: A Workbook*. Manila) produced an EIRR of 19.7% for TCGP, 28.6% for DDHP, and 37.7% for YGDP. The use of methane gas by YGDP will yield very high global benefits.

Project was approved before start of the Clean Development Mechanism under the Kyoto Protocol, it cannot access this financing facility. In the future, the ability of similar projects to avail of the incentives under this mechanism would make them more sustainable.

E. Impact

1. Environmental Impact

51. The Project achieved its stated objective of improving the air quality in the three main cities of Shanxi province. Taiyuan, Datong, and Yangquan have major industrial sectors, large coal-fired power plants, and topography that traps air pollution in urban areas. In recent years, the economy of each city has grown rapidly with associated increases in population, industrial capacity, and transport fleet. In response to these conditions, each city has implemented measures to reduce air pollution emissions. As a result, ambient levels of SO₂, total suspended particles (TSP), and nitrogen dioxide generally have decreased over the past 5 years (although ambient levels still exceed Class II standards in Datong and Yangquan). Emissions of SO₂ and TSP also have decreased or leveled out during the previous 5 years, despite accelerating urbanization. The Project has contributed considerably to the improvement in air quality in Taiyuan, Datong, and Yangquan, as demonstrated by the following results in 2005:

(i) TCGP Subproject:

- (a) Approximately 485 small, heavily polluting coal-fired boilers in the Taiyuan urban area were closed and replaced with environmentally cleaner gas-fired boilers.
- (b) Reduced coal usage in Taiyuan by about 392,000 t.
- (c) Households using gas increased by 19%; other users (industrial, commercial, and public facilities) grew by 49%.
- (d) Between 2003 (before Project) and 2005 (after Project), annual SO₂ emissions in Taiyuan dropped 19%, or 43,400 t. Reduced coal use from the subproject accounted for about 23% of this reduction (10,093 t SO₂).
- (e) Reduced TSP emissions by 12,754 t and nitrogen oxide (NO_x) emissions by 1,621 t.

(ii) DDHP Subproject:

- (a) Reduced coal usage in Datong by about 325,000 t.
- (b) Class II air quality conditions in Datong rose from 48 days in 2001 to 220 days in 2005.
- (c) Households, industrial facilities, and commercial facilities that use gas have increased by 30%.
- (d) Reduced SO₂ emissions by 5,200 t (9%) and TSP emissions by 6,500 t (9%).
- (e) Reduced NO_x emissions by 1,625 t.

(iii) YGDP Subproject:

- (a) Reduced coal usage in Yangquan by 76,000 t.
- (b) Approximately 753 small, heavily polluting coal-fired heating boilers and commercial stoves in the Yangquan urban area were closed and replaced with environmentally cleaner gas-fired boilers.
- (c) Class II air quality conditions in Yangquan rose from 7 days in 2001 to 225 days in 2005.
- (d) Reduced emissions of TSP by 1,066 t, SO₂ by 1,218 t, and NO_x by 579 t.

52. Appendix 13 presents the environmental indexes.

2. Social Impact

53. The Project (i) permanently acquired 5.98 hectares (ha) of land, which affected 50 persons; (ii) temporarily occupied 5.40 ha of land, which affected 88 persons; and (iii) demolished 589 m² of housing for pipe installation, which affected 40 persons. Resettlement costs totaled \$2.58 million. Resettlement issues associated with the Project were addressed in accordance with the PRC's laws and regulations. After installation of the pipes, households that had their houses demolished rebuilt them in the same place with larger floor sizes. Therefore, social capital was maintained in the original location, and the living conditions of the affected persons were improved. The incomes of persons affected by land acquisition have been restored. A portion of the funds for land acquisition was invested in village-level public infrastructure, such as roads and accommodation for senior citizens; and in income-generating activities, such as village enterprises. The relevant details are in Appendix 14.

54. The Project provided temporary employment for more than 2,000 people during project construction. Operation of the project facilities created new jobs for about 1,424 people, about 30% of whom were women. Additional employment was created for contracted services. No ethnic minority groups were in the areas affected by the Project.

3. Capacity Building

55. The advisory TA (paras. 34–35) for Taiyuan EPB has improved its institutional capabilities. The staff of the three PIAs also received foreign and local training on technical and management aspects. During project implementation, the PIAs sent 51 staff members abroad for training in environmental management and protection, as well as in pipeline network operation and security, network planning and strategy, and other relevant technical and management programs. In addition, more than 700 staff members received local training on (i) technical matters, (ii) finance and accounting, (iii) computers, and (iv) personnel administration. PMO staff also attended ADB-sponsored training programs on procurement and project management. The training programs enhanced the technical, operational, and managerial capabilities, and environmental consciousness, of the PIAs. These formal training programs, combined with experience in project management and operation during project implementation, helped staff to improve their institutional capability and competence in developing and expanding operations. They also helped the staff provide for a cleaner environment in Shanxi in the future. However, the original amount allocated to hire consultants for institutional development was not utilized, as SPG insisted that sufficient expertise already existed. Appendix 15 gives the details of the training programs.

4. Enterprise Reforms

56. The heating and gas distribution sectors have been undergoing reforms. However, many gas distribution and heating companies remain subsidized, which is common in PRC.²⁰ The recommendations developed by the recent TA on urban heating tariff reforms (footnote 11) can address some of the concerns. PRC is undertaking reforms to promote greater use of clean energy in the country. Since Shanxi is PRC's top coal producer, the state of its environment requires close attention. Further, implementing the policy and structural reforms to create a

²⁰ ADB. 2004. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of China for the Liaoning Environmental Improvement Project*. Manila. (Loan 2112-PRC, for \$70 million, approved on 25 November).

clean environment is crucial. The Project played an important role in realizing Shanxi's environmental goals.

IV. OVERALL ASSESSMENT AND RECOMMENDATIONS

A. Overall Assessment

57. Overall, the Project is rated successful.²¹ The Project was assessed highly relevant, highly effective, efficient and likely to be sustainable. The Project has had a strong and positive environmental and developmental impact.

58. All the three subprojects were implemented and are operating satisfactorily. Although project implementation was delayed initially, it proceeded smoothly once construction began. While the project cost was within estimates, the cost of some components increased due to design changes to expand the scope and extend the benefits to more users.

59. The Project has achieved its objectives of improving the air quality of the three cities in Shanxi. Since project implementation, ambient air quality has improved every year in Taiyuan, Datong, and Yangquan. The objective of using more environment-friendly alternatives to coal and coal gas also was met. Coal savings from burning less coal through district heating, and replacing coal with coal gas and coal mine methane gas, have reduced emissions. The Project resulted in reduced coal usage by a combined 793,000 t in 2005 in the three cities and lowered emissions of SO₂ by 16,511 t, TSP by 20,320 t, and NO_x by 3,825 t. From 2007, an estimated 53,000 t of coal mine methane gas (1.1 million t of carbon dioxide (CO₂) equivalent) will be stopped from being vented into the atmosphere. In addition, the generation of fly ash and slag, as well as associated disposal requirements, has declined. Further, the environmental programs developed under the Project have enhanced public awareness of environmental protection.

B. Lessons

60. A key factor in the success of the Project was the strong commitment of the project proponents. All concerned parties demonstrated ownership of the Project. Through the dedication of SPG, the local governments, and the three PIAs to achieving target outputs, the implementation met project objectives with close adherence to guidelines and procedures. Project implementation was undertaken through effective supervision, monitoring, and cost control.

61. Adequate planning and preparation are key elements of the smooth and timely execution of a project. Timely availability of the required funds is also important. The withdrawal of funding commitment by domestic banks delayed the approval of the project feasibility reports, and extended loan signing and effectiveness.

62. Responsiveness to significant changes in prevailing parameters could improve project design and benefits. Although the original design did consider the more efficient heat source, it was not firmed up at the time of formulation. The appropriate changes were made when the opportunity presented itself.

63. A properly administered bidding process, supported by detailed technical design and bid specifications, can generate advantageous bids. Selection and recruitment of competent international and national consultants have ensured quality standards.

²¹ The project rating is on the border of highly successful.

C. Recommendations

1. Project-Related

64. **Future Monitoring.** All project components have been implemented and are operating as planned, however, keeping track of developments related to the implementation of the permits trading mechanism would improve the responsiveness of future ADB assistance in the sector. The recent TA on heating tariff reforms (para. 32) contains recommendations that DDHC could adopt. Follow-up actions and consultations with the Government would increase ADB's sector knowledge.

65. **Further Action or Follow-up.** Although most performance targets have been met, future increases in gas tariffs to ensure adequate cost recovery is crucial. Continuous follow-through with SPG on needed tariff increases is proposed.²²

66. **Timing of Project Performance Evaluation Report Preparation.** A project performance evaluation review could be fielded in 2007–2008. By this time, the subprojects would have been in commercial operation for at least two years, and the reforms needed in PRC's heating and gas sectors would have taken shape.

2. General

67. A clean environment is essential for sustainable economic growth. PRC's recent economic growth will be hampered if urban pollution is not abated. The transformation of the environment sector in PRC entails short- and long-term adjustments. With the continuing toll of industrialization, population growth, and vehicle growth, adequate environmental protection measures need to be in place. Shanxi's environmental condition, in particular, needed urgent and close attention. The Project is the centerpiece of the environmental plan of Shanxi Province, and its success demonstrates that similar undertakings can be replicated.

²² This can be undertaken during the review missions for Loan 2146-PRC: Coal Mine Methane Development Project (footnote 17), which includes a component for distribution of coal mine methane gas.

CHRONOLOGY OF MAJOR EVENTS

15 April 1999	Fact-Finding Mission fielded
20 May 1999	Management review meeting
5 July 1999	Appraisal Mission fielded
11 August 1999	Staff review committee meeting
2 November 1999	Loan negotiations
7 December 1999	Asian Development Bank (ADB) approves a loan of \$102 million from ADB's ordinary capital resources to the People's Republic of China (PRC) for the Shanxi Environment Improvement Project (Loan 1715), and Technical Assistance (TA) of \$700,000 for the Shanxi Air Quality Improvement
10 May 2000	Loan downgraded to "unsatisfactory" status due to delay in signing of the Loan Agreement beyond 3 months
10 May 2000	Taiyuan Coal Gasification (Group) Company restructured to form Shanxi Shenzhou Coal Electricity Coking Ltd. Co.
24 July 2000	Inception Mission fielded
27 November 2000	Loan signing
27 November 2000	Loan is upgraded to "satisfactory" status following signing of the Loan Agreement
18 January 2001	Manager, Energy and Infrastructure Division, approves change in the procurement mode of three packages from local competitive bidding (LCB) to international shopping (IS) procedure under subproject 1
23 February 2001	Date for loan effectiveness extended from 25 February to 25 May 2001
23 February 2001	Project rating for implementation progress was downgraded from "satisfactory" to "unsatisfactory" due to delay in loan effectiveness
15 March 2001	Review Mission fielded
19 March 2001	TA consultant begins services

1 April 2001	Civil works under subproject 2 begin
25 May 2001	Loan becomes effective
13 August 2001	Bid documents for 10 packages under subproject 2 submitted to ADB
20 September 2001	ADB approves reallocation of \$1.33 million from civil works to the equipment category as a minor change in scope under subproject 2
21 October 2001	Review Mission fielded
15 November 2001	First disbursement
6 March 2002	Contract for package 1 (pre-insulated pipes) under subproject 2 approved
3 June 2002	ADB procurement committee approves awarding of contract for package No. A-6 (silica bricks for coke oven) for \$3,404,393 under subproject 1
20 June 2002	ADB approves awarding of contract for package No. 6 (pipes and fittings) for \$4,324,590 under subproject 3
9 July 2002	Civil works under subproject 3 begin
22 August 2002	ADB approves substitution of 20,000 cubic meter (m ³) tank with a 50,000 m ³ tank due to change in design under subproject 3
7 November 2002	ADB procurement committee approves awarding of contract for package No. A-11 (steel, cement and timber) for \$5,292,701 under subproject 1
27 November 2002	Review Mission fielded
December 2002	Civil works under subproject 1 begin
1 April 2003	Shanxi Provincial Government adjusts gas tariff
September 2003	Consultant submits final report for the TA
14 December 2003	Review Mission fielded
4 June 2004	Director, Energy Division, East and Central Asia Department (ECEN) approves extension of loan closing date from 30 June 2004 to 30 June 2005

10 June 2004	Construction of Beijiao gas station tank under subproject 3 completed
30 June 2004	Original loan closing date
11 August 2004	Review Mission fielded
5 October 2004	Director, ECEN approves a minor change in project scope to install 10 additional heat exchangers in place of the peaking boilers, and reallocation of loan proceeds (\$5.40 million) under subproject 2
January 2005	Compliance certificate by Shanxi province Environmental Monitoring Center under subproject 1 issued
20 January 2005	Certificate of acceptance for Beijiao gas station under subproject 3 issued
31 January 2005	TA financial closing
12 May 2005	Review Mission fielded
1 June 2005	Subproject 1 completed, begins operation
1 December 2005	Subproject 2 completed, begins operation
1 December 2005	Final disbursement
2 December 2005	Undisbursed loan balance of \$2,958,280.14 canceled and loan account closed
6 March 2006	Project Completion Review Mission fielded

OVERALL PROJECT COST AND FINANCING SOURCES
(\$ million)

Table A2.1: Project Cost

Subproject	Appraisal			Actual		
	FX	LC	Total	FX	LC	Total
Part A - Subproject 1: Taiyuan Coal Gasification Plant	69.39	50.90	120.29	61.51	54.57	116.08
Part B - Subproject 2: Datong District Heating Plant	17.81	20.30	38.11	23.33	16.96	40.29
Part C – Subproject 3: Yangquan Gas Distribution Plant	13.50	9.10	22.60	13.99	11.22	25.21
Part D – Institutional Strengthening	1.30	0.70	2.00	0.21	0.25	0.46
Total	102.00	81.00	183.00	99.04	83.00	182.04

FX = foreign exchange, LC = local currency

Sources: Project implementing agencies and project files

Table A2.2: Financing Sources

Subproject	Appraisal				Actual			
	ADB Loan	Commercial Bank Loan	Own Resources	Total	ADB Loan	Commercial Bank Loan	Own Resources	Total
Part A	69.39	21.08	29.82	120.29	61.51	0.00	54.57	116.08
Part B	17.81	0.00	20.30	38.11	23.33	3.60	13.36	40.29
Part C	13.50	1.96	7.14	22.60	13.99	3.11	8.11	25.21
Part D	1.30	0.00	0.70	2.00	0.21	0.00	0.25	0.46
Total	102.00	23.04	57.96	183.00	99.04	6.71	76.29	182.04

ADB = Asian Development Bank

Sources: Project implementing agencies and project files

COST BREAKDOWN BY PROJECT COMPONENTS

(\$ million)

Component	Appraisal Estimate			Actual		
	FX	LC	Total	FX	LC	Total
Part A - Subproject 1, Taiyuan Coal Gasification Plant						
Land Acquisition	0.00	2.57	2.57	0.00	0.30	0.30
Site Preparation	0.00	3.70	3.70	0.00	7.83	7.83
Engineering and Design including License Fees	2.05	3.79	5.84	0.00	0.00	0.00
Equipment and Materials	41.42	2.30	43.72	59.11	3.25	62.36
Auxiliary Equipment and Materials	9.44	0.86	10.30	0.00	0.00	0.00
Domestic Transport	0.00	0.42	0.42	0.00	0.00	0.00
Construction and Erection including Civil Works	3.40	25.14	28.54	0.00	35.92	35.92
Consulting Service	0.00	2.59	2.59	0.00	0.00	0.00
Human Resource Development	0.10	0.23	0.33	0.00	0.00	0.00
Commissioning and Start Up	0.00	0.70	0.70	0.00	0.00	0.00
Energy and Environmental Management	0.00	0.27	0.27	0.00	0.00	0.00
Project Management	0.35	0.60	0.95	0.00	7.27	7.27
Base Cost	56.76	43.17	99.93	59.11	54.57	113.68
Physical Contingency	2.84	2.16	5.00	0.00	0.00	0.00
Price Contingency	2.74	1.84	4.58	0.00	0.00	0.00
Subtotal	5.58	4.00	9.58	0.00	0.00	0.00
Interest During Construction	7.05	3.73	10.78	2.40	0.00	2.40
Subtotal (A)	69.39	50.90	120.29	61.51	54.57	116.08
Part B - Subproject 2, Datong District Heating Plant						
Land Acquisition	0.00	0.68	0.68	0.00	0.00	0.00
Site Preparation	0.00	0.20	0.20	0.00	1.34	1.34
Engineering and Design including License Fees	0.00	1.22	1.22	0.00	0.80	0.80
Equipment and Materials	12.00	8.08	20.08	22.24	1.38	23.62
Auxiliary Equipment and Materials	0.00	0.13	0.13	0.00	0.00	0.00
Domestic Transport	0.00	0.41	0.41	0.00	0.00	0.00
Construction and Erection including Civil Works	1.33	6.62	7.95	0.00	11.79	11.79
Consulting Service	0.00	0.31	0.31	0.00	0.16	0.16
Human Resource Development	0.32	0.22	0.54	0.00	0.07	0.07
Commissioning and Start Up	0.00	0.06	0.06	0.00	0.00	0.00
Energy and Environmental Management	0.00	0.57	0.57	0.00	0.00	0.00
Project Management	0.16	0.17	0.33	0.00	1.19	1.19
Base Cost	13.81	18.67	32.48	22.24	16.73	38.97
Physical Contingency	0.69	0.83	1.52	0.00	0.00	0.00
Price Contingency	1.68	0.80	2.48	0.00	0.00	0.00
Subtotal	2.37	1.63	4.00	0.00	0.00	0.00
Interest During Construction	1.63	0.00	1.63	1.09	0.23	1.32
Subtotal (B)	17.81	20.30	38.11	23.33	16.96	40.29

FX = foreign exchange, IDC = interest during construction, LC = local currency.

Sources: Project implementing agencies and project files.

Component	Appraisal Estimate			Actual		
	FX	LC	Total	FX	LC	Total
Part C: Subproject 3, Yangquan Gas Distribution Plant						
Land Acquisition	0.00	1.14	1.14	0.00	0.69	0.69
Site Preparation	0.00	0.08	0.08	0.00	0.13	0.13
Engineering and Design including License Fees	0.33	0.33	0.66	0.00	0.37	0.37
Equipment and Materials	6.36	2.22	8.58	12.81	0.42	13.23
Auxiliary Equipment and Materials	0.74	1.34	2.08	0.00	0.00	0.00
Domestic Transport	0.00	0.48	0.48	0.00	0.00	0.00
Construction and Erection including Civil Works	3.49	2.19	5.68	0.63	7.66	8.29
Consulting Service	0.00	0.04	0.04	0.00	0.00	0.00
Human Resource Development	0.02	0.04	0.06	0.00	0.00	0.00
Commissioning and Start Up	0.00	0.11	0.11	0.00	0.00	0.00
Energy and Environmental Management	0.00	0.14	0.14	0.00	0.00	0.00
Project Management	0.20	0.16	0.36	0.00	0.77	0.77
Base Cost	11.14	8.27	19.41	13.44	10.04	23.48
Physical Contingency	0.56	0.41	0.97	0.00	0.00	0.00
Price Contingency	0.46	0.23	0.69	0.00	0.00	0.00
Subtotal	1.02	0.64	1.66	0.00	0.00	0.00
Interest During Construction	1.34	0.19	1.53	0.55	1.18	1.73
Subtotal (C)	13.50	9.10	22.60	13.99	11.22	25.21
Part D: Institutional Development						
Land Acquisition	0.00	0.00	0.00	0.00	0.00	0.00
Site Preparation	0.00	0.00	0.00	0.00	0.00	0.00
Engineering and Design including License Fees	0.00	0.00	0.00	0.00	0.00	0.00
Equipment and Materials	0.58	0.00	0.58	0.03	0.25	0.28
Auxiliary Equipment and Materials	0.00	0.30	0.30	0.00	0.00	0.00
Domestic Transport	0.00	0.00	0.00	0.00	0.00	0.00
Construction and Erection including Civil Works	0.00	0.00	0.00	0.00	0.00	0.00
Consulting Service	0.30	0.07	0.37	0.00	0.00	0.00
Human Resource Development	0.12	0.13	0.25	0.17	0.00	0.17
Commissioning and Start Up	0.00	0.00	0.00	0.00	0.00	0.00
Energy and Environmental Management	0.00	0.00	0.00	0.00	0.00	0.00
Project Management	0.00	0.17	0.17	0.00	0.00	0.00
Base Cost	1.00	0.67	1.67	0.20	0.25	0.45
Physical Contingency	0.08	0.03	0.11	0.00	0.00	0.00
Price Contingency	0.10	0.00	0.10	0.00	0.00	0.00
Subtotal	0.18	0.03	0.21	0.00	0.00	0.00
Interest During Construction	0.12	0.00	0.12	0.01	0.00	0.01
Subtotal (D)	1.30	0.70	2.00	0.21	0.25	0.46

FX = foreign exchange, IDC = interest during construction, LC = local currency.

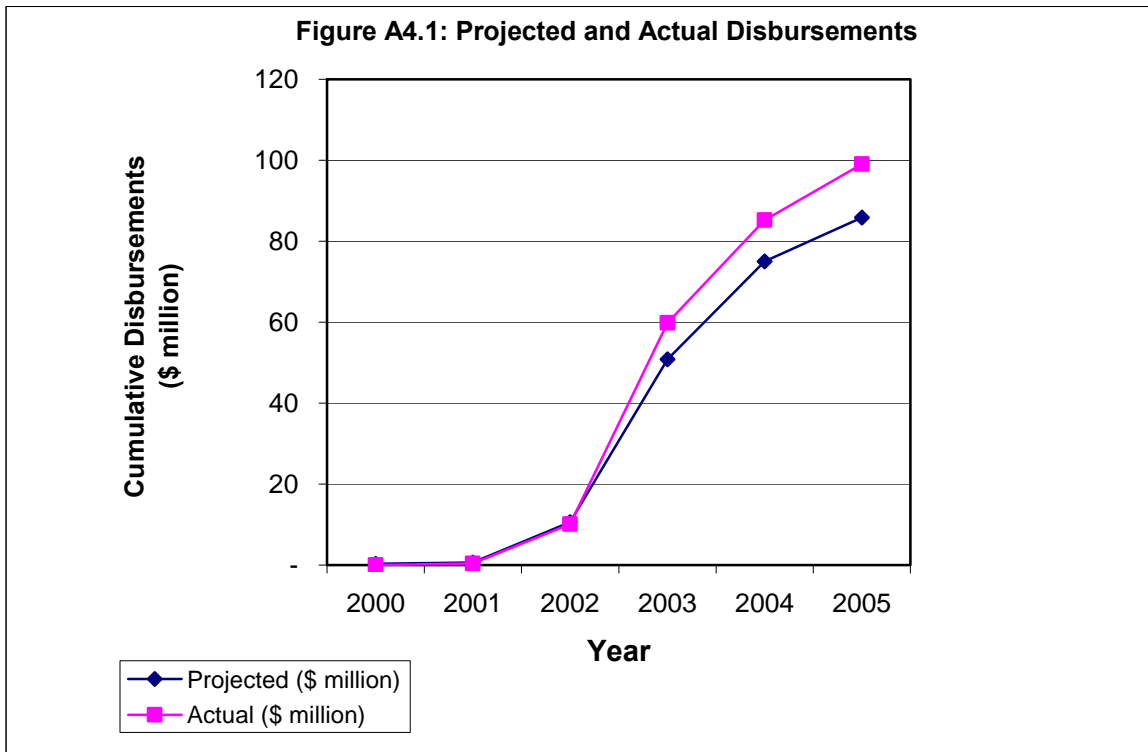
Sources: Project implementing agencies and project files.

PROJECTED AND ACTUAL DISBURSEMENTS, 2000–2005

Year	For the Year (\$ million)		Cumulative		
	Projected	Actual	Projected (\$ million)	Actual (\$ million)	% of Loan
2000	0.30	0.00	0.30	0.00	0
2001	0.30	0.39	0.60	0.39	0
2002	10.00	9.70	10.60	10.09	10
2003	40.20	49.74	50.80	59.83	60
2004	24.20	25.39	75.00	85.21	86
2005	10.81	13.83	85.81	99.04	100
Total	85.81	99.04			

Note: Annual projections exclude interest during construction.

Source: Project records. Projections based on annual submissions made by the executing and project implementing agencies.



PROJECT IMPLEMENTATION SCHEDULE
Taiyuan Coal Gasification Plant

Item	1999				2000				2001				2002				2003				2004				2005							
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
1. Preliminary Design																																
2. Bid Document Preparation																																
3. Detailed Engineering																																
4. Equipment Procurement																																
5. Land Acquisition																																
6. Site Preparation																																
7. Civil Works																																
8. Installation																																
9. Testing, Start-Up, and Commissioning																																
10. Commercial Operation																																

Q = quarter

Source: Project implementing agency

 Actual

 Planned

Datong District Heating Plant

Item	1999				2000				2001				2002				2003				2004				2005			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1. Preliminary Design		■	■	■					■																			
2. Bid Document Preparation			■	■	■	■			■	■	■	■	■	■	■	■												
3. Detailed Engineering					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
4. Equipment Procurement						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
5. Land Acquisition							■	■			■	■																
6. Site Preparation									■	■			■	■			■	■			■	■			■	■		
7. Civil Works									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
8. Installation									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
9. Testing, Start-Up, and Commissioning															■	■											■	■
10. Commercial Operation																	■	■	■	■	■	■	■	■				

Q = quarter

Source: Project implementing agency

■ Actual

■ Planned

Yangquan Gas Distribution Plant

Item	1999				2000				2001				2002				2003				2004				2005				2006			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1. Preliminary Design			■	■									▨	▨	▨	▨	▨	▨	▨	▨												
2. Bid Document Preparation					■	■	■	■																								
3. Detailed Engineering						■	■	■	■	■	■	■																				
4. Equipment Procurement									■	■	■	■	■	■	■	■																
5. Land Acquisition			■	■	■	■																										
6. Site Preparation					■	■	■																									
7. Civil Works							■	■	■	■	■	■																				
8. Installation										■	■	■	■	■	■	■	▨	▨	▨	▨	▨	▨	▨	▨								
9. Testing, Start-Up, and Commissioning															■	■																
10. Commercial																	■	■	■	■												

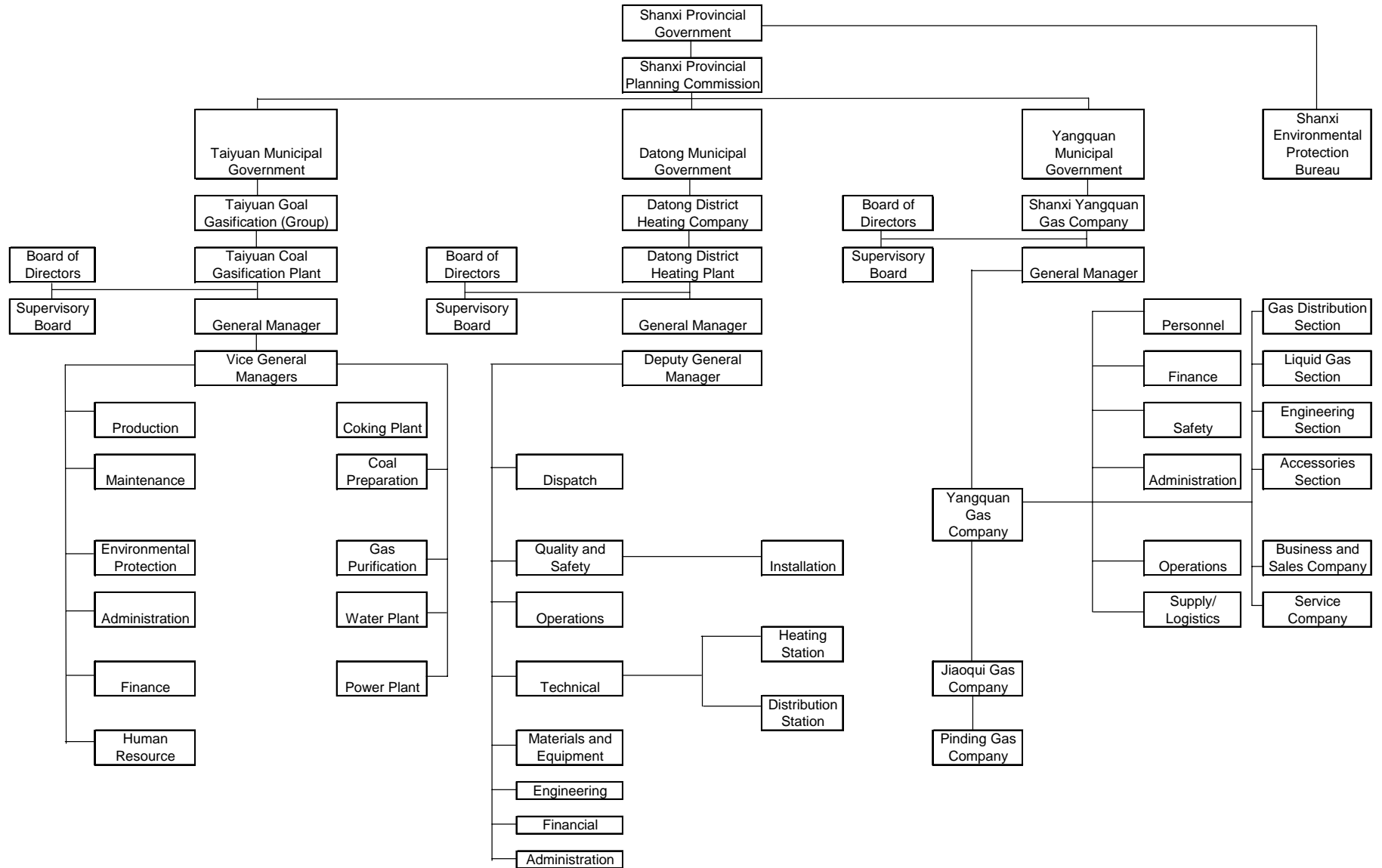
Q = quarter

Source: Project implementing agency

▨ Actual

■ Planned

ORGANIZATIONAL CHART OF EXECUTING ANG IMPLEMENTING AGENCIES



FINANCIAL PERFORMANCE OF PROJECT ENTERPRISES

Table A7.1: Financial Performance of Taiyuan Coal Gasification Company
(CNY million)

Year Ending December 31	2004	2005
Income Statements		
Sales	221.49	787.01
Less: Cost of Sales	176.24 ^a	734.82 ^a
Gross Profit	45.25	52.19
Less: Operating Expenses	3.64	41.91
Net Operating Income/(Loss)	41.61	10.28
Less: Interest Expense	0.32	1.31
Non-operating Income/(Expense)	(0.26)	(0.97)
Net Income Before Tax	41.03	8.01
Less: Income Tax	0.00	0.00
Net Income After Tax	41.03	8.01
Cash Flow Statements		
Net Income	41.03	8.01
Add: Depreciation and Other Non-cash Charge	4.07	24.55
Interest Expense	0.32	1.31
Net Cash Flow from Operations	45.42	33.87
Borrowings/Advances	(17.80)	70.59
Equity Contributions	0.00	0.00
Total Sources of Funds	27.62	104.46
Capital Expenditures	2.66	13.51
Debt Service	19.97	79.91
Principal Repayments	19.65	78.60
Interest	0.32	1.31
Dividends	0.00	0.00
Increase/ (Decrease) in Working Capital	3.15	10.74
Total Application of Funds	25.78	104.16
Changes in Cash	1.84	0.30
Cash Balance, Beginning of Year	0.00	1.84
Cash Balance, End of Year	1.84	2.14

Table A7.1: Financial Performance of Taiyuan Coal Gasification Company
(CNY million)

Year Ending December 31	2004	2005
Balance Sheets		
Current Assets	100.18	112.75
Cash and Deposits	1.84	2.14
Short-Term Investments	3.35	1.02
Accounts Receivables	112.41	66.44
Other Receivables	0.07	0.12
Inventories	42.08	155.22
Advances	0.28	0.89
Other Current Assets	(59.84)	(113.08)
Long-Term Investment	0.00	0.00
Net Fixed Assets	443.60	433.61
Plant in Service	447.67	462.23
Less: Accumulated Depreciation	4.07	28.62
Construction in Progress	2.66	1.61
Intangibles and Deferred Assets	0.00	0.00
Other Assets	0.00	0.00
Total Assets	546.44	547.964
Current Liabilities	95.20	96.72
Short-Term Loans	0.00	0.00
Accounts Payable	33.38	40.92
Advances	32.05	28.93
Other Payables	29.77	26.87
Long term Debt		
Other Liabilities (Account with Parent Company)	410.22 ^b	402.21 ^b
Equity	41.03	49.05
Paid in Capital	0.00	0.00
Surplus and Reserves	0.00	0.00
Retained Earnings	41.03	49.05
Total Liabilities and Equity	546.44	547.96
Financial Indicators		
Rate of Return on Net Fixed Assets(%)	9.4	2.3
Debt Service Ratio (times)	2.3	0.4
Current Ratio (times)	1.1	1.2
Accounts Receivables (months)	6.1	1.0
Self-financing ratio (%)	1,707.6	250.7

^a Balances provided by the project implementing agency includes debt servicing of ADB loan. These were excluded and the net income was adjusted accordingly.

^b The Project is structured as an independent department (profit center) of the Taiyuan Coal Gasification (Group) Company hence, no separate equity is established.

Source: Submitted financial statements.

Table A7.2: Financial Performance of Yangquan Gas Distribution Company
(CNY million)

Year Ending December 31	2001	2002	2003	2004	2005
Income Statements					
Sales	10.08	11.73	15.25	18.27	25.25
Less: Cost of Sales	14.12	14.88	16.70	19.41	29.92
Gross Profit	(4.04)	(3.15)	(1.45)	(1.14)	(4.67)
Less: Operating Expenses	3.85	4.51	5.89	7.44	6.66
Net Operating Income/(Loss)	(7.89)	(7.67)	(7.34)	(8.58)	(11.33)
Less: Interest Expense	0.86	0.95	0.94	0.83	2.30
Non-operating Income/(Expense)	0.01	0.19	0.03	0.14	(0.39)
Net Income Before Tax	(8.74)	(8.43)	(8.25)	(9.27)	(14.02)
Financial Subsidy	4.40	4.40	4.60	4.40	4.50
Other Adjustments	0.05	0.42	0.41	0.46	1.07
Less: Income Tax	0.00	0.00	0.00	0.00	0.00
Net Income After Tax	(4.29)	(3.61)	(3.24)	(4.41)	(8.45)
Cash Flow Statements					
Net Income		(3.61)	(3.24)	(4.41)	(8.45)
Add: Depreciation and Other Non-cash Charges		3.50	3.46	3.22	8.29
Interest Expense		0.95	0.94	0.83	2.30
Net Cash Flow from Operations		0.85	1.16	(0.36)	2.14
Borrowings		0.00	0.00	0.00	8.90
Equity Contributions		0.00	0.00	0.00	0.00
Total Sources of Funds		0.85	1.16	(0.36)	11.04
Capital Expenditures		0.04	0.21	0.16	1.91
Debt Service		1.25	1.14	4.73	6.40
Principal Repayments		0.30	0.20	3.90	4.10
Interest		0.95	0.94	0.83	2.30
Dividends		0.00	0.00	0.00	0.00
Increase/ (Decrease) in Working Capital		(1.78)	(1.02)	(0.37)	1.02
Total Application of Funds		(0.49)	0.33	4.52	9.33
Changes in Cash		1.34	0.83	(4.88)	1.71
Cash Balance, Beginning of Year		4.08	5.41	6.24	1.36
Cash Balance, End of Year		5.41	6.24	1.36	3.06

Year Ending December 31	2001	2002	2003	2004	2005
Balance Sheets					
Current Assets	30.75	23.08	34.17	32.46	44.91
Cash and Deposits	4.08	5.41	6.24	1.36	3.07
Notes Receivable	0.00	0.00	0.00	0.10	0.50
Accounts Receivables	0.48	0.54	0.54	0.54	0.54
Other Receivables	24.99	16.33	26.75	29.62	39.56
Inventories	1.20	0.80	0.63	0.83	1.24
Other Current Assets	0.00	0.00	0.00	0.00	0.00
Long-Term Investment	0.58	0.58	0.58	0.58	0.58
Net Fixed Assets	125.16	121.97	118.93	115.87	109.50
Plant in Service	160.06	160.09	160.09	160.25	162.16
Less: Accumulated Depreciation	34.90	38.13	41.16	44.38	52.67
Construction in Progress	10.71	0.45	0.45	0.45	0.41
Intangibles and Deferred Assets	0.00	0.00	0.00	0.00	0.00
Other Assets	0.28	0.00	0.00	0.00	0.00
Total Assets	167.47	146.09	154.14	149.36	155.40
Current Liabilities	24.38	25.38	34.59	42.54	51.06
Short-Term Loans	7.10	6.80	12.10	17.80	13.70
Notes Payable	0.00	0.00	5.00	0.00	1.45
Accounts Payable	16.01	17.80	17.21	24.22	34.79
Other Payables	1.27	0.78	0.27	0.52	1.12
Long-Term Debt	30.00	30.00	30.00	20.40	20.40
Other Long-Term Liabilities	31.84	13.06	15.14	16.42	21.03
Equity	81.26	77.65	74.41	70.00	62.90
Paid in Capital	64.17	64.17	64.17	64.17	65.53
Surplus and Reserves	44.75	44.75	44.75	44.75	44.75
Retained Earnings	(27.66)	(31.27)	(34.51)	(38.92)	(47.37)
Total Liabilities and Equity	167.47	146.09	154.14	149.36	155.40
Financial Indicators					
Rate of Return on Net Fixed Assets(%)	(6.3)	(4.2)	(4.1)	(4.9)	(6.8)
Debt Service Ratio (times)	–	(6.1)	(6.4)	(1.8)	(1.8)
Current Ratio (times)	1.3	0.9	1.0	0.8	0.9
Accounts Receivables (months)	30.3	17.3	21.5	19.8	19.1
Self-financing ratio (%)	–	2374.2	552.9	(228.8)	111.7
Debt as % of Debt and Equity (%)	27.0	27.9	28.7	22.6	24.5

Note: Accounts are for the operations of the Yangquan Gas Distribution Company; project expenditures are recorded under the newly created project company, Shanxi Yangquan Gas Company. These will be transferred to the heating companies (Yangquan City Gas Company, Pinding Gas Company and Jiaoqu Gas Company) after the project completion.

Source: Submitted financial statements.

STATUS OF COMPLIANCE WITH LOAN COVENANTS

Covenant	Reference in Loan Agreement	Status of Compliance
Loan Effectiveness		
1. The Loan Agreement (LA) will be approved by the State Council of the Borrower.	LA, Section 6.01(a)	Complied with.
Procurement		
2. Procurement of goods and services will be in accordance with ADB's <i>Guidelines for Procurement</i> .	LA, Schedule 4, para. 2	Complied with.
Execution of the Project		
3. SPG shall be the Executing Agency for the Project, providing overall coordination through the PMO. The PMO shall be under the direct supervision of SPPC. The PMO shall be headed by a director of SPPC, and shall comprise senior representatives from the Finance Bureau of SPG; the SEPB; the municipal governments of Datong, Taiyuan, and Yangquan; and the IAs. The PMO shall have an adequate number of appropriately trained staff, having experience in areas related to environment, policy analysis, accounting, financing, economics, construction engineering, and procurement.	PA, Schedule, para. 1	Complied with.
4. The PMO shall be responsible for (i) overall coordination, macro-level project management and monitoring, including implementation of policy reforms and other institutional measures relating to the Project; (ii) annual budget preparation and monitoring of the utilization of loan proceeds; (iii) quality assurance; (iv) reporting to SPG and ADB on progress in implementation, including information on cost management, project impact, and assessment of environmental improvement; (v) interagency coordination and procurement support; (vi) facilitation of training; and (vii) ensuring or reviewing, as the case may be, compliance with the provisions of this Loan Agreement, with special attention to loan covenants.	PA, Schedule, para. 2	Complied with.
5. Each Enterprise shall supervise day-to-day implementation of its subproject through its PIO. Each IA shall be headed by a general manager reporting to a board of directors and assisted by an appropriate number of assistant managers for sales, procurement, administration, finance, production, and maintenance, as well as a chief engineer responsible for construction. Each PIO shall be headed by a full-time director and staffed by an adequate number of appropriately qualified personnel.	PA, Schedule, para. 4	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
<p>6. The PIOs shall be responsible, in respect of the relevant subproject, for administrative, financial, and technical supervision and subproject implementation. In particular, the PIOs shall be responsible for (i) day-to-day implementation of the relevant project and subproject components; (ii) engagement of consultants; (iii) submission of all procurement and other project-related documents for ADB approval; (iv) evaluation of bids and recommendations for award of contracts; (v) preparation and submission of monthly progress reports and quarterly reports on subproject implementation, and financial statements of the subproject enterprises to ADB; (vi) procurement of equipment and materials financed by local currency funds; (vii) management of, and reporting on, the human resource development programs undertaken as part of the Project; (viii) supervision of civil works, and installation and commissioning of the subproject facilities; and (ix) liaison with government agencies concerned, as required.</p>	PA, Schedule, para. 5	Complied with.
Environment		
<p>7. SPG shall promote environmental monitoring and management pursuant to SPG's provincial environment improvement action plan that includes measures for strengthening the EIA process and other regulatory measures; strengthening monitoring and enforcement, and environmental audits; improving existing economic instruments, such as pollution levy system and sulfur tax; and introducing new MBIs. SPG shall keep ADB informed about progress in its implementation of the action plan.</p>	LA, Schedule, para. 6	Complied with.
<p>8. SPG shall ensure that, by 31 December 2000, DHC shall have undertaken and completed modifications to Datong Power Plant No. 1 (hereinafter referred to as DPP No. 1) such that DPP No. 1 complies with all applicable national, provincial, and local environmental standards to the satisfaction of SEPB; failing which DPP No. 1 shall be decommissioned forthwith, and DHC shall install the necessary plant, before commissioning of subproject 2, to provide the required input for subproject 2 in replacement of the input to be provided from DPP No. 1.</p>	PA, Schedule, para. 7	Complied with.
<p>9. SPG shall ensure that, by 31 December 2000, TCGC shall have undertaken and completed modifications to its coke-making facilities such that those facilities shall comply with all applicable national, provincial, and local environmental standards to the satisfaction of SEPB; failing which, those facilities shall be decommissioned in a manner as specified by the applicable regulation of the Borrower's State Council.</p>	PA, Schedule, para. 8	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
10. Each IA shall ensure that its subproject facilities are designed, constructed, operated, and maintained in conformity with the Borrower's environmental protection standards for waste disposal, and in accordance with applicable safety standards, for the public at large and for workers, in a manner acceptable to ADB. Each IA shall further ensure that the levels of emissions and effluents for its facilities are maintained at levels below the national standards, and shall upgrade its monitoring program and enforcement of air quality standards to include trace compounds and toxic elements.	PA, Schedule, para. 9	Complied with.
11. SPG shall ensure that the disposal of all equipment and materials that could be contaminated by asbestos or other toxic materials, arising from replacement or decommissioning of existing boilers and heating facilities in the subproject areas, shall be carried out with due regard to safety and the environment, strictly in accordance with the applicable standards and regulations of the Borrower, where such standards and regulations exist, or in the absence thereof, in accordance with international standards, in a manner acceptable to ADB.	PA, Schedule, para. 12	Complied with.
Policy		
A. Tariffs		
12. SPG shall ensure that each IA shall make adequate adjustments in the consumer tariffs for heat and gas as and when necessary to enable full cost recovery covering operation and maintenance costs, depreciation, debt service in excess of depreciation, and providing an adequate return on investment, which shall be at least 12% in nominal terms. SPG shall ensure that the relevant approving authorities approve such necessary tariff adjustments expeditiously.	PA, Schedule, para. 13	Not complied with.
B. Enterprise Restructuring		
13. Each subproject enterprise, before 31 December 2000, shall prepare a time-bound business plan for commercialization of operations and diversification of ownership, which shall be satisfactory to ADB, and shall implement the plan in accordance with the schedule agreed with ADB.	PA, Schedule, para. 14	Complied with.
14. TCGC shall make the necessary applications for listing its shares on the stock exchange after it has achieved a satisfactory level of financial performance as prescribed by the applicable laws and regulations of the Borrower. The Borrower and SPG shall take all necessary measures to facilitate the listing in a timely	PA, Schedule, para. 15	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
manner.		
Financial		
15. SPG shall ensure that sufficient counterpart funds and all other local and foreign financing shall be obtained by, or provided to, the IAs, as the case may be, in a timely manner to enable them to undertake procurement of civil works, equipment and materials, machinery, spare parts, chemicals, and all other implements for each subproject.	PA, Schedule, para. 16	Complied with.
16. From the effective date, each IA shall maintain its accounts receivable accruing after that date at a level not exceeding the equivalent of the previous 2 months' sales. Additionally, by 31 December 2003, TCGC shall reduce its outstanding accounts receivable from the levels existing on the effective date to zero.	PA, Schedule, para. 17	Not complied with.
17. Except as ADB shall otherwise agree, no IA shall incur additional long-term debt, in each fiscal year commencing from 1 January 2000, if after the incurring of such debt the ratio of debt-equity shall be greater than 70:30.	PA, Section 2.16	Complied with.
18. Except as ADB might otherwise agree, no IA shall incur any new debt if, after incurring the new debt, the debt service coverage ratio shall be less than (i) for the period beginning on 1 January 2000 until 31 December 2003, 1.1, and (ii) from 1 January 2004, 1.3.	PA, Section 2.17	Complied with.
19. Except as ADB shall otherwise agree, each IA shall maintain a ratio of current assets to current liabilities of not less than 1:1.	PA, Section 2.18	Partly complied with.
20. Except as ADB may otherwise agree, each IA annually shall (i) retain funds from operations (i.e., from the sum of net profit after tax depreciation, amortization, and other non-cash charges) to provide sufficient funds for current operations (i.e., the sum of the funds required for working capital, maintenance, and repairs); and (ii) accumulate adequate reserves to finance at least 10% of their annual investment requirements until 31 December 2003, and 20% of their annual investment requirements thereafter.	PA, Schedule, para. 19	Partly complied with.
Reports		
21. SPG and the IAs shall furnish to ADB quarterly reports on the execution of the Project and on the operation and management of the project facilities, and SPG shall furnish to ADB monthly reports on	PA, Section 2.08(b)	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
<p>project progress. Such reports shall be submitted in such form and in such detail as ADB shall reasonably request, and shall indicate, among other things, progress made and problems encountered during the quarter or month 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 or month.</p>		
<p>22. Promptly after physical completion of the Project, but in any event not later than 3 months thereafter or such later date as ADB might agree for this purpose, SPG and the IAs shall prepare and furnish to ADB a report on the execution and initial operation of the Project and the subprojects, respectively, including project and subproject cost, the performance by SPG and the IAs of their obligations under this Project Agreement, and the accomplishment of the purposes of the loan.</p>	PA, Section 2.08(c)	Complied with.
Accounts		
<p>23. SPG and the IAs shall (i) maintain separate accounts for the Project and for its overall operations, and each subproject, respectively; (ii) have such accounts and related financial statements (balance sheet, statement of income and expenses, and related statements) audited annually, in accordance with appropriate auditing standards consistently applied, by independent auditors whose qualifications, experience and terms of reference are acceptable to ADB; and (iii) furnish to ADB promptly after their preparation, but in any event not later than 9 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 auditor's 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/statement of expenditures), all in the English language. SPG and the IAs shall furnish to ADB such further information concerning such accounts and financial statements and the audit thereof as ADB shall from time to time reasonably request.</p>	PA, Section 2.09(a)	Complied with.
Others		
A. Benefit Monitoring and Evaluation		
<p>24. SPG shall provide an annual benefit monitoring and evaluation report to ADB for 5 years after the commissioning of the project facilities. The report shall assess the contribution of the subprojects to</p>	PA, Schedule, para. 24	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
<p>environmental improvement in the project area, and shall be based on individual benefit monitoring and evaluation reports prepared by each IA, which shall assess the actual environmental improvements achieved against the Borrower's air quality standards. The parameters for such assessment shall include improvement in operational efficiency, and reduction in material and energy consumption, and air pollution. The PMO shall collect data through a baseline survey prior to commencement of project implementation, and the database shall be updated annually thereafter. The annual report shall contain a summary of the reduction in the emissions attributable to the Project, and a summary of the status of SPG's environmental protection plan.</p>		
B. Resettlement		
<p>25. SPG shall ensure that the land acquisition and compensation plans prepared for each subproject in accordance with the 1998 Land Administration Law of the Borrower and ADB's Policy on Involuntary Resettlement, and agreed with ADB, shall be implemented fully. SPG shall keep ADB informed of the progress of land acquisition activities through the monthly and quarterly progress reports on project implementation.</p>	PA, Schedule, para. 21	Complied with.
C. Social Issues		
<p>26. SPG shall ensure that unemployed residents in the subproject areas are provided with a carefully targeted lifeline fee support for district heating facilities, or a social security premium program for payment of gas bills, as appropriate, through the existing social security and benefits packages. Such measures shall be implemented immediately after the commissioning of each subproject in the relevant subproject area.</p>	PA, Schedule, para. 20	Complied with.

ADB = Asian Development Bank; DHC = district heating company; DPP = Datong Power Plant; EIA = environmental impact assessment; IA = implementing agency; LA = loan agreement; MBI = market based instruments; PA project agreement; PIO = project implementation office; PMO = project management office; SEPB = Shanxi Environment Protection Bureau; SPG = Shanxi Provincial Government; SPPC = Shanxi Provincial Planning Commission; TCGC = Taiyuan Coal Gasification Company.

TECHNICAL ASSISTANCE COMPLETION REPORT

Division: ECEN

TA No. and Name TA 3325-PRC: Shanxi Air Quality Improvement			Amount Approved: \$700,000	
Executing Agency Shanxi Provincial Government		Source of Funding Japan Special Fund	TA Amount Undisbursed: \$7,704	TA Amount Utilized: \$692,296
Date			Completion Date	
Approval 7 Dec 1999	Signing 17 Jan 2000	Fielding of Consultants 19 Mar 2001	Original: 31 Jan 2002	Actual: 31 Dec 2003
			Closing Date	
			Original: 31 Jan 2002	Actual: 31 Jan 2005

Description

Shanxi Province is the largest coal producer in the People's Republic of China (PRC), and its air quality remains among the worst in the region. The three main cities, Taiyuan, Datong, and Yangquan, had particularly poor air quality. Taiyuan, the capital city, ranked among the most polluted cities in the world.¹ The situation needed to be addressed urgently. A project to improve ambient air quality in the three cities was formulated with Asian Development Bank (ADB) support under Loan 1715-PRC: Shanxi Environment Improvement Project. The Government also requested technical assistance (TA) for institutional strengthening to improve environmental management, which was attached to the Project. Taiyuan was selected as the demonstration site.

Objectives and Scope

The objectives of the TA were to (i) enhance the use of market-based instruments (MBI) for air quality management in Shanxi, and (ii) strengthen the institutional capabilities of the provincial agencies to facilitate their implementation. The TA helped the Shanxi Provincial Government develop an emissions trading system for sulfur dioxide (SO₂), and modify the existing pollution levy system to ensure the sustainability of environmental improvement measures. The scope included (i) strengthening the policy, institutional, and regulatory framework for introduction of new MBIs; (ii) developing and demonstrating the use of SO₂ emission permit trading system; and (iii) building the capacity for improved air quality management.

Evaluation of Inputs

The design, scope, and terms of reference (TOR) of the TA were considered appropriate for achieving the objectives of the TA. A team of consultants was engaged in accordance with ADB's *Guidelines on the Use of Consultants*. A US-based research institute was selected to lead the TA in cooperation with an environmental consulting firm, a Norwegian air research institute, and a PRC research academy. In addition, the US Environmental Protection Agency (EPA) provided extensive assistance in training and capacity building at the request of ADB. The consulting team, which consisted of experts, had the appropriate technical skills to carry out the assignment. The TA comprised about 34 person-months of international consulting services and 13 person-months of national consulting services. The consulting services inputs were adequate to achieve the TA

¹ ADB. 1999. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan and Technical Assistance Grant to the People's Republic of China for the Shanxi Environment Improvement Project*. Manila.

objectives and tasks outlined in the TOR. The consultants carried out the TA in accordance with the TOR. However, due to the delay in loan effectiveness, the TA inception also was delayed. The subsequent SARS²-related travel ban to PRC caused further delays. As such, a 1-year extension of the TA implementation period was necessary. The performance of the consultant was excellent.³ The Taiyuan Environmental Protection Bureau (EPB), the project implementing agency, was fully satisfied with the implementation. Taiyuan EPB provided office, communication, and transportation facilities, and assigned counterpart staff, who were fully involved in the Project. Taiyuan EPB's inputs were adequate, and their performance was satisfactory. The performance of ADB, which provided supervision through regular correspondence and review missions, is considered satisfactory.

Evaluation of Outputs

The TA activities and the discussions on the consultants' draft final report were completed in December 2003. The consultants submitted the final report in May 2004. The TA had three phases. The first covered the review of applicable regulatory framework, and an analysis of potential policies for air quality improvement. The recommendations on the appropriate MBIs for air quality improvement and additional work necessary for their successful implementation were tested through a trial demonstration, which comprised the second phase of the TA. During the third phase, a capacity building program was implemented based on the lessons learned during the TA implementation, including the development of a comprehensive air quality management plan.

The consultants successfully completed the components of the TA. In particular, the consultants (i) helped Taiyuan municipal government (TMG) expand a prototype trading system ("permits exchange") into a robust "cap and trade" system; (ii) completed the demonstration component, which included four of the largest SO₂ sources in the area; (iii) revised the SO₂ trading system to make it applicable for province-wide implementation, which could be expanded to include proposed national level SO₂ trading between power plants; (iv) in collaboration with the US EPA, successfully conducted training on complementary use of MBIs and command-and-control measures with focus on emissions trading system, as well as on monitoring and enforcement, which are necessary mechanisms for effective environmental management; and (v) developed and installed two user-friendly, computer-based systems for managing the emissions database and trading activity.

To enhance air quality improvement efforts, the TMG passed in October 2002 a new regulation for emissions trading, based on the draft proposed by the consultants. A vice mayor was given the responsibility for enforcing the SO₂ emissions quota and the emissions trading program. The Taiyuan EPB and TMG developed a detailed implementation program covering (i) scope of transactions, (ii) procedural requirements, (iii) management framework, and (iv) penalties. Of the 26 enterprises involved in the program, 11 have installed online SO₂ monitoring systems; the other 15 enterprises are required to install similar equipment. One trade⁴ of SO₂ credits was executed in December 2003, between two industrial enterprises. At least one other emissions trade was being worked out in late 2004. However, a national law on good governance that became effective in July 2004 created some uncertainty regarding the local government's authority for emissions trading. The pending regulatory clarification to ensure judicial consistency of the Taiyuan trading program with this new law has stalled the expansion of the trading program. TMG is trying to obtain the clarification to pave the way for the program expansion.

² Severe acute respiratory syndrome that was accompanied by either pneumonia or respiratory distress. The communicable disease spread in Asia in late 2002 until 2003 and restricted international travels particularly to PRC.

³ Consultant's Performance Evaluation Report, 16 May 2005.

⁴ The agreed trade was for 47 tons per year at a price of CNY1,500 per ton. The current SO₂ emissions fee is CNY600 per ton.

Overall Assessment and Rating

The TA successfully achieved its objectives. The consultant's TOR was fulfilled, and comprehensive training and capacity building were administered. The major recommendations under the TA were implemented—formal regulation on emissions trading was promulgated, and supporting administrative framework was established. More emission trades are expected once the uncertainties on the judicial consistency of the Taiyuan emissions trading regulations relative to the national law are ironed out. The TA is rated as successful.

Major Lessons Learned

The success of the TA proves that emissions trading is feasible, especially in cases such as Taiyuan, where the local government is well informed and has a high degree of ownership. Formulation of a sound TOR, selection of highly qualified consultants, and assistance from environmental experts were also instrumental to the TA success. The approach and recommendations in the TA might be useful in developing similar programs in other provinces in PRC.

Recommendations and Follow-Up Actions

An update on subsequently concluded trades would be useful. Support should be given for similar efforts in other highly polluted regions if the Government requests assistance.

Prepared by Merlita Pajarillo

Designation Energy Specialist (Finance)

SUMMARY OF CONTRACT PACKAGES

PCSS No.	Item	Mode of Procurement	Date of Contract (dd-mm-yy)	Contract Number	Contract Amount (\$)	Amount Disbursed (\$)
Part A: Taiyuan Coal Gasification Plant						
0011	Steel, Cement (Pkg. A-8)	IS	15Apr02	CCNFD-S022042/B	447,773	423,740
0012	Steel, Cement (Pkg. A-9)	IS	16Apr02	CCNFD-S022043/B	426,312	426,312
0013	Steel, Cement (Pkg. A-10)	IS	16Apr02	CCNFD-S022044/B	438,700	368,000
0015	Silica Bricks for Coke Oven (Pkg. A-6)	ICB	10Jun02	02CN01GTE4IWD0026	3,404,393	3,404,393
0016	Clay brick & refractory for coke oven	ICB	05Jun02	02CN01GTE4IWD0027	1,818,476	1,818,476
0017	Spiral welded steel anticorrosive pipe (Pkg A-19)	IS	01Jul02	02CN01GTE4IWD0028	501,344	501,344
0018	Steel pipe (Pkg. A-20)	IS	01Jul02	02CN01GTE4IWD0029	531,618	531,618
0020	Pusher machine (Pkg. A-1)	ICB	28Aug02	02CN01GTE4IWD0021	2,320,897	2,320,897
0021	Coke guide car (Pkg. A-2)	ICB	28Aug02	02CN01GTE4IWD0022	1,408,302	1,408,302
0022	Charging Car (Pkg. A-3)	ICB	28Aug02	02CN01GTE4IWD0023	1,156,254	1,156,254
0023	Quenching car and locomotive (Pkg. A-4)	ICB	28Aug02	02CN01GTE4IWD0024	527,521	527,521
0024	Gas exhauster & electrostatic par precipitator (A-5)	ICB	18Jul02	02CN01GTE4IWD0025	1,654,839	1,654,839
0029	Various	D/P		Imprest W/A0002	358,846	358,846
0032	Steel, Cement, Wood (Pkg. A-11)	ICB	15Nov02	02CN01GTE4IWS0067	5,292,701	5,292,701
0033	Oven Door frame, oven door (Pkg. A-12)	ICB	26Oct02	02CN01GTE4IWS0060	2,087,100	2,087,100
0034	Bends in waste gas flue, boxes & cocks (Pkg.A-13)	ICB	26Oct02	02CN01GTE4IWS0061	1,098,547	1,098,457
0035	Coal stockyard equipment (Pkg. A-14)	ICB	23Nov02	02CN01GTE4IWS0062	932,072	932,072
0036	Transportation equipment (Pkg. A-15)	ICB	27Oct02	02CN01GTE4IWS0063	2,342,763	2,342,763
0037	Non-standard equipment for gas purification (A-16)	ICB	26Oct02	02CN01GTE4IWS0064	481,132	481,132
0038	Standard equipment for gas purification (Pkg. A-17)	ICB	25Oct02	02CN01GTE4IWS0065	625,298	625,298
0039	Directly-fired lithium bromide ref & nitrogen gen (A18)	ICB	26Oct02	02CN01GTE4IWS0066	854,438	854,438
0044	Non-standard equipment for gas purification (A-21)	ICB	15May03	03CNO1GTE4IWD0102/G	2,920,165	2,920,165
0045	Equipment for Coal Prep & Coke Screening (A-22)	ICB	01Jun03	03CNO1GTE4IWD0103/G	2,002,256	2,002,256
0046	Iron Parts and Valves for Coke Ovens (A-23)	ICB	31May03	03CNO1GTE4IWD0104/G	911,000	911,000
0048	Equipment for Maintenance, Hoisting (A-25)	ICB	31May03	03CNO1GTE4IWD0106/G	555,387	555,387
0051	Casting Iron Pipe for Water Sup. & Drainage (A-36)	IS	28Jun03	03CN01GTE4IWD0095/J	167,398	145,346
0052	Cable (Pkg. A-26)	ICB	25Aug03	03CN01GTE4IWD0134	1,513,349	1,513,349
0053	Instruments (Pkg. A-27)	ICB	03Sep03	03CN01GTE4IWD0135	967,749	967,749
0054	Equipment for High Voltage Electric Sys (Pkg. A-28)	ICB	29Aug03	03CN01GTE4IWD0136	1,628,380	1,628,380
0055	Equipment for Low Voltage Electric Sys (Pkg. A-29)	ICB	25Aug03	03CN01GTE4IWD0137	1,364,288	1,364,288
0056	Automation Control System and Computer Network	ICB	16Sep03	03CN01GTE4IWD0138	905,428	905,428
0057	Steel (Pkg. No. A-31)	ICB	25Jul03	03HK01GTE4IWD0139	2,288,103	2,288,103
0058	Electrostatic Tar Precipitator	IS	02Sep03	03CN01GTE4IWD0163	368,300	368,300
0059	Ground De-dusting Equipment (Pkg. A-32)	ICB	20Sep03	03CN01GTE4IWD0159	2,120,527	2,120,527
0060	Production Supplementary Equipment (Pkg. A-33)	ICB	15Aug03	03CN01GTE4IWD0160	1,327,674	1,327,674
0061	Communications and Other Equipment (Pkg. A-34)	ICB	05Sep03	03CN01GTE4IWD0161	1,748,222	1,748,222
0062	Steel, Cement	ICB	16Sep03	03CN01GTE4IWD0162	4,287,288	4,287,288
0063	Anti-Corrosion and Wear-resisting mat. (Pkg.A-38)	IS	02Nov03	03CN01GTE4IWD0175	498,500	498,500
0064	Steel, Timber (Package A-39)	IS	25Mar04	04CN01GTE21IWD0005	538,958	538,958

PCSS No.	Item	Mode of Procurement	Date of Contract (dd-mm-yy)	Contract Number	Contract Amount (\$)	Amount Disbursed (\$)
0065	Steel, Cement (Package No. A-40)	IS	22Mar04	04CN01GTE21IWD0006	547,691	547,691
0066	Steel, Cement (Package No. A-42)	IS	05Jun04	04HK01GTE2IWD0037	547,678	547,678
0067	Steel (Package No. A-43)	IS	02June04	04CN01GTE2IWD0038	500,000	500,000
0070	Steel, Cable (Package No. A-41)	IS	11May04	04CN01GTE2IWD0031	557,390	557,390
Part B. Datong District Heating Plant						
0001	Sodium Ion Exchanger (Pkg. 1)	IS	14Dec01	01CN01M6I18418241	597,635	597,635
0002	Metallic sealed butterfly valve (Pkg. 2)	IS	14Dec01	01CN01M6I18418242	334,210	334,200
0003	Clamp-type butterfly valve (Pkg. 3)	IS	14Dec01	01CN01M6I18418243	192,153	192,153
0004	Conversion speed regulating equipment (Pkg. 4)	IS	14Dec01	01CN01M6I18418244	1,050,926	1,050,926
0005	Plate Heat Exchanger (A) (Pkg. 5)	IS	14Dec01	01CN01M6I18418245	931,160	931,160
0006	Plate Heat Exchanger (B) (Pkg. 5)	IS	14Dec01	01CN01M6I18418246	1,007,424	1,007,424
0007	Low Voltage Switchboard (Pkg. 7)	IS	14Dec01	01CN01M6I18418247	766,134	766,134
0008	Ball Valve (Pkg. 8)	IS	14Dec01	01CN01M6I18418248	196,208	196,208
0009	Water Pumps (Pkg. 9)	IS	14Dec01	01CN01M6I18418249	301,795	301,795
0010	Insulated Pipes (Pkg. 10)	ICB	11Mar02	02CN01M6I8418203	13,898,703	13,898,703
0014	Engineering Mechanics	IS	17May02	02HK01GTF1IW0005	360,858	360,858
0019	Automation Control and Instruments	ICB	03Sep02	02CNO1GTF1IWD0029	2,580,652	2,580,007
0073	Various	DP	23Feb05	Various	25,243	25,243
Part C: Yangquan Coalbed Methane Collection Plant						
0025	Pipes and Fittings (Pkg. No. 6)	ICB	04Sep02	02HK01GTE4IWD0036/G	5,019,460	5,002,059
0026	Rubberized Sealing-film gas tank and its access.	ICB	12Jul02	02CN01GTE4IWD0034/G	3,351,061	3,351,061
0027	Rubberized Sealing-film for gas tank	ICB	14Jun02	02CN01GTE4IWD0035/G	557,400	557,400
0028	Primer Paint & Corrosion resistance polyethylene	IS	14Jun02	02CN01GTE4IWD0037/G	651,400	651,400
0030	Gas and General Valves (Pkg. 8)	ICB	23Oct02	02CN01GTE4IWD0038/G	430,336	387,303
0031	Fire truck with medium low pressure water tank	ICB	11Oct02	02CN01GTE4IWD0030/G	88,274	88,274
0040	Methane Gas Process Equipment & Mat. (Pkg. 1)	ICB	15Jan03	02CN01GTE4IWD0031/G	430,867	430,867
0041	Control Equipment (Pkg. 2)	ICB	26Jan03	02CN01GTE4IWD0032/G	619,264	555,198
0042	Electric Equipment (Pkg. 3)	ICB	15Jan03	02CN01GTE4IWD0033/G	527,245	527,245
0043	Automatic Ambient Air Quality Monitoring System	IS	17Apr03	03CN01GTE4IWD0094/J	253,450	253,450
0068	Gas Pressure-adjust equipment (Pkg. 13)	ICB	09 Jun04	04CN01GTE2IWD0034	321,222	321,222
0069	Vehicle Equipment (Pkg. 15)	ICB	09Jun04	04CN01GTE2IWD0035	623,571	623,571
0049	Civil Works Contract Section C10 (Pingding)	LCB	15Jun03	03CN01GTE4IWT0122	376,186	376,186
0050	Civil Works Contract Section C11 (Shiqu)	LCB	15Jun03	03CN01GTE4IWT0121	160,543	160,543
0071	Various	D/P	30Apr04	Various	99,370	99,370
Part D: Institutional Development						
0072	Various	D/P	23Feb05	Various	28,535	28,535
0074	Various	D/P	23Feb05	Various	172,235	172,235

Source: project implementing agencies and project files.

FINANCIAL EVALUATION

A. General

1. The financial internal rate of return (FIRR) for the Shanxi Environmental Improvement Project was calculated for each subproject—Taiyuan Coal Gasification Plant (TCGP), Datong District Heating Plant (DDHP), and Yangquan Gas Distribution Plant (YGDP)—and for the overall Project. The FIRR was reevaluated based on financial and operational information provided by the project implementing agencies. Actual investments made for the Project were considered. The economic life of the project facilities, assumed at appraisal to be 20 years, was maintained with 10% residual value. Revenues and expenditures are in constant 2005 prices,¹ and exclude depreciation and interest.

B. Revenues and Operating Costs

2. Incremental revenues were calculated based on the actual and projected operating parameters at the existing approved tariffs for heating and gas supply, and prevailing prices for coke and other by-products. Revenues realized from the start of operations were considered. Future revenues were projected based on the assumed growth in consumption. Operating and maintenance costs were assumed to remain at current levels, but adjusted to reflect increases in variable costs due to higher production volumes. Expected capital costs for the Project, which are minimal, are considered in the maintenance costs. Value-added, income, and other taxes were based on actual rates and deducted from the net revenue stream.

C. Financial Internal Rate of Return

3. The recalculated FIRRs are 10.5% for TCGP, compared to 9.2% at appraisal; 8.1% for DDHP, compared to 8.7% at appraisal; and 6.9% for YGDP, compared to 10.3% at appraisal. The variance in the actual FIRRs from the appraisal estimates are due to (i) higher actual prices of coke and other by-products, which partly offset by the lower coal gas price for TCGP; (ii) lower actual heating tariff, mitigated by more efficient heat source and expanded scope for DDHP; and (iii) lower actual gas tariff for YGDP. The FIRRs are higher than the respective weighted average costs of capital (WACC).

D. Weighted Average Cost of Capital

4. The estimated WACC for the components—in real terms, after taxes—were derived following the methodology in the Asian Development Bank's *Guidelines for the Financial Management and Analysis of Projects*,² using actual capital mix and costs of funds. The real interest costs of loan funds were considered based on actual cost of loan funds from the Asian Development Bank and domestic banks. The cost of equity was assumed to be 8%, based on the current yield on the long-term Government bond, plus an assumed risk premium of 3%. An actual income tax rate of 33% was used. Domestic inflation is assumed at 3% per year.

5. The recalculated WACCs are 4.4% for TCGP, 4.3% for DDHP, and 4.3% for YGDP. The WACCs at appraisal were not disclosed.

¹ The People's Republic of China consumer price index was applied to local currency expenditures, and the Manufacturers' Unit Value G-5 index (G-5 countries are France, Germany, Japan, United Kingdom, and United States) was used for foreign currency expenditures.

² Asian Development Bank. 2006. *Financial Management and Analysis of Projects*. Manila.

Table A11.1: Financial Internal Rate of Return – Taiyuan Coal Gasification Plant
(CNY million)

Year	Capital Costs	Revenues	Operating Costs		Income Tax	Net Cash Flow After Tax
			Variable Costs	Fixed Costs		
2001	34.9					(34.9)
2002	119.9					(119.9)
2003	574.8					(574.8)
2004	280.9	221.5	95.7	77.1	0.0	(232.3)
2005		787.0	649.1	77.1	0.0	60.8
2006		935.4	683.2	77.1	41.1	133.9
2007		935.4	683.2	77.1	41.1	133.9
2008		935.4	683.2	77.1	41.1	133.9
2009		935.4	683.2	77.1	41.1	133.9
2010		935.4	683.2	77.1	41.1	133.9
2011		935.4	683.2	77.1	41.1	133.9
2012		935.4	683.2	77.1	41.1	133.9
2013		935.4	683.2	77.1	41.1	133.9
2014		935.4	683.2	77.1	41.1	133.9
2015		935.4	683.2	77.1	41.1	133.9
2016		935.4	683.2	77.1	41.1	133.9
2017		935.4	683.2	77.1	41.1	133.9
2018		935.4	683.2	77.1	41.1	133.9
2019		935.4	683.2	77.1	41.1	133.9
2020		935.4	683.2	77.1	41.1	133.9
2021		935.4	683.2	77.1	41.1	133.9
2022		935.4	683.2	77.1	41.1	133.9
2023		935.4	683.2	77.1	41.1	133.9
2024		935.4	683.2	77.1	41.1	133.9
2025	(101.0)	935.4	683.2	77.1	41.1	235.0
Total	909.4	19,716.7	14,409.6	1,696.9	821.8	1,879.0
FIRR						10.5%

() = negative

FIRR = financial internal rate of return.

Source: Asian Development Bank estimates.

Table A11.2: Financial Internal Rate of Return – Datong District Heating Plant
(CNY million)

Year	Capital Costs	Revenues	Operating Costs		Income Tax	Net Cash Flow After Tax
			Variable Costs	Fixed Costs		
2001	34.6					(34.6)
2002	51.6					(51.6)
2003	62.2					(62.2)
2004	96.6	23.1	12.9	2.6	0.0	(89.0)
2005	94.7	57.7	26.5	3.4	3.6	(70.5)
2006		92.3	49.1	3.4	7.5	32.3
2007		103.8	55.3	3.4	9.3	35.9
2008		103.8	55.3	3.6	9.2	35.7
2009		103.8	55.3	3.6	9.2	35.7
2010		103.8	55.3	3.6	9.2	35.7
2011		103.8	55.3	3.6	9.2	35.7
2012		103.8	55.3	3.6	9.2	35.7
2013		103.8	55.3	3.6	9.2	35.7
2014		103.8	55.3	3.6	9.2	35.7
2015		103.8	55.3	3.6	9.2	35.7
2016		103.8	55.3	3.6	9.2	35.7
2017		103.8	55.3	3.6	9.2	35.7
2018		103.8	55.3	3.6	9.2	35.7
2019		103.8	55.3	3.6	9.2	35.7
2020		103.8	55.3	3.6	9.2	35.7
2021		103.8	55.3	3.6	9.2	35.7
2022		103.8	55.3	3.6	9.2	35.7
2023		103.8	55.3	3.6	9.2	35.7
2024		103.8	55.3	3.6	9.2	35.7
2025	(34.0)	103.8	55.3	3.6	9.2	69.7
Total	305.8	2,145.0	1,138.3	77.6	186.4	436.9
FIRR						8.1%

() = negative

FIRR = financial internal rate of return.

Source: Asian Development Bank estimates.

Table A11.3: Financial Internal Rate of Return – Yangquan Gas Distribution Plant
(CNY million)

Year	Capital Costs	Revenues	Operating Costs		Income Tax	Net Cash Flow After Tax
			Variable Costs	Fixed Costs		
2001	14.0					(14.0)
2002	74.0					(74.0)
2003	88.7					(88.7)
2004	20.1					(20.1)
2005	21.5	12.5	6.5	3.9	0.0	(19.3)
2006		20.9	8.9	3.9	0.0	8.1
2007		46.3	11.6	3.9	6.6	24.3
2008		46.3	11.6	3.9	6.6	24.3
2009		46.3	11.6	3.9	6.6	24.3
2010		46.3	11.6	3.9	6.6	24.3
2011		46.3	11.6	3.9	6.6	24.3
2012		46.3	11.6	3.9	6.6	24.3
2013		46.3	11.6	3.9	6.6	24.3
2014		46.3	11.6	3.9	6.6	24.3
2015		46.3	11.6	3.9	6.6	24.3
2016		46.3	11.6	3.9	6.6	24.3
2017		46.3	11.6	3.9	6.6	24.3
2018		46.3	11.6	3.9	6.6	24.3
2019		46.3	11.6	3.9	6.6	24.3
2020		46.3	11.6	3.9	6.6	24.3
2021		46.3	11.6	3.9	6.6	24.3
2022		46.3	11.6	3.9	6.6	24.3
2023		46.3	11.6	3.9	6.6	24.3
2024		46.3	11.6	3.9	6.6	24.3
2025	(21.8)	46.3	11.6	3.9	6.6	46.1
Total	196.4	912.9	235.6	81.5	124.9	274.6
FIRR						6.9%

() = negative

FIRR = financial internal rate of return

Source: Asian Development Bank estimates.

ECONOMIC EVALUATION

A. General

1. The economic evaluation of the Shanxi Environmental Improvement Project followed the methodology used at appraisal. An evaluation was done for each subproject—Taiyuan Coal Gasification Plant (TCGP), Datong District Heating Plant (DDHP), and Yangquan Gas Distribution Plant (YGDP). Incremental costs and benefits for the Project were determined. The economic life of the project facilities, assumed at appraisal to be 20 years, was maintained. The residual value at the end of the economic life also was assumed at 10%. All costs and benefits were expressed in 2005 constant prices.¹

B. Capital Costs, Economic Benefits, and Operating Costs

2. Tradable goods were valued at their border prices, including transport and handling costs. Nontradable goods and services were converted into economic costs by applying the applicable specific and standard conversion factors.² Taxes and import duties and all financial charges, including interest during construction, were excluded.

3. The prevailing economic price of coal at the project site was determined using its border price, adjusted by the transportation and handling costs in Shanxi Province. Other operating costs were based on actual and assumed data obtained from the project implementing agencies, and adjusted to their economic values.

4. For TCGP, the economic benefits were determined based on the value of the outputs. Coal gas was regarded as incremental, because it will greatly improve the utility of fuel use. This was valued at existing financial tariff converted to economic values using the standard conversion factor. The 40% convenience premium for residents assumed at appraisal, as well as the 40% profitability premium for the industries, was maintained. Coke and the by-products were valued at their domestic prices. Market values of the land freed due to removal of hot water boilers, as well as space in residential households, were added to the benefits.

5. For DDHP, the subproject will replace existing sources of heat, and its output is not considered incremental. The heat supplied to customers is valued in terms of coal savings calculated by multiplying the amount of coal saved and the economic value of coal at the site. The value of land formerly used by the small boilers and coal ash yard, as well as the savings in the operating costs of small boilers, was included in the benefits.

6. For YGDP, the availability of methane gas will improve greatly the utility of fuel use. Thus, the output is valued at financial tariffs converted to economic price using the standard conversion factor. Like at appraisal, a 40% convenience premium was assumed for residents, as well as a 40% profitability premium for industries. Land savings due to the closing of hot water boilers and freed space in residential households were valued using the market values in Yangquan.

¹ The People's Republic of China consumer price index was applied to local currency expenditures, and the Manufacturers' Unit Value G-5 index (G-5 countries are France, Germany, Japan, United Kingdom, and United States) was used for foreign currency expenditures.

² The conversion factors used in this evaluation are 1.10 for civil works, 1.10 for local machinery, and 0.93 for others.

7. Other benefits identified at appraisal, which remained valid at project completion, include (i) environmental benefits from air quality improvements, (ii) removal of waste residues, and (iii) reduced toll on coal transport and handling due to lower coal volume. Except for the benefits related to the improvement of air quality, these benefits were not quantified at appraisal or at project completion.

C. Economic Internal Rate of Return

8. The recalculated economic internal rates of return (EIRR) are 14.5% for TCGP, compared with 23.9% at appraisal; 19.0% for DDHP, compared with 14.1% at appraisal; and 16.1% for YGDP, compared with 26.6% at appraisal. The recalculated EIRRs varied from appraisal estimates due to (i) lower coal gas tariff compared to the appraisal estimate for TCGC, (ii) higher efficiency of heat source and expanded project scope for DDHP, and (iii) lower actual gas tariff for YGDP. The recalculated EIRRs are higher than the Asian Development Bank's 12.0% threshold for the economic opportunity cost of capital. If the local environmental benefits resulting from reduced consumption of coal for the Project were quantified, the EIRR would be 19.6% for TCGP, 28.3% for DDHP, and 18.8% for YGDP. Further, if the local and global environmental benefits were considered, the EIRRs would be 19.7% for TCGP, 28.6% for DDHP, and 37.7% for YGDP. YGDP's use of methane gas will yield high global benefits. The valuation took into account the externality costs³ for air pollutants, including total suspended particles, sulfur dioxide, nitrogen oxides, carbon dioxide, and methane gas (in the case of YGDP). It followed the calculation using the benefit transfer method described in the Asian Development Bank's *Economic Evaluation of Environmental Impacts—A Workbook*.⁴

³ The workbook (footnote 4) defines externality cost as the cost associated with the impacts of actions taken to produce or consume goods that are not reflected in costs of prices, or that otherwise affect those who are not directly involved in or are compensated for production or consumption. Derived economic costs per ton of pollutants (2006) for (i) TCGP was CNY3,068 for total suspended particles (TSP), CNY746 for sulfur dioxide (SO₂), and CNY814 for nitrogen oxide (NO_x); (ii) DDHP was CNY3,068 for TSP, CNY746 for SO₂, and CNY814 for NO_x; and (iii) YGDP was CNY2,975 for TSP, CNY725 for SO₂, and CNY788 for NO_x. A 5% annual growth rate was assumed. The externality cost of carbon dioxide was assumed at \$8/tCO₂e based on United Nations Framework Convention on Climate Change, Kyoto Protocol, Clean Development Mechanism carbon market prices.

⁴ Asian Development Bank. 1996. *Economic Evaluation of Environmental Impacts—A Workbook*. Manila.

Table A12.1: Economic Internal Rate of Return – Taiyuan Coal Gasification Plant
(CNY million)

Year	Capital Costs	Coal Gas Output	Coke and Other By Products	Land Savings	O & M Costs	Net Economic Benefits	Environmental Local	Benefits Global
2001	37.6					(37.6)		
2002	127.1					(127.1)		
2003	594.8					(594.8)		
2004	288.4	12.3	219.7	46.3	174.0	(184.2)	18.6	0.5
2005		57.8	837.8	10.7	749.2	157.1	45.7	1.1
2006		61.0	891.8		784.7	168.1	48.0	1.1
2007		61.0	891.8		784.7	168.1	50.4	1.1
2008		61.0	891.8		784.7	168.1	52.9	1.1
2009		61.0	891.8		784.7	168.1	55.5	1.1
2010		61.0	891.8		784.7	168.1	58.3	1.1
2011		61.0	891.8		784.7	168.1	61.2	1.1
2012		61.0	891.8		784.7	168.1	64.3	1.1
2013		61.0	891.8		784.7	168.1	67.5	1.1
2014		61.0	891.8		784.7	168.1	70.8	1.1
2015		61.0	891.8		784.7	168.1	74.4	1.1
2016		61.0	891.8		784.7	168.1	78.1	1.1
2017		61.0	891.8		784.7	168.1	82.0	1.1
2018		61.0	891.8		784.7	168.1	86.1	1.1
2019		61.0	891.8		784.7	168.1	90.4	1.1
2020		61.0	891.8		784.7	168.1	94.9	1.1
2021		61.0	891.8		784.7	168.1	99.7	1.1
2022		61.0	891.8		784.7	168.1	104.7	1.1
2023		61.0	891.8		784.7	168.1	109.9	1.1
2024		61.0	891.8		784.7	168.1	115.4	1.1
2025	(104.8)	61.0	891.8		784.7	272.9	121.2	1.1
Total	943.1	1,290.7	18,893.8	57.0	16,618.2	2,680.2	1,649.9	23.8
						14.5%		
							19.6%	
								19.7%

() = negative

EIRR = economic internal rate of return.

O&M = operation and maintenance.

Source: Asian Development Bank estimates.

Table A12.2: Economic Internal Rate of Return – Datong District Heating Plant
(CNY million)

Year	Capital Costs	Coal Savings	Boilers		O & M Costs	Net		Environmental Benefits Local	Benefits Global
			Land Savings	O & M Savings		Economic Benefits			
2001	37.3					(37.3)			
2002	53.8					(53.8)			
2003	61.8					(61.8)			
2004	99.0	40.5	138.4	6.2	15.2	71.0	8.9		0.5
2005	99.1	79.8	31.6	9.3	29.4	(7.8)	18.3		0.9
2006		79.8		11.6	51.8	39.7	19.3		0.9
2007		79.8		11.6	57.8	33.6	20.2		0.9
2008		79.8		11.6	58.1	33.4	21.2		0.9
2009		79.8		11.6	58.1	33.4	22.3		0.9
2010		79.8		11.6	58.1	33.4	23.4		0.9
2011		79.8		11.6	58.1	33.4	24.6		0.9
2012		79.8		11.6	58.1	33.4	25.8		0.9
2013		79.8		11.6	58.1	33.4	27.1		0.9
2014		79.8		11.6	58.1	33.4	28.5		0.9
2015		79.8		11.6	58.1	33.4	29.9		0.9
2016		79.8		11.6	58.1	33.4	31.4		0.9
2017		79.8		11.6	58.1	33.4	32.9		0.9
2018		79.8		11.6	58.1	33.4	34.6		0.9
2019		79.8		11.6	58.1	33.4	36.3		0.9
2020		79.8		11.6	58.1	33.4	38.1		0.9
2021		79.8		11.6	58.1	33.4	40.0		0.9
2022		79.8		11.6	58.1	33.4	42.0		0.9
2023		79.8		11.6	58.1	33.4	44.1		0.9
2024		79.8		11.6	58.1	33.4	46.3		0.9
2025	(35.1)	79.8		11.6	58.1	68.5	48.7		0.9
Total	316.0	1,716.5	170.1	247.8	1,199.2	619.2	663.9		19.8
EIRR						19.0%			
EIRR Including Local Environmental Benefits							28.3%		
EIRR Including Local and Global Environmental Benefits									28.6%

() = negative

EIRR = economic internal rate of return.

O&M = operation and maintenance.

Source: Asian Development Bank estimates.

Table A12.3: Economic Internal Rate of Return – Yangquan Gas Distribution Plant
(CNY million)

Year	Capital Costs	Incremental Benefits	Land Savings	O & M Costs	Net		
					Economic Benefits	Environmental Local	Benefits Global
2001	15.1				(15.1)		
2002	79.7				(79.7)		
2003	89.1				(89.1)		
2004	20.7		56.4		35.7	2.0	24.1
2005	21.5	16.3	13.0	10.7	(2.9)	4.4	50.6
2006		22.4		13.1	9.2	5.6	61.2
2007		60.3		15.8	44.5	6.9	71.9
2008		60.3		15.8	44.5	7.2	71.9
2009		60.3		15.8	44.5	7.6	71.9
2010		60.3		15.8	44.5	8.0	71.9
2011		60.3		15.8	44.5	8.4	71.9
2012		60.3		15.8	44.5	8.8	71.9
2013		60.3		15.8	44.5	9.2	71.9
2014		60.3		15.8	44.5	9.7	71.9
2015		60.3		15.8	44.5	10.2	71.9
2016		60.3		15.8	44.5	10.7	71.9
2017		60.3		15.8	44.5	11.2	71.9
2018		60.3		15.8	44.5	11.8	71.9
2019		60.3		15.8	44.5	12.4	71.9
2020		60.3		15.8	44.5	13.0	71.9
2021		60.3		15.8	44.5	13.7	71.9
2022		60.3		15.8	44.5	14.3	71.9
2023		60.3		15.8	44.5	15.1	71.9
2024		60.3		15.8	44.5	15.8	71.9
2025	(22.6)	60.3		15.8	67.1	16.6	71.9
Total	203.4	1,183.8		323.2	726.5	222.7	1,501.4
EIRR					16.1%		
EIRR Including Local Environmental Benefits						18.8%	
EIRR Including Local and Global Environmental Benefits							37.7%

() = negative

EIRR = economic internal rate of return.

O&M = operation and maintenance.

Source: Asian Development Bank estimates.

ENVIRONMENTAL INDEXES

Taiyuan Coal Gasification Plant

Table A13.1: Taiyuan City Emission Data

Item		Before Project			After Project	
		2001	2002	2003	2004	2005
Average Ambient Air Quality						
	SO ₂ (mg/m ³)	0.153	0.129	0.099	0.079	0.077
	PM ₁₀ (mg/m ³)	0.206	0.177	0.172	0.164	0.139
	NO ₂ (mg/m ³)	0.042	0.037	0.030	0.022	0.020
Total Annual Emissions						
	SO ₂ (t/y)	245,600	225,100	227,900	217,900	184,500
	PM ₁₀ (t/y)	105,300	94,100	94,700	83,100	74,100
Total Coal Consumption						
	Industrial (million metric tons)	21.36	19.34	25.13	25.06	-
	Residential (million metric tons)	2.9	2.55	2.45	2.39	-

m³ = cubic meter; mg = milligram; NO₂ = nitrogen dioxide PM = particulate matter; SO₂ = sulfur dioxide; t/y = metric tons per year.

Sources: Taiyuan Environmental Protection Bureau and project implementing agency.

Table A13.2: Taiyuan Coal Gasification Plant Environmental Data

Item		Before Project			After Project	
		2001	2002	2003	2004	2005
Use of reticulated town gas in Taiyuan	Households	412,002	449,790	479,959	509,028	535,947
	Industrial, Commercial, Public Facilities	1,457	1,547	1,777	1,802	1,971
Use of reticulated gas from Project	Households				59,238	86,157
	Industry, Commercial, Public Facilities				480	649
Increase in usage of gas due to Project	Households				13%	19%
	Industry, Commercial, Public Facilities				36%	49%
Project gas generation (m ³ /day)					450,000	504,000
Annual reduction (t/y) in the use of coal due to replacement with gas from Project					167,900	392,308
Reduction in emission (t/y) ² by replacing coal with Project	TSP				5,458	12,754
	SO ₂				4,320	10,093
	NO _x				694	1,621
	CO				2,910	6,795

CO = carbon monoxide; NO_x = nitrogen oxide; SO₂ = sulfur dioxide; t/y - metric tons per year; TSP = total suspended particulates.

Sources: Taiyuan Environmental Protection Bureau and project implementing agency.

Datong District Heating Plant

Table A13.3: Datong City Emission Data

Item	GB3095-1996	Before Project			After Project	
		2001	2002	2003	2004	2005
Average Ambient Air Quality						
	Class II					
	SO ₂ (mg/m ³)	0.06	0.153	0.153	0.219	0.149
	TSP (mg/m ³)	0.20	0.52	0.482	0.245	0.240
Total Annual Emissions						
	SO ₂ (t/y)	48,000	61,200	61,000	61,900	58,400
	TSP (t/y)	60,000	76,500	76,300	77,400	73,000
Days Meeting Air Quality Standards (GB3095-1996)						
	Class II	48	92	142	156	220
	Class I	1	2	3	4	5
Total Coal Consumption						
	Industrial (t)	2,453,800	3,249,400	3,220,500	3,439,300	3,280,500
	Residential and service industries (t)	546,200	575,600	594,500	429,500	369,500
	Total	3,000,000	3825000	38125,000	3,868,800	3,650,000

NO₂ = nitrogen dioxide; SO₂ = sulfur dioxide; t = metric tons; t/y = metric tons per year; TSP = total suspended particulates.

Sources: Datong Environmental Protection Bureau and project implementing agency.

Table 13.4: Datong District Heating Plant Environmental Data

Item		Before Project			After Project	
		2001	2002	2003	2004	2005
Reticulated heating users in Datong	Households	184,400	195,000	205,000	215,000	225,000
	Industrial	13,500	14,200	15,000	15,900	16,700
	Commercial	784	814	857	900	943
Reticulated heating users from Project	Households				33,825	67,548
	Industrial				2,475	4,943
	Commercial				141	281
Increase in users due to Project (%)	Households				16	30
	Industrial				16	30
	Commercial				16	30
Project heating supply area (m ²)					3,300,000	6,900,000
Annual reduction (t/y) in the use of coal due to replacement with reticulated heating from Project					165,000	325,000
Emission reduction due to Project (t/y)	TSP				3,300	6,500
	SO ₂				2,640	5,200
	NO _x				825	1,625

CO = carbon monoxide; NO_x = nitrogen oxide; SO₂ = sulfur dioxide; TSP = total suspended particulates.

Source: Datong Environmental Protection Bureau and project implementing agency.

Yangquan Gas Distribution Plant

Table 13.5: Yangquan City Emission Data

Item	GB3095-1996	Before Project			After Project	
		2001	2002	2003	2004	2005
Average Ambient Air Quality	Class II					
SO ₂ (mg/m ³)	0.06	0.228	0.227	0.250	0.236	0.160 ^a
TSP (mg/m ³)	0.20	0.566	0.545	0.581	-	-
PM ₁₀ (mg/m ³)	0.10	No Data	No Data	0.175	0.162	0.126
NO ₂ (mg/m ³)	0.08	0.058	0.061	0.051	0.054	0.053
Total Annual Emissions						
Total SO ₂ (t/y)		115,000	107,900	125,200	134,000	136,200
Power Plant SO ₂ (t/y)		No Data	No Data	No Data	70,000	70,000 (estimated)
Industrial and Power Plant Particulate Emissions (t/y) ^b		99,000	94,000	100,000	97,000	78,000
Days Meeting Air Quality Standards (GB3095-1996)						
Class II		7	28	56	122	225
Class I		0	0	0	3	6
Total Coal Consumption						
Industrial, including TPP ³ (t)		7,421,600	8,743,000	8,852,200	9,213,900	10,470,000
TPP's (t)		No Data	No Data	No Data	7,260,000	7,100,000
Residential and service industries (t)		1,060,000	1,000,000	930,000	840,000	830,000
Total		8,481,600	9,743,000	9,782,200	10,053,900	11,300,000

EPB = environmental protection bureau; NO₂ = nitrogen dioxide; PM = particulate matter; SO₂ = sulfur dioxide; t = metric tons; t/y = metric tons per year; TPP = thermal power plant (coal fired).

^a Sulfur content of Yangquan coal is about 1%. High SO₂ baseline levels are due to a lack of coal treatment or emission controls.

^b This does not include transport emissions. Yangquan EPB does not calculate total TSP.

Source: Yangquan Environmental Protection Bureau and project implementing agency.

Table A13.6: Yangquan Gas Distribution Plant Environmental Data

Item	Before Project			After Project		
	2001	2002	2003	2004	2005	
	Households	49,302	53,588	56,098	58,483	64,395
Reticulated gas users in Yangquan	Industrial	0	0	1	4	8
	Commercial	0	0	48	No Data	174
	Households			2,510	4,895	10,807
Reticulated gas users from Project	Industrial ^a			1	4	8
	Commercial			0	No Data	126
	Households			4.5	8.4	16.8
Increase in gas users due to Project (%)	Industrial			100	100	100
	Commercial			0	No Data	72
	Households			4.5	8.4	16.8
Project gas generation (m ³ /year) ^b			13,350,000	24,810,000	52,140,000	
Annual reduction (t/y) in the use of coal due to replacement with gas from Project			19,491	36,223	76,124	
Emission reduction (t/y) due to replacement of coal with gas supplied by Project	TSP			274	507	1,066
	SO ₂			312	580	1,218
	NO _x			148	275	579
	CH ₄			3,754	6,977	14,662
	CO			955	1,775	3,730

CH₄ = methane; CO = carbon monoxide; NO_x = nitrogen oxide; SO₂ = sulfur dioxide; TSP = total suspended particulates.

Notes:

^a No industrial or commercial users had access to gas before the Project.

^b Estimated to reach design capacity of 94 million m³ in 2007.

Source: Yangquan Environmental Protection Bureau and project implementing agency.

IMPLEMENTATION OF LAND ACQUISITION PLAN

A. Resettlement Impacts and Budget

1. Land acquisition and resettlement began in 2002 and was completed by the end of 2005. Land acquisition costs totaled \$2.58 million. Compensation was paid before land acquisition and dispossession of assets.

2. The Project (i) permanently acquired 5.98 hectares (ha) of land, which affected 50 persons; (ii) temporarily occupied 5.40 ha of land, which affected 88 persons; and (iii) demolished 589 square meters (m²) of housing for pipe installation, which affected 40 persons or 11 households. Resettlement issues associated with the Project were addressed in accordance with the People's Republic of China's (PRC) laws and regulations. After installation of the pipes, households that had their houses demolished rebuilt them in the same place with larger floor sizes. They received temporary housing assistance until they rebuilt their houses. The affected people also received other assistance, such as food assistance, cash assistance to unemployed people, and employment opportunities at village-owned enterprises. Therefore, social capital was maintained in the original location, and the living conditions of the affected persons were improved. Income of persons affected by land acquisition was restored. A portion of the funds for land acquisition were invested in village-level public infrastructure, such as roads and accommodation for senior citizens; and in income-generating activities, such as village enterprises. The summary of the final resettlement impacts are in Table A14.1.

Table A14.1: Scope of Resettlement Impact in Resettlement Implementation

Item	Unit	TCGP	DDHP	YGDP	Total
Land Acquisition	ha	1.40	-	4.57	5.98
of which: Cultivated Land	ha	-	-	2.93	2.93
Waste Land	ha	0.67	-	-	0.67
Construction Land	ha	0.73	-	1.64	2.38
Urban Green Land	ha	-	-	-	0.00
Temporary Land Occupation	ha	-	5.40	-	5.40
Vegetable Land	ha	-	3.42	-	3.42
Dry Land	ha	-	1.98	-	1.98
Housing					
Affected Household	Household	-	11	-	11
Affected Person	Person	-	40	-	40
Housing Area	m ²	-	589.00	-	589.00
Affected enterprise^a	Number	1	20 ^b	1	22
Trees	Number	-	-	-	0
Roadside Shops	Number	-	-	-	0
Farmers Affected By Cultivated Land Acquisition	Person	-	-	25	25
Farmers Affected By Temporary Land Occupation	Person	-	88	-	88

DDHP = Datong District Heating Plant; m₂ = square meter; TCGP = Taiyuan Coal Gasification Plant; YGDP = Yangquan Gas Distribution Plant.

^a The gas tank constructed by Yangquan Coal Mine Corporation is not included in the affected enterprises.

^b The 20 affected enterprises in Datong were partially affected by the pipe construction, e.g., demolition of fence wall, damaged road, damaged yard, etc. The compensation for the 18 affected enterprises was CNY4.62 million.

Source: Project implementing agencies.

B. Compensation Standards and Costs

3. The compensation for permanent land acquisition is shown in Table 14.2.

Table 14.2: Compensation for Permanent Land Acquisition and Temporary Land Occupation

Item	Land Category A	Compensation Standard (CNY/ha) B=D/C	Amount of Acquired Land or Other Impacts C	Compensation Amount (CNY) D
1. TCGP				8,050,000
Xiaojingyu Village	Waste land	4,500,000	0.67 ha	3,000,000
Taiyuan Textile Corporation	Construction land	6,917,808	0.73 ha	5,050,000
2. DDHP (Temporary Land Occupation and Housing Demolition)			5.40 ha	8,258,030
Xishuimo Village	Vegetable land	614,318	2.64 ha	1,621,800
Shilipu Village	Dry land	218,687	1.98 ha	433,000
Yongjiu Village	Vegetable land	153,846	0.78 ha	120,000
Housing Demolition		2,235/m ²	589 m ²	1,316,630
Enterprises	Numbers	20 enterprises		4,766,600
3. YGDP				4,300,878
Yangquan Real Estate Corporation	Construction land	1,739,167	1.64 ha	2,860,000
Xigou Village	Dry land	1,087,875	2.24 ha	928,878
Dongguanjie Village	Dry land	764,648.4	0.68 ha	512,000
Total (1+2+3)				20,608,908

CNY = yuan; DDHP = Datong District Heating Plant; ha = hectare; TCGP = Taiyuan Coal Gasification Plant; YGDP = Yangquan Gas Distribution Plant.

Source: Project implementing agencies.

4. Affected houses were reconstructed in the same location after pipe installation. Compensation for the houses was above the replacement value.

5. For the temporary land occupation, the compensation was paid to affected individuals based mainly on the length of land occupation and annual average output value based on their agreement.

D. Rehabilitation of Livelihoods and Incomes

6. **Taiyuan Coal Gasification Plant (TCGP).** The village invested the land compensation fund in village-owned enterprises, such as a furniture processing factory, and generated revenue of more than CNY5 million each year. The net income per capita in affected village was CNY3,800 in 2003, increasing to CNY6,460 in 2005.

7. **Datong District Heating Project (DDHP).** The 11 households whose houses were demolished have reconstructed their houses with better structure and larger space at the original location. For example, one household had 42 m² of multipurpose plot (residential and commercial use). The commercial part was rented out for a truck repair shop, and generated

rental income of CNY4,000–5,000 per month before 2002. The new multipurpose plot is 150 m², and the commercial part has been rented out for a driver training school with rental income of CNY5,000 per month.

8. Incomes at the village level have been restored. Net income per capita in Xishuimo Village, which was CNY3,800 in 2003, reached CNY4,800 in 2005. In Yongjiu Village, net income per capita was CNY3,600 in 2003 and CNY4,300 in 2005.

9. **Yangquan Gas Distribution Plant (YGDP).** Xigou Village invested land compensation funds to expand the village-owned furniture processing factory. The new factory created jobs for 30 villagers, and generated CNY100,000 in additional revenue each year. The net income per capita in the affected village was CNY2,500 in 2003 and CNY3,000 in 2005.

10. Dongguanjie Village used the land compensation funds to partly finance a new accommodation for senior citizens, and offered jobs in village-owned enterprises to all affected families. Seven positions were offered to the five affected households. The net income per capita in affected village was CNY3,800 in 2003 and CNY4,700 in 2005.

E. Consultation, Participation, and Grievance Procedure

11. The project monitoring office (PMO) and concerned local government bureaus applied a highly consultative and participatory approach to the planning, design, implementation, and monitoring. All affected people received complete information on the Project, as well the resettlement policies and options, compensation measures, grievance procedures, and legal rights. In Dongguanjie Village, for example, three public meetings were held before land acquisition under the YGDP subproject. The meetings attracted 40 participants, including all affected family heads, villager representatives, county and town government officials, and village leaders.

12. A grievance mechanism that transparently outlined resettlement procedures was established in each subproject area at every level of government. One grievance regarding the restoration of land that was occupied temporarily was reported. In Xishuimo Village, 0.4 ha of land had not been restored to the same quality. Since a bulldozer needed to be rented to level the land (at a cost of CNY1,000–2,000 for half a day), the village head obtained additional assistance from the Project, although the village had been compensated for the land restoration.

F. Resettlement Management, Supervision, and Monitoring

13. Project resettlement was implemented in accordance with the laws and regulations of the State and Provincial Council under the Land Administration Law. Each subproject office directly managed resettlement implementation. Each office had full-time staff assisted by resettlement working groups in the affected counties, townships, and villages. An internal monitoring report was prepared in each subproject, and a short summary was included in the quarterly progress reports submitted to ADB. Resettlement issues were addressed based on established national law and provincial regulations. Through the efforts of local subproject offices, compensation was delivered to the affected villages and individuals. The contractors restored temporarily occupied land. Relocated households rebuilt their houses with the necessary infrastructure provided. In terms of economic rehabilitation, the affected villages invested in village enterprises to restore their incomes.

TRAINING PROVIDED UNDER THE PROJECT
(Technical and Management)

Type	Location	No. of People	No. of Person-Days
Overseas Training			
Taiyuan	Japan	7	105
	USA	8	120
	Germany, USA	7	105
	Australia	3	45
Datong	Germany, Finland	10	140
	Denmark	10	140
Yangquan	France, Italy	6	90
Total		51	745
Local Training			
Taiyuan	PRC	300	3,000
Datong	PRC	10	70
		180	900
Yangquan	PRC	12	240
		84	840
		88	30,624
		42	1,260
Total		716	36,934
Grand Total		767	37,679

PRC: People's Republic of China; USA = United States of America.
Source: Project implementing agencies.