

Project Completion Report

PCR: PRC 25371

Beijing Environmental Improvement Project (Loan 1336-PRC) in the People's Republic of China

June 2005

Asian Development Bank

CURRENCY EQUIVALENTS

Currency Unit – yuan (CNY)

		At Appraisal (1 November 1994)	At Project Completion (1 December 2004)
CNY1.00	=	\$0.115	\$0.1208
\$1.00	=	CNY8.679	CNY8.2768

ABBREVIATIONS

ADB	–	Asian Development Bank
BCW3	–	Beijing Chemical Works No. 3
BDHC	–	Beijing District Heating Company
BEPB	–	Beijing Environmental Protection Bureau
BIHWMC	–	Beijing Industrial Hazardous Waste Management Center
BMG	–	Beijing municipal government
BNGC	–	Beijing Natural Gas Company
BWCB	–	Beijing Water Conservation Bureau
CNG	–	compressed natural gas
EIRR	–	economic internal rate of return
FIRR	–	financial internal rate of return
ICB	–	international competitive bidding
IDC	–	interest during construction
LPG	–	liquefied petroleum gas
MOF	–	Ministry of Finance
PIA	–	project implementing agency
PRC	–	People's Republic of China
SCADA	–	supervisory control and data acquisition
SO ₂	–	sulfur dioxide
TA	–	technical assistance
TSP	–	total suspended particles

WEIGHTS AND MEASURES

ha	–	hectare
km	–	kilometer
km ²	–	square kilometer
m ²	–	square meter
m ³	–	cubic meter
t	–	metric ton

NOTES

- (i) The fiscal year (FY) of the Government and its agencies ends on 31 December.
- (ii) 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	1336-PRC
3.	Project Title	Beijing Environmental Improvement Project
4.	Borrower	People's Republic of China
5.	Executing Agency	Beijing municipal government
6.	Amount of Loan	\$112.70 million
7.	Project Completion Report Number	PCR: PRC 880

B. Loan Data

1.	Appraisal	
	– Date Started	11 July 1994
	– Date Completed	9 August 1994
2.	Loan Negotiations	
	– Date Started	25 October 1994
	– Date Completed	27 October 1994
3.	Date of Board Approval	29 November 1994
4.	Date of Loan Agreement	28 November 1995
5.	Date of Loan Effectiveness	
	– In Loan Agreement	26 February 1996
	– Actual	26 May 1996
	– Number of Extensions	1
6.	Closing Date	
	– In Loan Agreement	30 June 2002
	– Actual	21 September 2004
	– Number of Extensions	2
7.	Terms of Loan	
	– Interest Rate	Pool-based variable lending rate for US dollars
	– Maturity (number of years)	25
	– Grace Period (number of years)	5
8.	Terms of Relending	
	– Interest Rate	Pool-based variable lending rate for US dollars
	– Maturity (number of years)	25
	– Grace Period (number of years)	5
	– Second-Step Borrower	Beijing municipal government

9. Terms of Onlending
- Interest Rate Pool-based variable lending rate for US dollars
 - Maturity (number of years) 25
 - Grace Period (number of years) 5
 - Third-Step Borrowers Component 1: Beijing District Heating Company
Component 2: Beijing Natural Gas Company
Component 3: Beijing Water Conservation Bureau
Component 4: Beijing Chemical Works No. 3
Component 5: Beijing Industrial Hazardous Waste Management Center
Component 6: Beijing Environmental Protection Bureau

10. Disbursements

a. Dates

Initial Disbursement	Final Disbursement	Time Interval
1 June 1996	26 June 2003	84 months
Effective Date	Original Closing Date	Time Interval
26 May 1996	30 June 2002	73 months

b. Amount (\$ million)

Category	Original Allocation	Last Revised Allocation	Amount Cancelled	Amount Disbursed	Undisbursed Balance ^a
Machinery and Equipment	123.40	91.65	31.75	91.56	0.09
Consultant Services	1.80	0.71	1.09	0.61	0.10
Training	1.90	1.18	0.72	1.07	0.11
Recovering Cost of PPTA	0.32	0.32	0.00	0.32	0.00
Interest During Construction	19.30	19.14	0.16	19.14	0.00
Unallocated	10.28	0.00	10.28	0.00	0.00
Total	157.00	113.00	44.00	112.70	0.30

PPTA = project preparatory technical assistance.

^a Cancelled at loan closing date.

Source: Project records.

C. Project Data

1. Project Cost (\$ million)

Cost	Appraisal Estimate	Actual
Foreign Exchange Cost	157.00	112.70
Local Currency Cost	302.00	744.85
Total	459.00	857.55

2. Financing Plan (\$ million)

Cost	Appraisal Estimate			Actual		
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total
Implementation Costs						
Borrower-Financed	0.00	282.00	282.00	0.00	490.42	490.42
ADB-Financed	137.70	0.00	137.70	93.56	0.00	93.56
Other External Financing	0.00	18.20	18.20	0.00	183.91	183.91
Subtotal	137.70	300.20	437.90	93.56	674.33	767.89
IDC Costs						
Borrower-Financed	0.00	0.00	0.00	0.00	0.63	0.63
ADB-Financed	19.30	0.00	19.30	19.14	0.00	19.14
Other External Financing	0.00	1.80	1.80	0.00	69.89	69.89
Subtotal	19.30	1.80	21.10	19.14	70.52	89.66
Total	157.00	302.00	459.00	112.70	744.85	857.55

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

Source: Project implementing agencies.

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

Cost	Appraisal Estimate			Actual		
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total
Site Preparation	0.00	43.60	43.60	0.00	210.12	210.12
Equipment and Machinery	108.90	49.80	158.70	91.56	62.23	153.79
Civil Works and Installation	0.00	115.50	115.50	0.00	312.30	312.31
Engineering and Design	0.00	3.00	3.00	0.00	73.51	73.51
Licensing	2.90	0.00	2.90	0.00	0.59	0.59
Consultants	1.80	0.00	1.80	0.61	3.59	4.20
Training	1.90	0.00	1.90	1.07	1.15	2.22
Project Management	0.00	8.90	8.90	0.00	10.84	10.84
TA Cost Recovery	0.32	0.00	0.32	0.32	0.00	0.32
Contingencies	21.88	79.40	101.28	0.00	0.00	0.00
IDC	19.30	1.80	21.10	19.14	70.52	89.66
Total	157.00	302.00	459.00	112.70	744.85	857.55

IDC = interest during construction, TA = technical assistance.

Source: Project implementing agencies.

4. Project Schedule

Item	Appraisal Estimate	Actual
Date of Contract with Consultants		
Component 1	Apr 1995	Nov 1999
Component 2	Mar 1996	Mar 1996
Component 4 ^a	Feb 1996	Nov 1996
Completion of Engineering Designs		
Component 1	Mar 1996	Oct 2000
Component 3	Jun 1995	Oct 2001
Component 4 ^a	Sep 1995	
Civil Works Contract		
Date of Award		
Component 1	May 1996	Jan 1996
Component 2	Jan 1996	Aug 1997
Completion of Work		
Component 1	Dec 1999	Jun 2001
Component 2	Dec 1999	Sep 2001
Equipment and Supplies		
First Procurement		
Component 1	Aug 1995	Feb 1997
Component 2	Jun 1995	Dec 1996
Component 3	Jul 1995	Dec 1996
Component 6	Jul 1996	Jul 1997
Last Procurement		
Component 1	Jan 1998	Jul 2001
Component 2	Dec 1999	Jul 2002
Component 3	Oct 1995	Dec 2002
Component 6	Dec 1996	Oct 2001
Completion of Equipment Installation		
Component 1	Dec 1999	Jun 2001
Component 2	Dec 1996	Jun 2003
Component 3	Apr 1997	Jun 2003
Component 6	Dec 1997	Dec 1998
Start of Operations		
Completion of Tests and Commissioning		
Component 1	Dec 1999	Mar 2002
Component 2	Dec 1999	Dec 2003
Component 3	Apr 1997	Jun 2003
Component 6	Dec 1997	Dec 1998

^a Component cancelled.

Source: Project implementing agencies.

5. Project Performance Report Ratings

Implementation Period	Ratings	
	Development Objectives	Implementation Progress
From 29 Nov 1994 to 29 Jun 1998 ^a		
From 30 Jun 1998 to 30 Mar 1999	PS	S
From 31 Mar to 30 May 1999	S	S
From 31 May 1999 to 30 Mar 2000	PS	PS
From 31 Mar 2000 to 21 Sep 2004	S	S

PS = partly satisfactory, S = satisfactory.

^a Before the implementation of the new project performance report system, the Project was classified as an AAA project, where A corresponds to the highest rating that can be given for each of the criteria (i.e., project implementation progress, project cost, and submission of financial statements).

D. Data on Asian Development Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-Days	Specialization of Members ^a
Fact-Finding	18 Apr–3 May 1994	5	54	a, b, d, e, f
Appraisal	11–31 Jul 1994	7	96	a, b, c, d, e, f, g
Review 1	12–26 Aug 1996	2	14	a, h
Review 2	7–15 Apr 1997	2	18	a, h
Special Loan Administration	2–4 Jul 1997	2	6	a, h
Review 3	25–28 May 1998	2	8	a, h
Review 4	24–26 May 1999	2	6	a, h
Reappraisal	13–17 Sep 1999	3	15	a, b, d
Review 5	31 Oct to 2 Nov 2000	2	6	a, h
Review 6	13–16 Nov 2001	2	8	a, h
Review 7	23–27 Sep 2002	2	10	a, h
Review 8	25–28 Feb 2003	2	8	a, h
Review 9	18 Aug 2004	2	2	a, h
Project Completion Review ^b	29 Nov–7 Dec 2004	4	32	b, f, h, i

^a a = engineer, b = financial analyst, c = counsel, d = economist, e = programs officer, f = environment specialist, g = young professional, h = assistant project analyst, i = staff consultant.

^b The project completion report was prepared by M. Pajarillo (energy specialist [finance] and mission leader), assisted by staff consultants on environment and economics.

I. PROJECT DESCRIPTION

1. The rapid economic growth and industrialization experienced by the People's Republic of China (PRC) since the early 1990s and its heavy dependence on coal to meet energy requirements have resulted in severe environmental degradation in the PRC's major cities. Declines in urban air and water quality and in the standards related to the disposal of industrial solid and hazardous wastes were seen as major environmental problems. Harmful emissions were produced by heavy industries that used low-quality coal and employed outdated technologies and inefficient designs. Coal-burning household stoves and boilers and commercial furnaces also produced harmful emissions. Industrial wastewater was the main source of river and lake pollution. Hazardous and toxic wastes were also contaminating urban groundwater sources. Recognizing the need to address growing environmental concerns, the Government formulated a comprehensive plan¹ to arrest urban pollution. This plan covered 52 major cities (including Beijing), focusing on abatement measures for the targeted urban industrial and household sectors that are using large amounts of coal and are energy inefficient.

2. Beijing was one of the priority cities selected because of the severity of its environmental problems. The Beijing municipal government (BMG) and Beijing Environmental Protection Bureau (BEPB) formulated the city's environmental strategy, which is consistent with the national policy framework. The primary objectives of the environmental protection strategy² were to (i) control air pollution through using clean energy, developing centralized heating, relocating industry, and developing clean production technologies; (ii) control water pollution through treating and protecting water sources; and (iii) control waste through developing waste regulations, adopting incentives for pollution prevention and comprehensive reuse, and developing an integrated waste management plan.

3. BMG's environmental improvement plan³ covered expanding the natural gas supply and district heating and increasing the amounts of process steam, to replace coal burning in open, low-efficiency household stoves and low-efficiency boilers and furnaces. Selected enterprises producing toxic fumes were to be relocated outside the city, thereby reducing the harmful effects of emissions. Steps were to be taken to protect drinking water from contamination, and wastewater and sewage treatment facilities were to be established, to reduce water pollution. Systems for the proper transport and disposal of hazardous wastes were to be developed and implemented. Measures were also to be taken to address noise pollution, address vehicle emissions, and increase urban tree planting. Targets for environmental quality were established and included in the plan, with corresponding expenditure budgets. The Project formed an integral part of the city's investment program.

4. The Project sought to reduce Beijing's severe air and water pollution and hazardous waste problems by introducing environmentally sound technology, substituting cleaner energy forms for direct coal burning, conserving energy, and supporting policy reforms conducive to good environmental management. The use of market-oriented pricing is promoted, to encourage environment friendly behavior, and appropriate tariffs are incorporated for urban services needed to sustain improvements to the environment. The construction of infrastructure that will address the PRC's requirement for a clean environment was strategically important for the PRC, to support and sustain its rapidly growing economy. The Project will support the sustainable economic growth of Beijing, as a premier city and the nation's capital, in an efficient

¹ The PRC's plans for urban environmental improvement were outlined in the country's program for comprehensive renovation of the urban environment.

² Asian Development Bank. 1994. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan and Technical Assistance Grants to the People's Republic of China for the Beijing Environmental Improvement Project*. Manila.

³ For the eighth 5-year period (1991–1995) and ninth 5-year period (1995–2000).

and environmentally desirable manner. This was the third⁴ Asian Development Bank (ADB) project to support the Government's environmental protection efforts.

5. The Project originally consisted of four parts and six components, but in March 2000, the two components under part C were cancelled (para. 16). The original parts and components are

- (i) Part A: Air Quality Improvement (Component 1: District Heating System and Component 2: Natural Gas Distribution System),
- (ii) Part B: Drinking Water Quality Improvement (Component 3: Pollution Abatement at Drinking Water Reservoirs),
- (iii) Part C: Toxic and Hazardous Waste Management (Component 4: Relocation and Renovation of Beijing Chemical Works No. 3 and Component 5: Treatment and Disposal of Industrial Hazardous Waste), and
- (iv) Part D: Capacity Building of Environmental Agencies (Component 6: Capacity Building of Environmental Agencies).

6. Part A, for the improvement of air quality, aims to curb direct coal burning for space heating in residential areas and commercial and residential establishments by supplying steam and hot water for district heating systems (component 1) and using natural gas, instead of coal, for households and commercial establishments (component 2). Part B will provide facilities to prevent erosion through comprehensive watershed management and reduce contamination of Beijing's drinking water reservoirs (component 3). Part C will help relocate Beijing Chemical Works No. 3 (BCW3), which was the third worst water pollution source in Beijing; introduce modern technology (component 4); and help provide facilities for the incineration, treatment, and disposal of hazardous solid wastes (component 5). Part D will build capacities in BEPB and its attached agencies.

7. ADB approved a \$157.00 million loan for the Project on 29 November 1994. The Loan Agreement was signed on 28 November 1995 and became effective on 26 May 1996, due to slow project initiation and mobilization of domestic funds. The original loan closing date was 30 June 2002, but this was extended to 31 December 2002, to accommodate the delayed procurement of the supervisory control and data acquisition (SCADA) system and completion of the expanded project scope for component 2. The loan closing date was further extended to 31 March 2003, to accommodate the delayed completion of the SCADA system. The loan was reduced to \$123.37 million after the cancellation of \$33.63 million allocated to the two cancelled components. On 15 May 2002, a loan savings of \$7.70 million was identified and cancelled. Actual loan closing, however, took place on 21 September 2004, after the full refund of the unused cash advance for overseas training was remitted to ADB. The net loan amount was \$112.70 million. As of 15 May 2005, \$14.09 million in principal has been repaid.

8. Two complimentary technical assistance (TA) grants were also extended. The first was for capacity building of environmental protection agencies in Beijing,⁵ and this was designed to strengthen BEPB and its three environmental agencies (Beijing Environmental Monitoring Center, Beijing Research Institute of Environmental Protection, and Beijing Technical Training Center for Environmental Protection). The second was for capacity building of the Beijing

⁴ The other two projects were the \$103 million Qingdao Environmental Improvement Project, which was approved on 10 December 1992 (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 Qingdao Environmental Improvement Project*. Manila.), and the \$140 million Tangshan and Chengde Environmental Improvement Project, which was approved on 25 November 1993 (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 Qingdao Environmental Improvement Project*. Manila.).

⁵ ADB. 1994. *Technical Assistance to the People's Republic of China for the Capacity Building of the Beijing Municipal Environmental Protection Bureau and Affiliated Agencies*. Manila.

Industrial Hazardous Waste Management Center (BIHWMC),⁶ to improve its organizational structure; create a management information system; develop hazardous waste management, planning, treatment, incineration, and disposal practices; and develop human resources.

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: increasing economic efficiency, reducing poverty, and improving the environment and conserving natural resources (footnote 2). The strategy supported the PRC's programs to prevent urban pollution and encourage investments in industries and areas that promote energy conservation and environmental protection. ADB's assistance in environmental projects, as a means of supporting environment friendly economic growth in Beijing, was relevant to the Government's programs and consistent with ADB's strategy at the time of appraisal and now. Since the start of its development in 1990, Beijing's economy has grown phenomenally. Beijing's gross domestic product in 2003⁷ was 3.8 times higher than in 1990, representing an annual increase of 10.9% in terms of comparable prices. The pace of economic development in Beijing required a clean environment, to attract the types of firms that were envisaged in the Beijing development master plan, and the assistance provided under the Project was instrumental in implementing that plan. The selection of Beijing as the official site for the 2008 Olympic Games has further reinforced the need for a clean environment.

11. The Project was designed to replace the use of coal gas⁸ with environment friendly natural gas in the Beijing metropolitan area and promote energy efficiency in coal use through district heating. Capacity building of environmental agencies was also appropriately considered in the Project's design. Industrial retrofitting and modernization of facilities, as well as waste management, were originally envisaged but subsequently cancelled (para. 16).

12. The consultant's report under the project preparatory TA⁹ approved by ADB confirmed the feasibility of project components and recommended their implementation. Project facilities under components 1 and 2 were adequately designed to distribute heat and gas, respectively. The basic technical designs in the approved feasibility studies were used but modified for the expanded scope and other changes made during project implementation. During the construction of component 1, the open flume system originally envisaged in the design was converted to an excavated system in some busy districts. For component 2, additional areas to be supplied with natural gas were included in the Project's scope. These changes substantially increased project cost (para. 19), but the increased investment in the distribution network and storage facilities was useful and appropriate, and expanded project benefits. The original capacities designed for the two components were based on supply limitations at the time of appraisal. The increased supply sources for heat and gas allowed for the expansion of scope to serve Beijing's increasing demand. The designs for components 3 and 6 were appropriate and

⁶ ADB. 1994. *Technical Assistance to the People's Republic of China for Capacity Building of the Beijing Industrial Hazardous Waste Management Center*. Manila.

⁷ National Bureau of Statistics. 2004. *China Statistical Yearbook*, China Statistics Press. People's Republic of China.

⁸ 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. However, unlike natural gas, which is a natural primary energy resource, coal gas production creates pollution.

⁹ ADB. 1993. *Technical Assistance to the People's Republic of China for the Beijing Environmental Improvement Project*. Manila.

implemented accordingly. Components 4 and 5 were cancelled (para. 16). For component 4, the project preparatory TA was not able to detect critical developments in the major decision parameters (e.g., high cost of equipment and raw materials; depressed demand for output; and inability to mobilize local financing), which eventually led to the component's cancellation. For component 5, the project preparatory TA recommendations were inconclusive and were only based on certain assumptions that needed verification with a follow-up detailed study.¹⁰

B. Project Outputs

13. The district heating and natural gas distribution facilities have been meeting target beneficiaries' heat and natural gas requirements. For component 1, 27.5 kilometers (km) of hot water pipelines (25 km at appraisal) and 4.4 km of steam pipelines (2.9 km at appraisal) were laid. Other major subcomponents (i.e., those involving electrical equipment and instrumentation and control, as well as a computer-based heat supply, control, and monitoring system) were fully installed. About 84 million square meters (m²) of space were provided for district heating in 2004, compared to 46 million m² in 1999. About 25 million m² (from the 19 million m² estimated at appraisal) of the increase is attributed to the Project. In 2003 alone, 1,914 coal-fired boilers were closed, allowing about 1 million metric tons (t) of net annual coal savings.

14. Component 2 was also completed and is now operating, thereby complementing the existing gas distribution network of the Beijing Natural Gas Company (BNGC). The gas distribution network was expanded from the original design and is now capable of supplying more than 2.0 billion¹¹ cubic meters (m³) of gas per year (from 1.0 billion m³ at appraisal). Major subcomponents under the Project include (i) 340.0 km of high- and medium-pressure pipeline network systems (106.9 km at appraisal [55.6 km of high-pressure networks and 51.3 km of medium-pressure networks]); (ii) three storage stations (two at appraisal) and one central control station; (iii) 18 high- to medium-pressure regulating stations (four at appraisal); (iv) 10 gas storage tanks; and (v) one pipe network automation dispatch system and pressure and flow rate monitoring, remote control and metering, and data transmission system leasing. Natural gas consumption in Beijing increased from 180.0 million m³ in 1995 to 1.1 billion m³ in 2000 and 2.2 billion m³ in 2003. Estimated 2004 consumption is 2.7 billion m³. More than 2 million households are now using natural gas, which is double the appraisal estimate. With BMG's direction toward promoting clean energy and more gas becoming available, BNGC estimates that total gas consumption will reach 6.0 billion m³ by 2010. Coal savings in 2004 was about 4.7 million t.

15. Component 3 was designed to prevent soil erosion and control pollution in the Miyun and Huairou reservoirs, two of Beijing's main drinking water sources. The project scope includes planting trees and contouring hills in the high elevation area; constructing terraces; checking dams, pond dams, and canals; and developing water conservation systems. The control area covers about 654 square kilometers (km²), 50% more than the appraisal target of 436 km². Overall, about 130% of the appraisal targets for the various conservation measures were achieved. Degraded land has been rehabilitated, including 4,522 hectares (ha) of terraced hills, 26,955 ha of conservation forest, and 16,395 ha of commercial forest. About 40,000 check dams, 43 km of drainage canals, and 16 km of protective dams were constructed. Vegetation coverage increased to about 70%, thereby reducing soil deposits by about the same percentage and soil resettlement in reservoirs by over 350,000 t per year. Items planted included fruit trees and vegetables, which augmented the incomes of farmers within the area. Water quality

¹⁰ The feasibility study for component 5 was provided by the Executing Agency. The consultant under TA 2211-PRC (footnote 6) undertook a detailed review of the feasibility study and recommended the cancellation. The TA completion report is attached (Appendix 9).

¹¹ The Project is an integral part of the overall natural gas distribution network in Beijing and constitutes more than half of the 2003 distribution capacity.

improved. Vegetation measures increased the vegetation cover and played an important role in protecting biological diversity—wildlife returned, as some disappearing animals (e.g., Mongolian gazelle, fox, and roe deer) were again spotted. Since its implementation in 1996, component 3 has reinforced domestic and international scientific exchanges and served as a model for integrated watershed management. The demonstration areas have hosted many international experts, to showcase soil and water conservation in Beijing.

16. Components 4 and 5 were cancelled in March 2000. BCW3, the main facility under component 4, was decommissioned. This move to close BCW3 effectively eliminated a main source of pollution in the city. As designed, component 4 would have renovated the facilities for processing industrial water discharges by relocating BCW3's pentaerythritol and trimethylolpropane units to a chemical industrial park situated outside the residential area of Beijing and upgrading these units. However, project constraints following loan approval (e.g., high cost of equipment and raw materials and depressed demand for output, as well as an inability to mobilize local financing) restrained the investment decision. The decision not to proceed with the renovation of BCW3 proved to be sensible, as the intended chemical products would not have been able to compete commercially with the outputs of larger and more modern chemical plants, and the undertaking did not possess the economy of scale necessary to become financially viable. Similarly, the projected high cost of treatment of industrial hazardous waste deterred component 5. Instead, hazardous wastes are being disposed of yearly through a cement kiln and three other incinerators. This was decided after domestic experts engaged by BMG concluded that cement kilns can effectively and safely incinerate industrial toxic wastes at a capacity that is twice that originally envisaged under component 5 (i.e., 20,000 t per year). The estimated cost to modify the cement kilns was only about 10% of the estimated project cost for the component and translated to a much lower treatment cost per t of waste. About 90% of the solid waste in urban areas is now treated in 12 solid waste treatment plants. Therefore, even though components 4 and 5 were cancelled, the environmental benefits were considerably achieved by alternate arrangements.

17. Component 6 provided for the purchase of equipment and facilities. Training was also provided to strengthen the technical and management capabilities of BEPB and BMG's other environmental agencies. The component was successfully executed, and ADB approved the use of loan savings to procure additional monitoring and surveillance equipment designed to improve enforcement. Automatic air quality monitoring stations were established at strategic locations, to allow daily monitoring of air quality. Water and air pollutant sampling and analysis instruments were purchased to strengthen the agencies' research and monitoring capabilities. Studio equipment for BEPB's training center was also procured, and this enabled the center to produce videotapes and training materials that enhance environmental consciousness and awareness of the need for environmental protection among students and the general public.

18. For all components, staff member training and consulting services were adequately undertaken. Similarly, training and study tours provided under complimentary TAs were successfully completed. These interventions proved to be useful in improving the technical and management skills of the various implementing and environmental agencies.

C. Project Costs

19. At appraisal, total cost, including contingencies and interest and other financial charges during construction, was estimated at \$459.0 million, consisting of \$157.0 million in foreign exchange costs, representing 34% of the total cost, and \$302.0 million in local currency costs, representing the other 66% of the total cost. Actual total cost was \$857.6 million, with \$112.7 million in foreign exchange costs and \$744.9 in local currency costs. Taking out the allocated amounts for the two cancelled components in the comparison, the increase in actual

project cost goes up to 106%, with foreign exchange costs lower by 15% and local currency costs higher by 164%. Savings in foreign exchange costs were the result of advantageous international competitive bidding (ICB) and gains over the estimated foreign exchange rate conversion. The increase in local currency costs for component 1 (175%) was due to the longer length of the pipelines, which was needed to accommodate a wider heating area (para. 13); higher resettlement costs; and higher construction costs, mainly due to the change in design from an open flume system to an excavated system. For component 2, the higher local currency costs (162%) were primarily a result of the higher costs incurred for site preparation, installation and civil works, and design and engineering cost increases, on account of the longer distribution pipelines installed to accommodate the expansion in area coverage (para. 14). In both components, increased interest costs contributed to the higher project cost, as local loans were obtained to fund the expanded scope, even though local borrowing was not envisaged for components 1 and 2 during project preparation. These loans carry higher interest rates than ADB's loan. The extended construction period was also a major factor in the higher interest costs. Actual costs for components 3 and 6 were also higher than estimates, since more monitoring equipment was acquired than originally envisaged. Appendix 2 shows projected and actual project costs and financing plans. Appendix 3 shows the cost breakdown by project component.

20. The financing plan at appraisal consisted of a total loan from ADB of \$157.0 million, local borrowing of \$20 million, and total BMG equity of \$282.0 million. Actual funding came from ADB (reduced to \$112.7 million) and domestic loans (increased to \$253.8 million) and BMG's equity (increased to \$491.1 million). ADB's loan amount was reduced with the cancellations (para. 21), but a substantial increase occurred in local borrowing to fund the increased local costs (para. 19). Even with these significant changes, the total borrowing for the Project changed nominally (i.e., from 39% to 43%), although interest costs increased substantially (para. 19).

D. Disbursements

21. Disbursements under ADB's loan began in June 1996, with an initial drawdown of \$0.32 million for related TA cost recovery. Disbursements were highest in the last 2 years of project implementation (2002 and 2003), when most of the pipes were laid and most of the major equipment installed. Contract awards and disbursements initially lagged behind but were exceeded or at par in the last 2 years. Final disbursement was made in June 2003 for the final payment on the contract for the SCADA system. The loan was closed on 21 September 2004, with a total disbursement of \$112.7 million. By the loan closing date, disbursements for contracts totaled \$93.2 million, while interest during construction and commitment fees amounted to \$19.1 million. Of the total unused balance of \$44.3 million that was canceled, \$33.6 million pertains to components 4 and 5, which were cancelled in March 2000 (para 16). At the same time, ADB approved the use of anticipated loan savings and reallocation of loan funds for the remaining four components. Overall, 72% of ADB's loan was used. Disbursements were made mainly through letters of credit and direct payment. Appendix 4 compares projected and actual disbursements.

E. Project Schedule

22. At appraisal, project implementation was expected to take about 5 years. Preparatory work for detailed engineering and procurement started immediately after the approval of the loan, as planned. All project implementation activities were expected to have been completed by the end of 1999. However, a delay of more than 1 year was encountered between loan approval and effectivity, due to some organizational changes within the Executing Agency and difficulties encountered in obtaining firm commitments for local funding of component 4. Subsequent delays were also experienced during construction, due to the expanded scope of components

1–3. Some delays also occurred in the procurement and installation of the SCADA system (component 2), due to changes in specifications that were needed to accommodate a much wider coverage area. For components 1 and 2, commissioning and start-up were scheduled to have been completed by end 1999 but were extended to March 2002 and December 2003, respectively. Nevertheless, gradual commissioning took place during the implementation period, as certain sections of the pipelines and stations were completed. Appendix 5 shows projected and actual implementation schedules for each completed component.

F. Implementation Arrangements

23. As envisaged at appraisal, BMG was designated as the Executing Agency. Separate project implementing agencies (PIAs) were responsible for the implementation of their respective components. Beijing District Heating Company (BDHC) was responsible for implementing component 1. BNGC was responsible for implementing component 2. Beijing Water Conservation Bureau (BWCB) was responsible for implementing component 3. BEPB was responsible for implementing component 6.

24. BDHC and BNGC 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 provided technical consulting services and assisted the PIAs in reviewing the design, preparing tender documents, and constructing facilities. BEPB and BWCB undertook their respective components as envisaged at appraisal. Appendix 6 shows the organizational setup of the Executing Agency's project monitoring office.

25. The PIAs undertook all ADB-financed procurement for the Project with the assistance of a tendering company. Local contractors carried out construction of civil works and installation of equipment, while the equipment suppliers carried out the supply, supervised installation, and supervised commissioning of equipment procured under ICB. Problems encountered during project implementation (e.g., those related to requirements accompanying the changes in scope) were eventually resolved with the assistance of the consultants and ADB staff members.

G. Conditions and Covenants

26. In general, the loan covenants were complied with, except for the covenant related to the phase out of consumer subsidies for heating, which was only partially complied with, and some financial covenants (Appendix 7). The subsidy for natural gas was removed in 2001. The subsidy for liquefied petroleum gas (LPG) was also removed, and the price is now liberalized. However, BMG still subsidizes the operation of BDHC, which continues to show losses, due to limited tariff adjustment. Full compliance with the covenant requires removal of the subsidy and approval of an appropriate heating tariff that would allow full cost recovery. BDHC and BMG were advised of the completion of TA 3673-PRC: Pro-Poor Urban Heating Tariff Reforms (para. 52).¹²

27. The audited project accounts were submitted regularly and mostly on time, but audited financial statements were submitted only for BDHC. BNGC submitted its 2003 and 2002 financial statements only during the Project Completion Review Mission. Appendix 7 shows the status of compliance with the covenants in the Loan Agreement.

¹² ADB. 2001. *Technical Assistance to the People's Republic of China for Pro-Poor Urban Heating Tariff Reforms*. Manila. The TA aims 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.

H. Related Technical Assistance

28. ADB provided a TA grant (footnote 5) to assist BEPB and its affiliated agencies (para. 8) in strengthening their monitoring and enforcement capabilities. An international environmental consulting firm was engaged to provide the consulting services. The consultant evaluated the issues and made recommendations covering institutional management, as well as technical and policy issues. The major recommendations developed by the consultant were implemented. Equipment for BEPB and the three affiliated agencies was procured under the loan, in accordance with the TA recommendation. An audit center for an environmental monitoring system was established. Staff member training and international study tours were undertaken. The performance of the consultant was considered satisfactory. The environmental action plan that was formulated and implemented was effective in improving pollution control and environmental management in Beijing, as evidenced by the steady improvement in Beijing's air and water quality and enhanced public awareness regarding environmental issues. The TA was rated successful.¹³ The TA completion report is attached (Appendix 8).

29. ADB provided another advisory TA (footnote 6) to assist the Government in building BIHWMC's institutional capacity to construct and operate centralized facilities for incineration, treatment, and disposal of accumulated hazardous wastes in the municipality. The TA aimed to improve BIHWMC's organizational structure, establish an effective management information system, develop an environmental plan, and address short- and long-term training and personnel needs. The international consulting firm hired under the TA reviewed the adequacy of the existing treatment, storage, and disposal facilities and suggested improvements and enhancements of current practices. The consultant also evaluated the feasibility study for the proposed construction of a hazardous waste management facility (footnote 10). The consultant's review led to the cancellation of component 5, as the services would have been unaffordable for the local industry. The consultant's performance was satisfactory and addressed the relevant issues. The TA successfully achieved its objectives, which were to formulate specific actions for institutional strengthening and provide appropriate training to BIHWMC staff members. The TA was rated successful.¹⁴ The TA completion report is attached (Appendix 9).

I. Consultant Recruitment and Procurement

30. BDHC and BNGC hired international consulting firms to assist them in 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 PIAs used domestic design institutes for the engineering design of the Project and a research institute for the environmental impact assessment.

31. Sixty contract packages for materials, equipment supply, and installation, with a combined value of \$91.6 million, were awarded. 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 advantageous bids, which allowed BDHC and BNGC to realize tangible cost savings in the foreign exchange cost. Appendix 10 shows the ADB-financed contract packages.

¹³ TA completion report, 22 March 2005.

¹⁴ TA completion report, 22 March 2005.

J. Performance of Consultants, Contractors, and Suppliers

32. The performance of the international and domestic consultants was satisfactory. The consulting services were performed in accordance with their terms of reference and contributed positively to the successful implementation of the Project.

33. The design and installation of the district heating system and the gas distribution system were executed as planned, with some modifications (para. 12), and the installed facilities are operating satisfactorily. For components 3 and 6, equipment supplied is also operating as designed. The PIAs expressed satisfaction with the performance of the equipment supplied by the manufacturers and with the quality of the construction completed by civil works contractors and installers. Problems encountered were accordingly addressed.

K. Performance of the Borrower and the Executing Agency

34. The performance of the Borrower (the PRC, initially through the People's Bank of China and subsequently through the Ministry of Finance [MOF]) was generally satisfactory, as was that of the Executing Agency. However, the effectivity of the loan and the subsidiary Loan Agreement for the relending of loan proceeds to the PIAs was made 1.5 years after loan approval (para. 22). MOF's supervision and monitoring of the Project did not require significant staff member time, as the PIAs assumed the major responsibilities for project implementation. ADB review missions gave MOF regular briefings on the Project's progress and implementation issues. The performance of BMG and the PIAs was generally satisfactory, and project implementation was carried out systematically, after the issues regarding the cancelled components were finally resolved, although further delays were still encountered, due to some changes in scope, which also resulted in increased project costs and capacities.

L. Performance of the Asian Development Bank

35. ADB's performance in monitoring the Project was satisfactory, but the process for evaluating certain components for inclusion in ADB's loan can still be improved (para. 12). Regular project review missions and frequent consultations and briefings with MOF demonstrated ADB's efforts in monitoring the progress of project implementation. Nine regular review missions and one special review mission were fielded, and ADB staff members spent adequate time reviewing physical progress and resolving issues with the PIAs' staff members during the implementation period. ADB provided prompt approvals for the contracts it financed as well as necessary funds disbursements. After experts determined that the implementation of components 4 and 5 would not be economically feasible, ADB took immediate action to cancel these components and the corresponding amounts of the loan. ADB also approved in a timely manner the requested changes in project scope and the reallocation of loan proceeds. BMG and the PIAs expressed appreciation for the timely action of ADB in resolving project implementation issues.

III. EVALUATION OF PERFORMANCE

A. Relevance

36. The Project was consistent with the priorities of ADB and the Government at the time of appraisal and contributed to the improvement of the environment in Beijing. Except during 1996–1998, when a financial crisis hit most Asian economies, the economy of Beijing has achieved double-digit growth rates since 1992. Rapid economic growth has increased the level of urban pollution. This is made even more severe with the continuously growing vehicle

population, which is seen to further increase. Thus, the need for the PRC to address environmental concerns and promote investments to improve the environment in urban centers has become even more pronounced. The Project was assessed as highly relevant.

37. The Project helped create a market for natural gas in Beijing. Natural gas produced from the Shaan-Gan-Ning¹⁵ basin in west-central PRC found a ready market. The first Shaanxi-Beijing natural gas pipeline was completed in 1997. Portions of the distribution lines in Beijing were also completed on a staggered basis until 2003. A second Shaanxi-Beijing pipeline will be completed in 2005, and this increases energy security and enhances the gas supply for Beijing, which experienced shortages in gas supply during the winter of 2004-2005. With additional gas supply assured, further expansion of the area supplied by natural gas is now being undertaken.

B. Efficacy in Achievement of Purpose

38. The Project achieved its objectives of improving the environment in Beijing by helping the city meet part of its energy requirements through desirable and safe environmental investments and practices. The Project also helped establish an attractive environment for sustainable economic growth. Despite the cancellation of component 4, the objective of improving Beijing's environment was achieved, since the source of pollution from BCW3 was eliminated. The decision to cancel component 5 was also justified, as the component would not have been economically feasible. More importantly, cheaper but effective alternatives were subsequently worked out. The Project was rated efficacious.

C. Efficiency in Achievement of Outputs and Purpose

39. Project implementation for the four remaining components proceeded efficiently, although with an extended schedule and cost increases, mainly for the expanded scope. Project facilities under components 1 and 2 were constructed and successfully installed and commissioned with few problems. The changes made during implementation allowed wider coverage and more beneficiaries to be served. Components 3 and 6 were also carried out efficiently. The organizational setup, management, and approval processes of the Executing Agency and PIAs were responsive to the Project's requirements. ICB resulted in cost savings. Cofinancing and counterpart funds were adequate and provided in a timely manner, after some initial delays.

1. Financial Evaluation

40. Appendix 11 summarizes the financial performance of BDHC and BNGC. BDHC's financial performance in the past was not robust, and yearly operating losses were registered. Its operations continue to be subsidized by BMG, as heating tariffs remain low. For BNGC, financial statements were provided only for 2002 and 2003, when major sections of the Project started operating. The results in 2003 showed BNGC's improved profitability.

41. 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 are minimal and considered in the maintenance costs. All revenues and expenditures are in constant 2004 prices and exclude depreciation and interest. The recalculated FIRRs for component 1 and component 2 were 5.9% and 11.1%, respectively, compared with the 7.3% and 10.0% estimated at appraisal. These rates are higher than their respective weighted average costs of capital of 4.6% and 4.7%. The lower recalculated FIRR for

¹⁵ Shaan-Gan-Ning gas field is in Jingbian, Shaanxi Province. Proven gas reserves are estimated to be 500 billion m³.

component 1 resulted from lower tariffs than those assumed at appraisal and higher capital costs. However, the higher capital costs of component 2 were more than offset by the more favorable revenue stream triggered by increased demand for natural gas at market prices. A summary of the FIRR calculation is shown in Appendix 12.

2. Economic Evaluation

42. The economic evaluation of the Project followed the methodology used at appraisal and was conducted only for components 1 and 2, as the intangible benefit of water quality improvement under component 4 and the benefits of component 6 could not be measured. The investment costs and related benefits of the expanded project scope were included. Taxes and duties on equipment and other items were excluded. Financial costs were converted to their economic values at 2004 constant prices. Tradable goods were valued at their border prices, including transport and handling costs, while nontradable goods and services were converted into economic costs by applying the applicable specific and standard conversion factors.¹⁶ The economic benefits were valued based on cost savings resulting from the substitution of the fuel (mainly coal for component 1 and coal and LPG for component 2) that would have otherwise been used by the industrial and small boilers that were replaced by the Project. The prevailing economic price of coal and the prevailing LPG price to domestic consumers were used in the calculations. Operating costs were based on actual and assumed data obtained from BDHC and BNGC and adjusted to their economic values.

43. The recalculated economic internal rates of return (EIRRs) for component 1 and component 2 were 16.9% and 18.5%, respectively. These are higher than the respective 12.8% and 12.2% estimated at appraisal and exceeded ADB's 12.0% hurdle rate for economic opportunity cost of capital. The higher EIRRs resulted from higher benefits, which offset the higher capital costs. The higher benefits mainly result from the current high economic prices of coal and LPG and the increased volume of coal savings. Valuation of the economic benefits from environmental improvement will further improve the EIRR.¹⁷ Aside from the benefits from pollution abatement, other economic benefits include the availability of areas previously occupied by district boiler houses; removal of waste residues, reduction of the toll on transport and handling system, due to reduced coal volume; and increase in recreational benefits from new reforested areas. A summary of the EIRR calculation is shown in Appendix 13.

D. Preliminary Assessment of Sustainability

44. The operating parameters of the two components under part A assure its sustainability, as district heating and natural gas supply are two essential public services. As the public becomes increasingly aware of the need for a cleaner environment, the demand for these services is seen to multiply. The operating facilities were properly designed and installed and function well. The PIAs possess the institutional capability and expertise required to manage and operate the facilities effectively and efficiently. However, the operation of BDHC remains subsidized, and the issue of an adequate heating tariff that is sufficient to allow full cost recovery should be addressed. Nevertheless, projected net revenue flows for each component are positive, actual FIRRs remain above the weighted average cost of capital, and actual EIRRs are above the 12% minimum rate for the economic opportunity cost of capital. Adjustment in heating tariffs will improve the sustainability of component 1. Components 3 and 6 will also likely

¹⁶ The conversion factors used in this evaluation are 1.10 for civil works, 1.10 for local machinery, and 0.93 for others.

¹⁷ An attempt to place a value on the local 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 21.9% for component 1 and 28.3% for component 2.

be sustainable, with their institutional capabilities enhanced and the existence of a favorable enabling environment and strong support from BMG.

45. BMG's plan to improve the city's environment in time for the Beijing Olympics, in 2008, will enhance the demand for natural gas. The completion of the second Shaanxi-Beijing pipeline in 2005 will allow greater availability and security of gas supply for Beijing. This will guarantee full use of project facilities and, consequently, improve profitability. This development also requires further expansion of the natural gas network, which BNGC is now undertaking. BMG is also promoting the use of compressed natural gas (CNG) for buses and taxis, targeting the conversion of the majority of buses and taxis in Beijing by 2008. To support this program, some loan savings were used to construct CNG filling stations in strategic locations. About 2,000 buses in Beijing are now fueled by natural gas. BNGC is in a strategic position in a fast-growing market.

E. Environmental, Sociocultural, and Other Impacts

46. **Environmental Impact.** The Project clearly achieved its stated objective of improving Beijing's air and water quality. Air quality has continuously improved from the before project scenario, despite economic growth of more than 10% in the last 10 years. Similarly, the city's population increase of about 43% and vehicle fleet increase of about 242% over the last 10 years have placed a heavy strain on the environment, as has desertification.¹⁸ Coal savings from burning less quantity of coal equals about 5.7 million t per year (about 88% more than the appraisal estimate), thereby avoiding sulfur dioxide (SO₂), total suspended particles (TSP), and carbon dioxide emissions, in addition to reducing fly ash and slag. Compared to 1998 levels, air quality for 2003 showed reductions of 49%, 33%, and 38%, respectively, in SO₂, TSP, and nitrogen oxide ambient concentrations. In 2003, more than 224 days during the year (61.4%) exhibited air quality that met Class II¹⁹ standards, yielding an improvement of 124% over 1998 (100 days). Thirty-three monitoring stations record real-time measurements of air quality. Public awareness of environmental issues is promoted through daily reporting of air quality via a television program and through a special environmental portion featured on a weekly television show, using facilities provided under component 6. BEPB's programs have also increased the involvement of volunteer groups in environmental protection activities. Congestion in railway and port facilities and associated energy consumption for coal transportation were also reduced through lower coal consumption.

47. In regard to water quality, levels of various parameters in Miyun and Huairou reservoirs are consistently below Class II²⁰ maximum allowable concentrations. The indicators have shown continuing improvement in the last 3–6 years, except for slight increases in the phosphate level of Miyun and in the chemical oxygen demand and biological oxygen demand levels of Huairou reservoirs in 2003. The other environmental impacts are discussed in para. 15.

¹⁸ Desertification is the expansion of the desert area, which has adversely affected Beijing and some northern areas in the PRC.

¹⁹ Class II standard is one of the three classes. Class I, the highest standard, is for natural conservation areas, scenic spots and historical sites, and other zones that require special protection. Class II is for residential areas; cultural and education zones; mixed commercial, traffic, and residential areas; industrial areas, and rural areas. Class III is for special industrial zones. (Source: National Standard 3095-1996).

²⁰ Class II standard is one of five classes. Class I, the highest standard, is for headwaters and national nature reserves and may require limited treatment. Class II and III designate water for drinking, fishing, and recreation and may be used as water supply sources with full treatment. Class IV is water suitable for industrial uses and noncontact recreational uses. Class V denotes water for agricultural purposes and landscaping. (Source: National Standard 3838-2002).

48. Air pollution and water quality monitoring indexes (Appendix 14) show the improvement since the Project started operating.

49. **Social Impact.** For component 1, resettlement issues associated with the Project were properly addressed, in accordance with the PRC's rules and regulations and the approved resettlement plan. The land was acquired by the municipal administrative agency, and actual resettlement work was undertaken by another state-owned enterprise. Many houses along the routes were dilapidated and already programmed for removal, due to road expansion. The affected residents were relocated to government housing projects and given larger housing units with better construction and improved amenities. Actual resettlement cost was more than triple the estimate. Since the Project is within the city, employment of most of the resettled people was not affected. All affected people were given compensation. For component 2, there were no resettlement issues for the enterprise as laying of the gas pipelines coincided with the road expansion project undertaken by the municipal government. In the same manner, land required for the storage and regulating stations formed part of the overall land development program of the municipal government and BNGC took possession of the land from the developer free of any structures. Relevant details are presented in Appendix 15.

50. Temporary employment for more than 7,000 people was provided during project construction. The operation of project facilities created permanent employment in BDHC and BNGC for about 3,000 people for the entire network, and about 40% of these were women. Additional employment was created for contracted services. The employees who lost jobs when BCW3 closed were given separation compensation. Many found employment in other chemical plants and in project enterprises, as additional job opportunities were created with the expansion of the district heating and gas distribution networks.

51. **Capacity Building.** The two advisory TAs (paras. 28 and 29) for BEPB and BIHWMC improved their institutional capabilities. Foreign and local training were also provided to BDHC, BNGC, and BWCB staff members on technical and management aspects. During project implementation, the PIAs sent 229 staff members abroad for training in environmental management and protection and for training in pipeline network operation and security, network planning and strategy, and other relevant technical and management programs. In addition, more than 350 staff members received local training on technical matters and on finance and accounting, computers, and personnel administration. The training programs enhanced the technical, operational, and managerial capabilities and environmental consciousness of the PIAs. These formal training programs, combined with actual experience in project management and operation during project implementation, helped staff members improve institutional capability and competence in developing and expanding operations and meeting future challenges in providing a cleaner environment in Beijing. Appendix 16 gives the details of the training programs.

52. **Enterprise Reforms.** Industry reforms have been taking place in the heating and gas distribution sectors. However, BDHC still receives a government subsidy, as its operations remain unprofitable, which is a common situation in most district heating companies in the PRC.²¹ The recommendations developed under the recently concluded TA on urban heating tariff reforms (footnote 11) can address most of the concerns. The recent positive developments in the natural gas sector in the PRC are along with the policy initiatives set out under the Ping Hu Oil and Gas Development Project.²² Reforms to promote greater use of natural gas in the PRC are being undertaken. Beijing is at the forefront of implementing the needed policy and

²¹ 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.

²² ADB. 2004. *Project Completion Report on the Ping Hu Oil and Gas Development Project in the People's Republic of China*. Manila.

structural reforms to create a clean environment. The programs also aim to fulfill commitments for the clean and green 2008 Olympics. The Project played a pioneering role in these developments.

IV. OVERALL ASSESSMENT AND RECOMMENDATIONS

A. Overall Assessment

53. The Project's components that were implemented are operating satisfactorily. Although implementation took longer than envisaged at appraisal, the Project was implemented smoothly, once construction work actually began. The increase in project cost and the extension of the completion period were primarily due to (i) the expanded project scope when additional gas and heat supply sources were confirmed and (ii) the changes in design to better address environmental concerns and successfully meet strict environmental performance requirements. These changes allowed the distribution of benefits to more beneficiaries. The Project has clearly achieved its stated objectives of improving Beijing's air and water quality. The objective of using more environment friendly alternatives to coal and coal gas was achieved. Air quality has continuously improved from the before project scenario. Coal savings from burning less amount of coal through district heating and replacing coal with natural gas have reduced emissions, in addition to reducing fly ash and slag. The environmental programs developed under the Project have enhanced public awareness of environmental protection. Water quality also improved and has maintained Class II standards. Although the two components of part C were cancelled, the environmental objectives were effectively met, with the source of pollution eliminated and the implementation of an alternative waste disposal scheme.

54. The Project has had a strong and positive environmental and developmental impact and is financially and economically viable. Based on the criteria of relevance, and institutional development and other impacts, the Project is rated highly successful. In terms of efficacy, efficiency and sustainability, the Project is rated successful. Overall, the Project's rating is successful.²³

B. Lessons Learned

55. Conducting more preparatory work could have avoided the delays encountered during project implementation. Greater scrutiny of the market and financial situations, customers' affordability levels, assumptions, and risks could have identified unfeasible components, which could have been removed from the Project at the outset, thereby not holding up implementation overall. Closer attention should be paid to details during the project preparatory TA stage.

56. For project components that are based on the feasibility studies conducted by other institutions, mandatory reviews should be undertaken prior to inclusion in the ensuing project loan. This could have brought out critical issues of component 5 at the outset and improved project design.²⁴

57. Slow mobilization of domestic loan funds accounted for some initial delays. Timely availability of the required funds is important and should be given adequate attention. Up-front confirmation of the funding source should be secured and arrangements for possible shortfalls during implementation should be in place.

²³ This project completion report is part of a sample of the project completion reports that have been independently reviewed by the Operations Evaluation Department. This review has validated the methodology used and the rating given.

²⁴ From TCR for TA 2211-PRC (footnote 6).

58. The substantial increase in project cost was due to the expansion in scope and some technical difficulties encountered during construction, which were not anticipated at the design stage. While, to a large extent, the expansion in scope enhanced project benefits, the implementation period could have been shortened by accurately envisaging the scope at the outset. Up to now, knowledge of critical supply sources and proper planning and preparation are key elements in suitable project design and smooth and timely execution.

59. Greater attention to supervision of resettlement activities should be observed during project review missions so that the quality of reports submitted by the PIAs can be improved and their compliance to their social obligations can be better assessed.

C. Recommendations

1. Project-Related

60. **Future Monitoring.** No future project monitoring by ADB is necessary. All project components have been implemented and are operating as planned. However, keeping track of developments related to the implementation of the heating tariff sector reforms would improve the responsiveness of future ADB assistance in the sector. The recently concluded TA on heating tariff reforms (para. 52) contains recommendations that BDHC could adopt. Follow-up actions and consultations with the Government would increase ADB's sector knowledge.

61. **Further Action or Follow-up.** The Project does not require any specific future action from ADB, as most performance targets have been met.

62. **Timing of Project Performance Audit Report Preparation.** A project performance audit review may be fielded in 2007 to assess the impact of new developments in the PRC's heating and gas sector on the Project. By that time, the envisaged investments and reforms for a cleaner Beijing's environment shall have taken shape.

2. General

63. A clean environment is essential for sustainable economic growth. The past pace of the PRC's economic growth, and Beijing's in particular, would have been hampered if urban pollution had not been abated. The transformation of the environment sector in the PRC entails adjustments that can be accomplished in the short and long terms. With the continuing toll of industrialization and population and vehicle growth, adequate environmental protection measures need to be in place. The Project is a precursor to other environmental development projects in Beijing, and its success demonstrates that similar undertakings can be supported.

CHRONOLOGY OF MAJOR EVENTS

28 Jul 1993	Approval of project preparatory technical assistance (TA) for the Beijing Environmental Improvement Project
18 Apr 1994	Fact-finding mission
22 Jun 1994	Management review meeting
11 Jul 1994	Appraisal mission
4 Oct 1994	Staff review committee meeting
25 Oct 1994	Loan negotiations
29 Nov 1994	Asian Development Bank (ADB) approves a \$157.000 million loan from ADB's ordinary capital resources to the People's Republic of China (PRC) for the Beijing Environmental Improvement Project (Loan 1336-PRC)
28 Nov 1995	Loan signing
26 May 1996	Loan effectiveness
27 Mar 1996	Contract with consultants for supervisory control and data acquisition (SCADA) system for component 2 is signed
29 Apr 1997	Contract with consultants for spherical gasholders under component 2 is signed
12 Aug 1996	Review mission
12 Dec 1996	First procurement contract for equipment under component 2 is signed
27 Dec 1996	First procurement contract for equipment under component 3 is signed
28 Feb 1997	First procurement contract for equipment under component 1 is signed
7 Apr 1997	Review mission
23 May 1997	Director, Infrastructure and Energy Department, ¹ approves the request under component 4 to increase the trimethylolpropane plant's capacity and relocate Beijing Chemical Works No. 3 to Ciqu Industrial Development Zone
2 Jul 1997	Special review mission
11 Jul 1997	First procurement contract for equipment under component 6 is signed
5 Mar 1998	The People's Bank of China ² requests for approval of a change in scope under component 4

¹ This was the name of the department before the reorganization.

² Former focal point in PRC.

25 Mar 1998	Vice-President (East) approves the People's Bank of China's request for a change in scope under component 4, which consists of the reallocation and use of loan savings, relocation of Beijing Chemical Works No. 3, increase in production capacity, and construction of a new wastewater treatment plant
30 Apr 1998	Approval of overseas study tour program under component 4
25 May 1998	Review mission
15 Nov 1998	Start of operation of the first segment of the steam pipelines under component 1
24 May 1999	Review mission
30 Jun 1999	Ministry of Finance (MOF) requests for approval of use of loan savings
23 Jul 1999	MOF requests approval for direct engagement of an international consulting firm under component 1
4 Aug 1999	Vice-President (East) approves the request of MOF for direct engagement of an international consulting firm
6 Aug 1999	MOF submits revised request for approval of use of loan savings
13 Sep 1999	Reappraisal mission to review MOF's request for approval of use of loan savings
16 Nov 1999	Contract with consultants for implementation supervision under component 1 is signed
25 Nov 1999	MOF requests cancellation of components 4 and 5 and their undisbursed allocated loan funds and use of anticipated loan savings under components 1, 2, 3, and 6
15 Dec 1999	Vice-President (East) endorses the cancellation of components 4 and 5 and their undisbursed balance of about \$33.630 million, as well as the use of anticipated loan savings of \$34.310 million under components 1, 2, 3, and 6 through a major change in project scope and reallocation of loan funds, and issues instructions for the preparation of a Board paper to be circulated to management
17 Mar 2000	Board approves management's recommendation
31 Oct 2000	Review mission
2 May 2000	Approval of request for first and second training programs under component 1 (12 people toured Denmark, Finland, and Germany in May–June 2000, to study district heating network management and computerized control and monitoring systems)
31 May 2001	Approval of request for third and fourth training programs under component 1 (18 people toured Australia, Europe, and United States in June–July 2001, to study district heating systems)

30 Jun 2001	Final segment of the steam pipelines under component 1 is completed
25 Jul 2001	Award of contract for control and monitoring system (last procurement under component 1)
16 Aug 2001	Approval of request for fifth and sixth training programs under component 1 (18 people were trained in Australia, New Zealand, and United States, in September–October 2001, on advanced planning and design of district heating networks and management)
30 Sep 2001	Construction of pressure regulator stations under component 2 is fully completed
13 Nov 2001	Review mission
11 Oct 2001	Last procurement contract for equipment under component 6 is signed
1 Feb 2002	Approval of request for seventh and eight training programs under component 1 (12 people were trained in Australia, Germany, and New Zealand, in February–May 2002, on advanced planning and design of district heating networks and management)
28 Apr 2002	MOF requests reallocation of loan proceeds under category 5 (interest during construction [IDC]) and a net loan cancellation of \$7.702 million)
15 May 2002	Director, Energy Division (ECEN), East and Central Asia Regional Department, approves request of MOF to reallocate loan proceeds under category 5 (IDC) and a net loan cancellation of \$7.702 million, effective 28 April 2002
8 Jul 2002	Last procurement contract for equipment under component 2 is signed
7 Nov 2002	Receipt of request from the Borrower to extend loan closing date from 31 December 2002 to 31 March 2003 and reallocate loan proceeds from components 2 and 3 to IDC category
11 Nov 2002	Director, ECEN, approves the Borrower's request for an extension of the loan closing date and reallocation of loan proceeds
27 Dec 2002	Last procurement contract for equipment under component 3 is signed
25 Feb 2003	Review mission
18 Aug 2004	Review mission
13 Sep 2004	Partial cancellation of \$2.695 million under IDC category
21 Sep 2004	Receipt of full refund for unused advance for training; ADB cancels undisbursed balance of \$0.300 million and closes the loan account
29 Nov 2004	Project completion review mission

PROJECT COSTS AND FINANCING PLANS
(\$ million)

Table A2.1: Project Costs

Item	Appraisal			Actual		
	FX	LC	Total	FX	LC	Total
Part A: Air Quality Improvement						
Component 1: District Heating System	55.00	125.00	180.00	33.52	344.67	378.19
Component 2: Natural Gas Supply System	70.00	145.00	215.00	65.86	381.37	447.23
Part B: Drinking Water Quality Improvement						
Component 3: Pollution Abatement at Drinking Water Reservoirs	6.00	11.00	17.00	9.19	16.36	25.55
Part C: Toxic and Hazardous Waste Management						
Component 4: Relocation and Renovation of a Chemical Plant	17.00	14.00	31.00	1.06	1.20	2.26
Component 5: Treatment and Disposal of Industrial Hazardous Waste	7.00	6.00	13.00	0.22	0.00	0.22
Part D: Capacity Building of Environmental Agencies						
Component 6: Capacity Building	2.00	1.00	3.00	2.85	1.25	4.10
Total	157.00	302.00	459.00	112.70	744.85	857.55

FX = foreign exchange, LC = local currency.
Source: Project implementing agencies.

Table A2.2: Financing Plans

Item	Appraisal				Actual			
	ADB Loan	Commercial Bank Loan	Own Sources	Total	ADB Loan	Commercial Bank Loan	Own Sources	Total
Part A: Air Quality Improvement								
Component 1	55.00	0.00	125.00	180.00	33.52	158.01	186.66	378.19
Component 2	70.00	0.00	145.00	215.00	65.86	95.79	285.58	447.23
Part B: Drinking Water Quality Improvement								
Component 3	6.00	0.00	11.00	17.00	9.19	0.00	16.36	25.55
Part C: Toxic and Hazardous Waste Management								
Component 4	17.00	14.00	0.00	31.00	1.06	0.00	1.20	2.26
Component 5	7.00	6.00	0.00	13.00	0.22	0.00	0.00	0.22
Part D: Capacity Building of Environmental Agencies								
Component 6	2.00	0.00	1.00	3.00	2.85	0.00	1.25	4.10
Total	157.00	20.00	282.00	459.00	112.70	253.80	491.05	857.55

ADB = Asian Development Bank.
Source: Project implementing agencies.

COST BREAKDOWN BY PROJECT COMPONENTS
(\$ million)

Item	Appraisal Estimate			Actual		
	FX	LC	Total	FX	LC	Total
Part A: Component 1- District Heating System						
Site Preparation	0.00	20.50	20.50	0.00	97.38	97.38
Equipment and Machinery	37.80	2.30	40.10	23.09	2.87	25.96
Civil Works/Installation	0.00	62.50	62.50	0.00	188.23	188.23
Engineering and Design	0.00	2.70	2.70	0.00	6.10	6.10
Licensing	0.00	0.00	0.00	0.00	0.00	0.00
Consultants	0.40	0.00	0.40	0.10	0.00	0.10
Training	0.70	0.00	0.70	0.44	0.00	0.44
Project Management	0.00	2.00	2.00	0.00	6.06	6.06
Base Cost	38.90	90.00	128.90	23.63	300.64	324.27
Physical Contingency	3.90	9.00	12.90	0.00	0.00	0.00
Subtotal	42.80	99.00	141.80	23.63	300.64	324.27
Price Contingency	4.34	26.00	30.34	0.00	0.00	0.00
TA Cost Recovery	0.06	0.00	0.06	0.06	0.00	0.06
IDC	7.80	0.00	7.80	9.83	44.03	53.86
Total	55.00	125.00	180.00	33.52	344.67	378.19
Part A: Component 2- Natural Gas Distribution System						
Site Preparation	0.00	21.40	21.40	0.00	109.29	109.29
Equipment and Machinery	51.90	31.50	83.40	58.92	48.44	107.36
Civil Works/Installation	0.00	48.60	48.60	0.00	122.92	122.92
Engineering and Design	0.00	0.00	0.00	0.00	66.84	66.84
Licensing	0.00	0.00	0.00	0.00	0.59	0.59
Consultants	0.40	0.00	0.40	0.28	2.99	3.27
Training	0.40	0.00	0.40	0.21	1.15	1.36
Project Management	0.00	5.90	5.90	0.00	2.66	2.66
Base Cost	52.70	107.40	160.10	59.41	354.88	414.29
Physical Contingency	5.30	10.70	16.00	0.00	0.00	0.00
Subtotal	58.00	118.10	176.10	59.41	354.88	414.29
Price Contingency	4.43	26.90	31.33	0.00	0.00	0.00
TA Cost Recovery	0.07	0.00	0.07	0.07	0.00	0.07
IDC	7.50	0.00	7.50	6.38	26.49	32.87
Total	70.00	145.00	215.00	65.86	381.37	447.23

FX = foreign currency, IDC = interest during construction, LC = local currency, TA = technical assistance.

Source: Project implementing agencies.

Item	Appraisal Estimate			Actual		
	FX	LC	Total	FX	LC	Total
Part B: Component 3- Pollution Abatement at Drinking Water Reservoirs						
Site Preparation	0.00	0.80	0.80	0.00	3.45	3.45
Equipment and Machinery	3.80	6.30	10.10	7.34	10.27	17.61
Civil Works/Installation	0.00	0.60	0.60	0.00	1.15	1.15
Engineering and Design	0.00	0.20	0.20	0.00	0.57	0.57
Licensing	0.00	0.00	0.00	0.00	0.00	0.00
Consultants	0.00	0.00	0.00	0.00	0.00	0.00
Training	0.30	0.00	0.30	0.39	0.00	0.39
Project Management	0.00	0.60	0.60	0.00	0.92	0.92
Base Cost	4.10	8.50	12.60	7.73	16.36	24.09
Physical Contingency	0.40	0.90	1.30	0.00	0.00	0.00
Subtotal	4.50	9.40	13.90	7.73	16.36	24.09
Price Contingency	0.36	1.60	1.96	0.00	0.00	0.00
TA Cost Recovery	0.04	0.00	0.04	0.04	0.00	0.04
IDC	1.10	0.00	1.10	1.42	0.00	1.42
Total	6.00	11.00	17.00	9.19	16.36	25.55
Part C: Component 4- Relocation and Renovation of a Chemical Plant						
Site Preparation	0.00	0.60	0.60	0.00	0.00	0.00
Equipment and Machinery	9.10	5.10	14.20	0.00	0.00	0.00
Civil Works/Installation	0.00	3.40	3.40	0.00	0.00	0.00
Engineering and Design	0.00	0.10	0.10	0.00	0.00	0.00
Licensing	2.90	0.00	2.90	0.00	0.00	0.00
Consultants	0.80	0.00	0.80	0.23	0.00	0.23
Training	0.40	0.00	0.40	0.03	0.00	0.03
Project Management	0.00	0.30	0.30	0.00	1.20	1.20
Base Cost	13.20	9.50	22.70	0.26	1.20	1.46
Physical Contingency	1.30	1.00	2.30	0.00	0.00	0.00
Subtotal	14.50	10.50	25.00	0.26	1.20	1.46
Price Contingency	0.73	1.70	2.43	0.00	0.00	0.00
TA Cost Recovery	0.07	0.00	0.07	0.07	0.00	0.07
IDC	1.70	1.80	3.50	0.73	0.00	0.73
Total	17.00	14.00	31.00	1.06	1.20	2.26

FX = foreign currency, IDC = interest during construction, LC = local currency, TA = technical assistance.

Source: Project implementing agencies.

Item	Appraisal Estimate			Actual		
	FX	LC	Total	FX	LC	Total
Part C: Component 5- Treatment and Disposal						
Industrial Hazardous Waste						
Site Preparation	0.00	0.30	0.30	0.00	0.00	0.00
Equipment and Machinery	4.70	3.80	8.50	0.00	0.00	0.00
Civil Works/Installation	0.00	0.40	0.40	0.00	0.00	0.00
Engineering and Design	0.00	0.00	0.00	0.00	0.00	0.00
Licensing	0.00	0.00	0.00	0.00	0.00	0.00
Consultants	0.20	0.00	0.20	0.00	0.00	0.00
Training	0.10	0.00	0.10	0.00	0.00	0.00
Project Management	-	0.10	0.10	0.00	0.00	0.00
Base Cost	5.00	4.60	9.60	0.00	0.00	0.00
Physical Contingency	0.50	0.50	1.00	0.00	0.00	0.00
Subtotal	5.50	5.10	10.60	0.00	0.00	0.00
Price Contingency	0.36	0.90	1.26	0.00	0.00	0.00
TA Cost Recovery	0.04	0.00	0.04	0.04	0.00	0.04
IDC	1.10	0.00	1.10	0.18	0.00	0.18
Total	7.00	6.00	13.00	0.22	0.00	0.22
Part D: Component 6- Capacity Building of						
Environmental Agencies						
Site Preparation	0.00	0.00	0.00	0.00	0.00	0.00
Equipment and Machinery	1.60	0.80	2.40	2.21	0.65	2.86
Civil Works/Installation	0.00	0.00	0.00	0.00	0.00	0.00
Engineering and Design	0.00	0.00	0.00	0.00	0.00	0.00
Licensing	0.00	0.00	0.00	0.00	0.00	0.00
Consultants	0.00	0.00	0.00	0.00	0.60	0.60
Training	0.00	0.00	0.00	0.00	0.00	0.00
Project Management	0.00	0.00	0.00	0.00	0.00	0.00
Base Cost	1.60	0.80	2.40	2.21	1.25	3.46
Physical Contingency	0.20	0.10	0.30	0.00	0.00	0.00
Subtotal	1.80	0.90	2.70	2.21	1.25	3.46
Price Contingency	0.06	0.10	0.16	0.00	0.00	0.00
TA Cost Recovery	0.04	0.00	0.04	0.04	0.00	0.04
IDC	0.10	0.00	0.10	0.60	0.00	0.60
Total	2.00	1.00	3.00	2.85	1.25	4.10
Grand Total	157.00	302.00	459.00	112.70	744.85	857.55

FX = foreign currency, IDC = interest during construction, LC = local currency, TA = technical assistance.

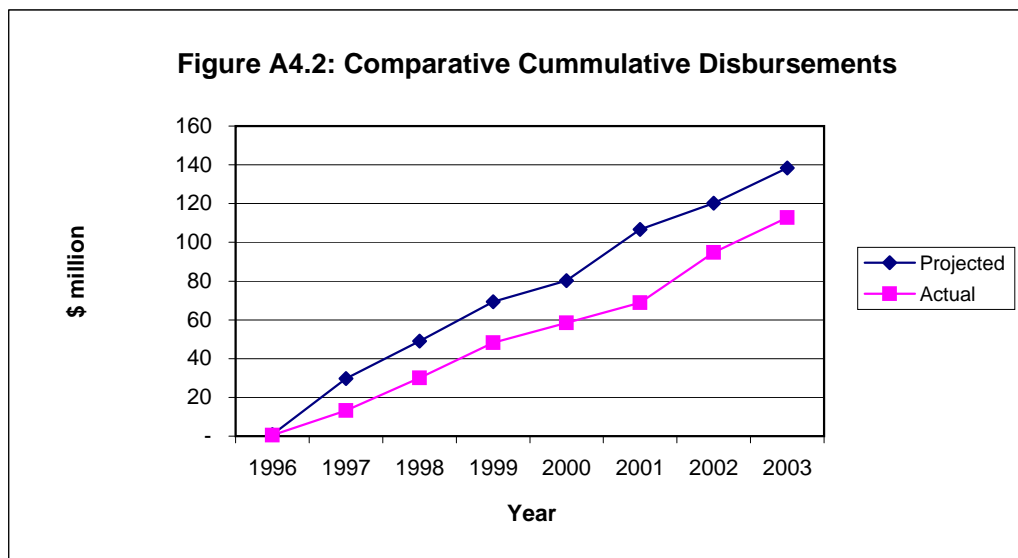
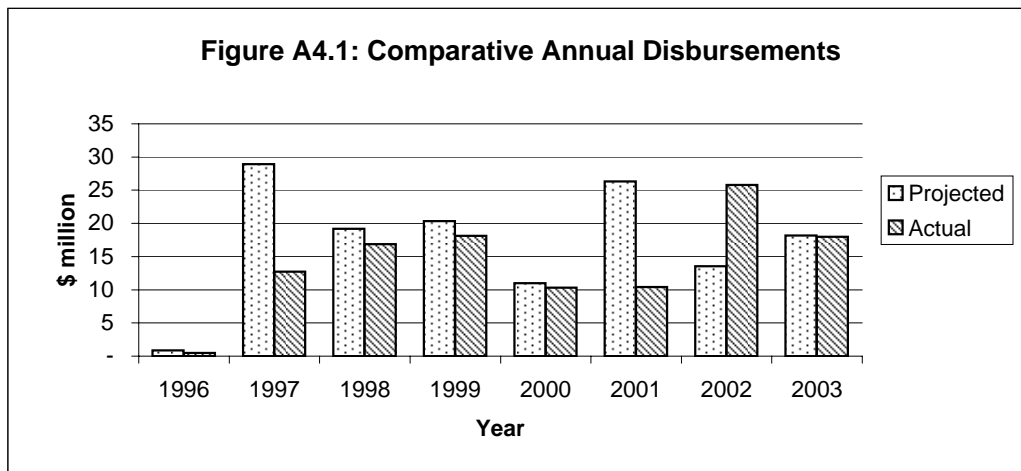
Source: Project implementing agencies.

PROJECTED AND ACTUAL DISBURSEMENTS
1996–2003
(\$ million)

Year	For the Year		Cumulative		% of Loan
	Projected	Actual	Projected	Actual	
1996	0.88	0.48	0.88	0.48	0
1997	28.91	12.74	29.79	13.22	12
1998	19.20	16.85	49.00	30.07	27
1999	20.35	18.11	69.35	48.18	43
2000	10.97	10.33	80.32	58.51	52
2001	26.31	10.42	106.63	68.93	61
2002	13.56	25.78	120.19	94.71	84
2003	18.16	17.99	138.35	112.70	100
Total	138.35	112.70			

Note: Projections were adjusted to exclude cancelled components 4 and 5 and include actual interest during construction.

Source: Project loan records.



PROJECT IMPLEMENTATION SCHEDULE
PART A: COMPONENT 1- DISTRICT HEATING SYSTEM

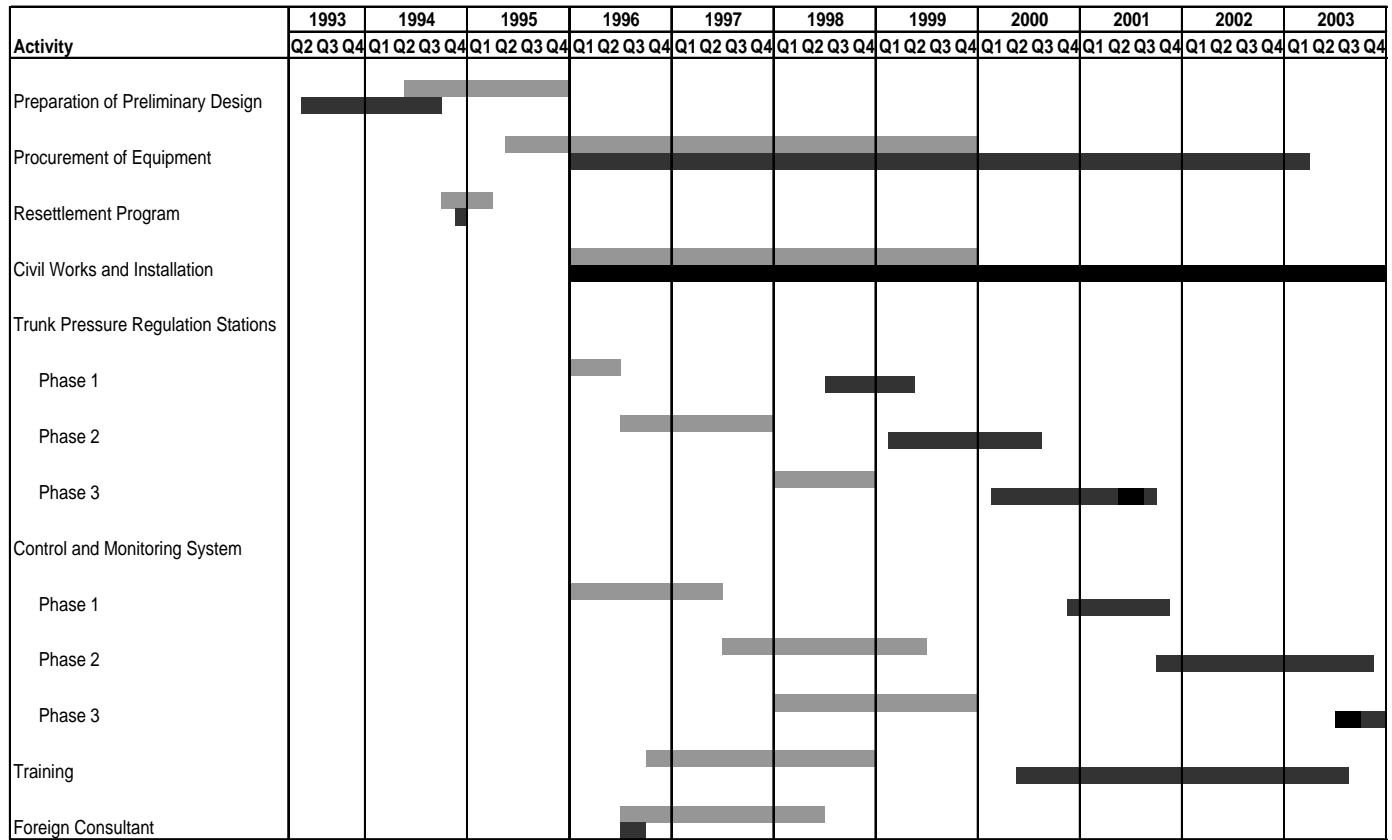
Activity	1994				1995				1996				1997				1998				1999				2000				2001				2002							
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
Preparation of Preliminary Design																																								
Consulting																																								
Review Bid Document/Bidding Evaluation																																								
Negotiation/Contract																																								
Delivery of Equipment 1																																								
Delivery of Equipment 2																																								
Detailed Design																																								
Resettlement Program																																								
Civil Works																																								
Hot Water Line																																								
North Transmission Line 1																																								
North Transmission Line 2																																								
South Transmission Line 1																																								
South Transmission Line 2																																								
Steam Line 2																																								
Installation																																								
Commission Operation																																								
Training																																								

Q = quarter.

Source: Project implementing agency.

Planned
 Actual

PART A: COMPONENT 2 - NATURAL GAS DISTRIBUTION SYSTEM



Q = quarter.

Note: Construction, installation and commissioning activities were completed in 2003. Work done in 2004 was limited to testing and correction of the control and monitoring system.

Source: Project implementing agency.

 Planned

 Actual

PART B: COMPONENT 3 - POLLUTION ABATEMENT AT DRINKING WATER RESERVOIRS

Activity	1994				1995				1996				1997				1998				1999				2000				2001				2002				2003			
	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	Q1	Q2	Q3	Q4				
Design																																								
Research																																								
Engineering Measure																																								
Vegetative Measure																																								
Bid Documents																																								
Bid Evaluation, Approval and Contracting																																								
Equipment Manufacture																																								
Equipment Arrival																																								

Q= quarter.

Source: Project implementing agency.



PART D: COMPONENT 6 - CAPACITY BUILDING OF ENVIRONMENTAL AGENCIES

Activity	1994				1995				1996				1997				1998				1999				2000							
	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				
Domestic Training																																
Overseas Training																																
Bids, Purchases of Equipment																																
Overseas Inspection																																
Installation and Testing of Equipment																																
Study of Organization																																

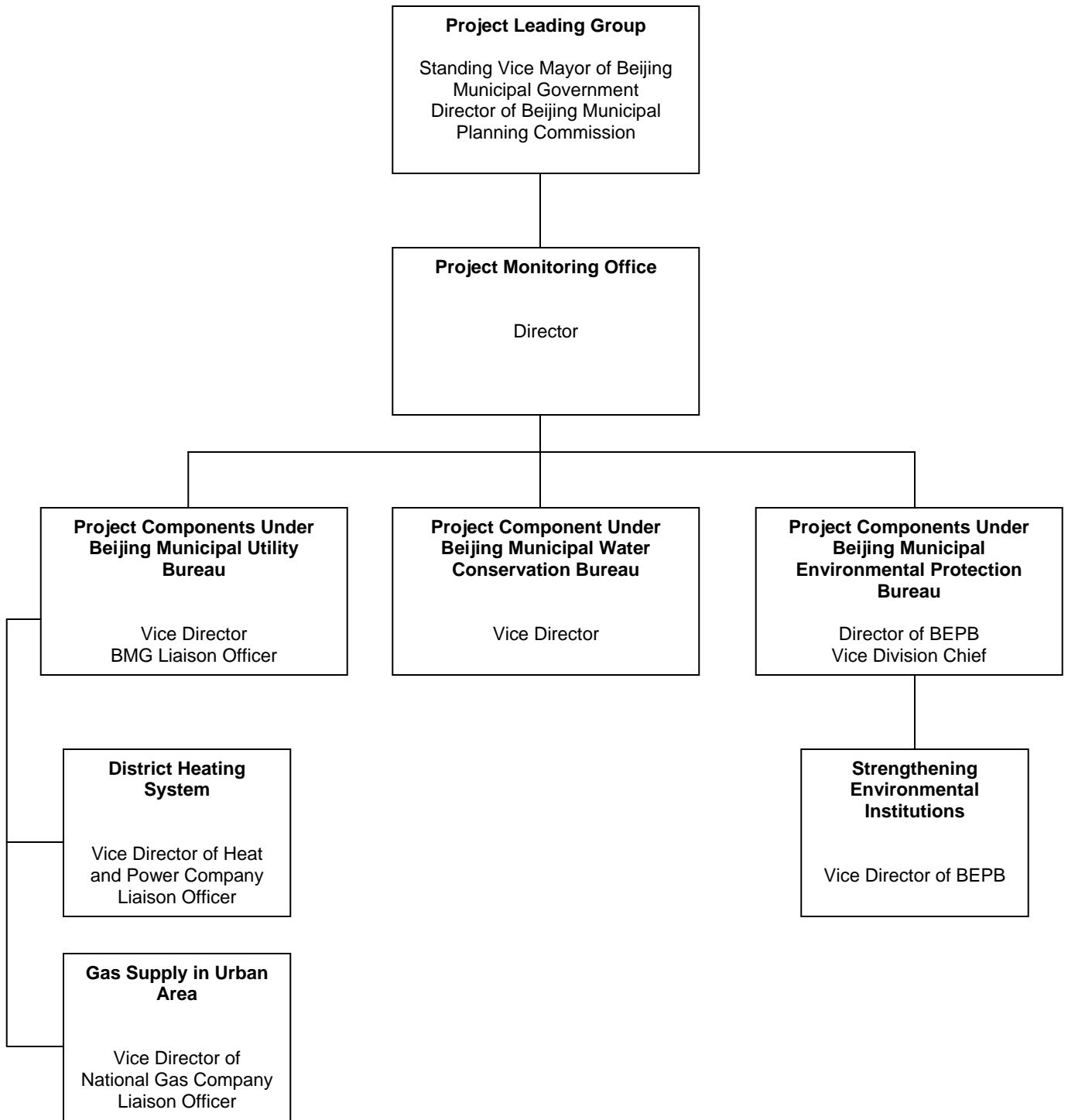
Q = quarter.

Source: Project implementing agency.

 Planned

 Actual

ORGANIZATION CHART OF THE PROJECT MONITORING OFFICE



BMG = Beijing Municipal Government, BEPB = Beijing Environmental Protection Bureau.
Source: Project monitoring office.

STATUS OF COMPLIANCE WITH LOAN COVENANTS

Covenant	Reference in Loan Agreement	Status of Compliance
Execution of the Project		
1. BMG shall be the Executing Agency for the entire Project and shall implement component 3 through BWCB and component 6 through BEPB. BMG shall bear overall responsibility for project implementation by BDHC for component 1, by BNGC for component 2, by BCW3 for component 4, and by BIHWMC for component 5.	LA, Schedule 6, para. 1	Complied with.
2. BMG shall supervise the Project through a project leading group under the direct supervision of it's the standing vice mayor. BMG shall coordinate project implementation through a project office consisting of representatives of the PIAs. The project office shall also provide liaison among ADB, BMG, the Borrower, and PIAs.	LA, Schedule 6, para. 2	Complied with.
3. Each PIA shall be responsible for the financial, technical, and administrative control and execution of its part of the Project.	LA, Schedule 6, para. 3	Complied with.
Environmental Protection		
4. The Borrower shall cause		
(i) BMG and each PIA to design, construct, operate, and maintain their respective project components in accordance with (a) the relevant provisions of the environmental impact assessment approved by the Borrower's National Environmental Protection Agency, (b) the Borrower's environmental protection standards for waste disposal, and (c) the agreed upon environmental management plan, which identifies the required technical and managerial staff resources; required monitoring parameters for air quality, water quality, and solid waste and noise frequencies; and required organizational structures for environmental management and monitoring;	LA, Schedule 6, para. 4(a)	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
(ii) BMG and each PIA to implement, operate, and maintain the Project facilities for which each is responsible in strict conformity with the Environmental Protection Law of 1989 and with all other applicable national and local environmental protection regulations and standards concerning the control of emissions and effluents;	LA, Schedule 6, para. 4(b)	Complied with.
(iii) BMG and each PIA to (a) place the highest priority upon proper operation and adequate maintenance of the pollution control and monitoring equipment included in their respective components of the Project; (b) ensure that the environmental standards to be met by the Project facilities, as initially designed, are in fact maintained and enforced at all times throughout the life of such facilities and throughout the life of the Project's facilities; (c) monitor carefully and continuously the efficacy of the pollution control equipment; and (d) make, from time to time, promptly as needed, all necessary repairs and renewals thereof;	LA, Schedule 6, para. 4(c)	Complied with.
(iv) BMG and each PIA to design and install the Project's facilities under their responsibility, in accordance with national standards, including the provision of adequate and appropriate protection of said facilities;	LA, Schedule 6, para. 4(d)	Complied with.
(v) BMG and each PIA to (a) review the adequacy of their pollution monitoring programs with ADB, as and when required, and undertake such actions as may be necessary, including the installation of new facilities to reduce the levels of all pollutants, to ensure continuous compliance with all applicable emission standards and (b) include within the quarterly reports required under Section 2.8(b) of the PA a report on the status of compliance with the undertakings set out in this subparagraph;	LA, Schedule 6, para. 4(e)	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
(vi) BCW3, after the commissioning of project facilities for the units producing PE and TMP, to dismantle and dispose of the existing facilities producing PE and TMP, including equipment, processes, and machinery from such existing facilities, so that each item within such facilities contaminated with toxic and hazardous chemicals is properly cleaned, detoxified, or neutralized, and in no event shall the equipment, processes, or machinery from the existing facilities of BCW3 be installed for use within 100 kilometers of Beijing.	LA, Schedule 6, para. 4(f)	Not applicable. Component cancelled in 2000.
5. BMG and each PIA shall at all times operate the Project's facilities under their responsibility in accordance with all applicable safety standards, and each PIA shall establish procedures for training its employees during the operation stage in safe work and maintenance practices and in handling emergency situations, by means of periodic fire and other drills.	LA, Schedule 6, para. 5	Complied with.
6. BMG, the Borrower, and each PIA shall (i) implement the levy system provided under the Environmental Protection Law of 1989, on the basis of the polluter pays principle; (ii) implement measures for the prompt collection of amounts levied against any major polluter in Beijing; and (iii) provide to ADB, on an annual basis, a statement of levies imposed and collected during the preceding year, in a format agreed with ADB.	LA, Schedule 6, para. 6	Complied with.
7. Prior to the commissioning of its project facilities, BCW3 shall enter into an agreement with Beijing Dyestuffs Plant or any other entity accepting wastewater from BCW3 to ensure that wastewater from the PE and TMP units under the Project is disposed of upon terms and conditions satisfactory to ADB and that the sludge from such project facilities is disposed of in conformity with the Borrower's environmental standards and regulations.	LA, Schedule 6, para. 7	Not applicable. Component cancelled in 2000.

Covenant	Reference in Loan Agreement	Status of Compliance
8. Each year during project implementation, the Borrower shall cause each PIA to furnish ADB a report on the monitoring of environmental aspects of the Project's facilities.	LA, Schedule 6, para. 8	Complied with.
9. The Borrower shall cause BMG and the PIAs to satisfy national and local emission standards concerning emission levels of sulfur dioxide, in accordance with Beijing's Environmental Plan for the Year 2000.	LA, Schedule 6, para. 9	Complied with.
Resettlement Plan		
10. The Borrower shall ensure that BMG and the PIAs carry out the agreed upon resettlement plan, including acquisition, compensation, and rehabilitation by		
(i) taking or causing to be taken all necessary measures to ensure that all people adversely affected by the carrying out of the Project shall (a) improve or at least regain their prior standard of living; (b) be relocated, if necessary, in accordance with plans acceptable to ADB, and be fully integrated into the community in which they move; and (c) be provided with appropriate compensation and adequate social and physical community facilities and services, all in accordance with the resettlement plan;	LA, Schedule 6, para. 10(a)	Complied with.
(ii) providing, if necessary, people adversely affected by any component with training for employment near the agreed upon resettlement sites;	LA, Schedule 6, para. 10(b)	Complied with.
(iii) taking or causing to be taken all necessary measures to ensure that the planning and implementation of the resettlement and rehabilitation activities under the resettlement plan for such adversely affected people are carried out in a timely and efficient manner, and, in any case,		

Covenant	Reference in Loan Agreement	Status of Compliance
sufficiently in advance of the implementation of construction and other activities under the Project that result in the resettlement of such people;	LA, Schedule 6, para. 10(c)	Complied with.
(iv) causing BMG and each PIA to include within the quarterly reports required under Section 2.08(b) of the project agreement a report concerning the implementation of the resettlement plan, including problems encountered and proposed corrective actions to be taken.	LA, Schedule 6, para. 10(d)	Partly complied with.
Policy Reforms		
11. The Borrower shall take all necessary measures to ensure that		
(i) the price of coal in Beijing for domestic households, commercial establishments, and industrial enterprises, which has been market-determined since 1 January 1994, continues to be market-determined;	LA, Schedule 6, para. 11(i)	Complied with.
(ii) the Borrower shall take all necessary measures to ensure that BMG allows (a) the price to consumers in Beijing of LPG to increase gradually from the current level of about CNY0.70 per cubic meter to CNY2.00 per cubic meter in 1998 and (b) the price to consumers in Beijing of natural gas to increase gradually from the current average price of CNY0.80 per cubic meter to at least CNY1.70 per cubic meter in 1998;	LA, Schedule 6, para. 11(ii)	Complied with. The LPG price is now liberalized. The price of natural gas per cubic meter increased in March 2003: for commercial users, from CNY1.70 to CNY1.90 and for domestic users, from CNY2.20 to CNY2.40. the price for industrial users was retained at CNY1.80.
(iii) the Borrower shall take all necessary measures to ensure that after 3 December 1997 BMG provides no subsidy to BCW3, BDHC, BIHWMC, and BNGC or;	LA, Schedule 6, para. 11(iii)	Partly complied with. Not applicable for BCW3 and BIHWMC. Subsidy for BNGC stopped in 2001. Subsidy for BDHC continues.

Covenant	Reference in Loan Agreement	Status of Compliance
(iv) the Borrower shall take all necessary measures to ensure that BCW3, BDHC, BIHWMC, BNGC and implement the regulations on transforming the management of state-owned industrial enterprises issues by the Borrower in July 1992;	LA, Schedule 6, para. 11(iv)	Complied with. Not applicable for BCW3 and BIHWMC.
(v) the Borrower shall take all necessary measures to ensure that BMG allows BCW3, BDHC, BIHWMC, and BNGC to set prices for their respective goods and services at levels that allow full recovery of operating and capital costs, including depreciation, and provide an adequate return on investments;	LA, Schedule 6, para. 11(v)	Complied with, except for BDHC. Not applicable for BCW3 and BIHWMC.
(vi) BMG shall, in consultation with ADB, revise every 2 years the tariff structure applicable, to ensure that BWCB's income is sufficient to pay for operational expenses and satisfy fully debt service requirements;	LA, Schedule 6, para. 11(vi)	Complied with.
(vii) BMG introduces measures to collect promptly amounts levied against major polluters in Beijing under the Environmental Protection Law of 1989 and provides ADB, under Section 2.08(b) of the project agreement, with a statement on an annual basis of levies imposed and collected in the preceding year.	LA, Schedule 6, para. 11(vii)	Complied with.
Financial		
12. BMG shall ensure that commencing in 1995 BCW3, BDHC, and BNGC shall maintain at all times (i) a debt service ratio of not less than 1.3:1 and (ii) a debt-equity ratio of not higher than 70:30, and the same will be ensured for BIHWMC, commencing in 2001.	PA, Section 2.17	Complied with.
13. BMG shall ensure that BDHC and BNGC achieve by FY1998 positive earnings and return on equity of 6% by FY2000 and 10% by FY2004 and thereafter.	PA, Section 2.18	Not complied with by BDHC. Partly complied with by BNGC.

Covenant	Reference in Loan Agreement	Status of Compliance
Reports		
14. BMG shall carry out or cause each PIA to carry out the Project with due diligence and efficiency and in conformity with sound administrative, financial, engineering, environmental, and public utility processes.	PA, Section 2.01(a)	Complied with.
15. BMG shall furnish and cause each PIA to furnish to ADB quarterly reports on the execution of the Project and on the operation and management of the Project's facilities.	PA, Section 2.08(b)	Complied with.
16. Promptly after physical completion of the Project, but in any event not later than 3 months thereafter or such later date as ADB may agree for this purpose, BMG shall prepare and furnish to ADB a report on the execution and initial operation of the Project, including cost, performance of BMG's and each PIA's obligations under the project agreement, and accomplishment of the purposes of the loan.	PA, Section 2.08(c)	Complied with.
Accounts		
17. BMG shall (i) maintain separate accounts for the Project; (ii) cause each PIA to maintain separate accounts for the Project and for their respective overall operations; (iii) have or cause each PIA to have such accounts and related financial statements (balance sheet for each PIA but not for BMG, statement of income and expenses, and other 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 (iv) furnish or cause each PIA to furnish to ADB, promptly after their preparation but in any event not later than 6 months after the close of the fiscal year to which they relate, certified copies of such audited accounts and financial statements and the report of the auditors relating thereto (including the auditors' opinion on the use of loan proceeds and compliance with the covenants of the LA, all in the English language).	PA, Section 2.09 (a)	Complied with, except for the submission of audited financial statements by BNGC.

Covenant	Reference in Loan Agreement	Status of Compliance
Training		
18. The Borrower shall cause BMG to ensure that each PIA submits to ADB, for prior approval not later than 2 months after all procurement contracts with supplier have been awarded for its part of the Project, comprehensive in-country and international training programs proposed to be implemented under the Project.	LA, Schedule 2, para. 12	Complied with.
19. The Borrower shall ensure that BMG causes each PIA to provide to ADB, on an annual basis, a benefit monitoring and evaluation report for the first 5 years after the first month in which full production capacity is reached under its part of the Project.	LA, Schedule 6, Para. 13(a)	Complied with.

ADB = Asian Development Bank, BCW3 = Beijing Chemical Works No.3, BDHC = Beijing District Heating Company, BEPB = Beijing Environmental Protection Bureau, BIHWMC = Beijing Industrial Hazardous Waste Management Center, BMG = Beijing municipal government, BNGC = Beijing Natural Gas Company, BWCB = Beijing Water Conservation Bureau, FY = fiscal year, LA = loan agreement, LPG = liquefied petroleum gas, PA = project agreement, PE = pentaerythritol, PIA = project implementing agency, TMP = trimethylolpropane.

TECHNICAL ASSISTANCE COMPLETION REPORT

Division: ECEN

TA No. and Name TA 2210- PRC: Capacity Building of the Beijing Municipal Environmental Protection Bureau and Affiliated Agencies			Amount Approved: \$600,000		
			Revised Amount: \$600,000		
Executing Agency / Implementing Agency Beijing Municipal Government / Beijing Environmental Protection Bureau		Source of Funding Japan Special Fund	TA Amount Undisbursed: \$2,944	TA Amount Utilized: \$597,056	
Date			Completion Date		
Approval 29 Nov 1994	Signing 10 Oct 1995	Fielding of Consultants 8 Jan 1996	Original 8 Jan 1997	Actual 31 Mar 1997	
			Closing Date		
			Original 31 Aug 1997	Actual 31 Jul 1998	
Description					
<p>The severe air and water pollution in Beijing required measures to address the residents' basic need for clean air and water. To determine appropriate actions for improvement of environmental conditions, the municipal government aimed to fully evaluate the capability of environmental institutions along with existing environmental policy and legislation. The TA was piggybacked to Loan 1336- PRC: Beijing Environmental Improvement Project¹ (the Project), and was intended to complement Component 6 (Capacity Building of Beijing Environmental Protection Bureau [BEPB] and its three affiliated agencies, namely, Beijing Research Institute of Environmental Protection, Beijing Environmental Monitoring Center, and Beijing Technical Training Center for Environmental Protection).</p>					
Objectives and Scope					
<p>The objective of the TA was to help strengthen the institutional capacity of BEPB and its three affiliated agencies. Experts financed under the TA were to help improve organizational arrangements, establish an effective management information system (MIS), develop environmental planning guidelines, and address the short and long-term training and personnel needs. It also included institutional strengthening study; assessment of required laboratory, monitoring and training equipment; and domestic and overseas training for staff.</p>					
Evaluation of Inputs					
<p>An international consulting firm (consultant) was engaged to provide the consulting services. Eleven person-months of international, and 6 person-months of domestic consulting services were provided. The consulting team included specialists on institutional analysis, environmental MIS, air quality, water quality and solid waste. The international and domestic experts were qualified to undertake the TA and were selected consistent with the ADB guidelines. The consulting services inputs were adequate to achieve the TA objectives and the tasks outlined in the terms of reference (TOR). Performance of the consultant was fully satisfactory² and the TA implementation was strongly supported by BEPB. BEPB provided office, communication, and transportation facilities, and assigned counterpart staff, who were fully involved in the Project. Its performance, as the implementing agency was also satisfactory. ADB provided supervision through regular correspondence and review missions and its performance is considered satisfactory.</p>					
Evaluation of Outputs					
<p>The TA final report was submitted in March 1997 and fully addressed the TOR. During the study period, the required institutional analysis was conducted and domestic and overseas training were organized. The review phase of the TA provided an evaluation of the organizational practice and performance, environmental MIS, and environmental quality and policies.</p>					

¹ A Project Completion Report (PCR) is concurrently being prepared, and this TA Completion Report is being prepared to coincide with the PCR.

² Performance Evaluation Report, 12 May 1997.

The training comprised overseas visits for an overview of regulatory framework and implementation; and technical and operational environmental management. On-the-job training was also provided for appreciation of day-to-day working environment.

Based on the comprehensive appraisal of institutional capacity, environmental policies, and legislation, the consultant provided appropriate recommendations on pollution control, environmental management and monitoring/data collection, creation of an environmental MIS, improvement of organizational structure, and management capacity building. Most of the recommendations were adopted and implemented by BPEB and its agencies.

Various equipment for the three BEPB affiliated agencies were procured consistent with the TA recommendation. The cooperation between BEPB, ADB, the project monitoring office, procurement agent, suppliers and related agencies provided for a smooth procurement process. All equipment recommended under the TA were purchased under the Loan. These are currently operational and are being fully utilized by the recipient agencies. To further enhance their air pollution monitoring capability, BEPB requested reallocation of loan amount for Component 6 to procure additional instruments for the automatic air quality monitoring system.

Overall Assessment and Rating

The TA carried out a thorough and satisfactory analysis of BEPB's environmental management practices. Relevant recommendations were made for strengthening its capability on environmental monitoring, laboratory testing, MIS, and improvement of organizational structure. The environmental action plan has been effective in improving pollution control and environmental management as evidenced by the steady improvement in Beijing's air and water quality and enhanced public awareness on environmental issues. These are largely attributed to improvement in organizational set-up, well-trained staff in environmental management and monitoring, and availability of updated equipment for monitoring, laboratory, and training purposes. The TA is rated successful.

Major Lessons Learned

The success of the TA was largely due to the formulation of a sound TOR that comprehensively addressed various aspects of the environmental management structure of BEPB and its affiliated agencies, fielding of highly qualified consultants, and strong collaboration between BEPB and ADB. The approach and recommendations in the TA may be useful in the enhancement of environmental protection in other provinces in PRC as well as in other DMCs.

Recommendations and Follow-Up Actions

No further action required.

Prepared by Merlita Pajarillo

Designation Energy Specialist (Finance)

TECHNICAL ASSISTANCE COMPLETION REPORT

Division: ECEN

TA No. and Name TA 2211- PRC: Capacity Building of the Beijing Industrial Hazardous Waste Management Center			Amount Approved: \$425,000		
			Revised Amount: \$425,000		
Executing Agency/Implementing Agency Beijing Municipal Government/Beijing Industrial Hazardous Waste Management Center		Source of Funding Japan Special Fund	TA Amount Undisbursed: \$8,412	TA Amount Utilized: \$416,588	
Date			Completion Date		
Approval 29 Nov 1994	Signing 10 Oct 1995	Fielding of Consultants 22 Jan 1996	Original 30 Jun 1996	Actual 24 Jan 1997	
			Closing Date		
			Original 30 Oct 1996	Actual 30 Jun 1998	
Description					
<p>The collection, transport, storage, treatment and disposal of toxic and hazardous wastes were especially sensitive operations near Beijing, where the population density along the transport corridor was high, but it was difficult to dedicate large tracts of land necessary for a buffer zone. Thus, the skills and practical experience regarding toxic and hazardous waste management would be critical to preventing accidents and contamination of ground water resources. The TA was piggybacked to Loan 1336- PRC: Beijing Environmental Improvement Project¹ (the Project), specifically for Component 5 (Treatment and Disposal of Hazardous Wastes), which would help provide facilities for the treatment and disposal of industrial hazardous wastes. The planned facility would have been the first in the People's Republic of China (PRC), and personnel training was an essential component of the Project. As practical training could not be offered in the PRC, overseas training was required.</p>					
Objectives and Scope					
<p>The objective of the TA was to assist Beijing Industrial Hazardous Waste Management Center (BIHWMC), build its capacity to construct and operate centralized facilities for incineration, treatment, and disposal of accumulated hazardous wastes in the municipality. The TA specifically aimed to improve BIHWMC's organizational arrangements, establish an effective management information system (MIS), develop an environmental plan, and address short and long-term training and personnel needs.</p>					
Evaluation of Inputs					
<p>Consulting services were provided by an international consulting firm (consultant) and consisted of 7 person-months. The team comprised: an environment specialist for institutional development; hazardous waste treatment and disposal (incineration) expert; hazardous waste disposal (landfill) expert; and a hazardous waste MIS specialist. The consultant has an organization and management development background as well as expertise in technical specialization relevant to the industrial hazardous waste management. The consultant provided the necessary inputs as required in the terms of reference (TOR). The TA commenced in January 1996 and training was completed in September 1996, three months beyond the target completion date, due to rescheduling of the overseas training as requested by BIHWMC. BIHWMC was satisfied with the performance of the consultant and provided office, communication, and transportation facilities, and assigned counterpart staff, who were fully involved in the Project. Required data were made available to the consultant although there were some delays due to translation. The inputs from both the consultant,² and BIHWMC as the implementing agency, were satisfactory. ADB provided supervision through regular correspondence and review missions and its performance is considered satisfactory.</p>					

¹ A Project Completion Report (PCR) is concurrently being prepared, and this TA Completion Report is being prepared to coincide with the timing of the PCR.

² Performance Evaluation Report, 28 February 1997.

Evaluation of Outputs

The final report was submitted in January 1997. The TA provided a thorough assessment of the current institutional, organizational, management and technical operations of the BIHWMC and recommended approaches and implementation plans that strengthened BIHWMC's capacity to provide efficient, effective, and environmentally sound management of the industrial hazardous wastes generated in Beijing. The TA reviewed the adequacy of existing treatment, storage and disposal facilities, and suggested improvements of storage, incineration and landfill facilities. Recommendations were also made on further enhancement of waste reduction, reuse and exchange already being practiced by industries. Determination of data reporting and monitoring requirements as well as software development for the MIS was provided. BIHWMC representatives participated in overseas training to develop their technical and managerial skills for conducting effective hazardous waste management and monitoring. The TA also identified long-term staffing and training needs.

Further, the TA consultant reviewed a donor-funded feasibility study (FS) of an incinerator that was included as Component 5 in the Project. Significant changes were suggested to reduce capital and operating costs for the incinerator and to improve its performance and reliability. However, the TA's proposal for government subsidy for waste treatment was not supported by the Beijing Municipal Government as it was against the "polluter pays" principle, and ADB loan condition required that the BIHWMC should recover full operating and capital costs, including depreciation. The high operating costs, along with the lack of local laws and regulations for pollution limits, and associated fees and fines, made the proposed incinerator unviable at that time. It was subsequently agreed that BIHWMC would pursue a market-driven plan to establish the treatment facilities, and undertake the interim measures recommended in the TA. Later, BIHWMC commissioned another FS for an alternate facility, a geological investigation for a landfill site, and the related environmental impact assessment. However, it did not submit a formal proposal to ADB for inclusion of the alternate facilities in the Project, and Component 5 was cancelled in 2000. Although it was a relatively small part of the consultant's TOR, the review of the FS led to a substantial change in Project design.

Overall Assessment and Rating

The TA successfully achieved its objectives to formulate specific actions for institutional strengthening and to provide appropriate training to BIHWMC staff. With regards to the hazardous waste treatment facility included in the Project (Component 5), the consultant's review led to its cancellation. The decision was justified as the services would have been unaffordable for the local industry. Presently, partial disposal of industrial hazardous wastes is carried out through a cement kiln (alternate recommended under the TA) and several existing incinerators. The capacity building inputs have, therefore, been utilized effectively by BIHWMC. The consultant's TOR was fulfilled. The major recommendations under the TA were implemented and the TA is rated as successful.

Major Lessons Learned (if any)

For project components that are based on FS conducted by other institutions, ADB should require mandatory review prior to inclusion in the ensuing Project loan. This would have brought out critical issues of Component 5 at the outset, and improved project design.

Recommendations and Follow-Up Actions

No further action required.

Prepared by Merlita Pajarillo

Designation Energy Specialist (Finance)

SUMMARY OF CONTRACT PACKAGES

PCSS No.	Item	\$ Equivalent	Mode of Procurement	Country of Origin	Date of Approval	Date of Contract
Part A: Component 1: District Heating System						
0009	Steel pipes	5,307,857	ICB	PRC	10-Feb-97	26-Feb-07
0011	Expansion joints	476,990	IS	PRC	28-May-97	19-Mar-97
0012	Valves	543,570	IS	GER	18-Feb-97	11-Apr-97
0014	Channels, ribbed bars and steel strips	2,189,060	ICB	PRC	20-Jun-97	01-Aug-97
0015	Expansion joints	1,467,405	ICB	PRC	24-Jul-97	01-Aug-97
0021	Steel pipes	3,318,678	ICB	PRC	26-Sep-97	10-Oct-97
0033	Valves	995,895	ICB	FIN	20-Oct-98	16-Nov-98
0037	Expansion joints	795,568	ICB	PRC	21-Jan-99	08-Feb-99
0038	Steel pipes	3,875,604	ICB	USA	29-Jan-99	10-Feb-00
0039	Steel pipes	942,113	ICB	PRC	18-Jan-99	10-Feb-00
0043	Consulting services for project implementation	98,000	DP	DEN	11-Aug-99	16-Nov-99
0045	Overseas study tour/training	66,000	DP	HKG	20-May-00	02-May-02
0046	Expansion joints	417,788	ICB	PRC	10-Aug-00	08-Sep-00
0047	Channels and ribbed bars	372,590	ICB	PRC	02-Aug-00	08-Sep-00
0051	Overseas training	112,308	DP	HKG	02-Jul-01	03-Jul-01
0052	Field instruments	528,029	ICB	USA	19-Mar-01	06-Jul-01
0053	Control and monitoring system	1,859,490	ICB	PRC	17-Mar-01	25-Jul-01
0060	Overseas training	113,976	DP	HKG	09-Nov-01	20-Aug-01
0076	Overseas training	150,680	DP	PRC	13-Jun-02	24-May-02
	Subtotal	23,631,601				
Part A: Component 2: Natural Gas Distribution System						
0001	Consulting services for spherical gas holder	96,000	O	JPN	27-Feb-96	29-Apr-97
0002	Consulting services for SCADA system	181,169	O	FRA	27-Feb-96	27-Mar-96
0004	Pressure regulators and fittings	498,692	IS	SIN	24-Dec-96	12-Dec-96
0005	Filters	515,000	IS	AUS	24-Dec-96	17-Dec-96
0006	Safety valves	69,667	IS	USA	24-Dec-96	11-Dec-96
0007	Odorant injection systems	118,227	IS	USA	24-Dec-96	11-Dec-96
0016	Analytical instruments	388,735	ICB	USA	25-Jun-97	08-Aug-97
0017	Flow measure equipment	805,558	ICB	USA	25-Jun-97	08-Aug-97
0018	Electrical and manual ball valves	4,340,585	ICB	PRC	28-Jul-97	21-Aug-97
0026	Spherical gas holders	15,324,133	ICB	FRA	04-Sep-97	13-May-98
0029	Electrical ball valves	459,500	IS	USA	04-Nov-98	23-Oct-98
0030	Operation and maintenance equipment for pipelines	486,800	IS	AUS	11-Nov-98	29-Sep-98
0049	Axial type electric pressure control valve	193,930	IS	CAN	29-May-01	05-Feb-01
0050	Natural gas tube renovation equipment	465,000	IS	HKG	29-May-01	02-Feb-01
0054	Gas meters	911,520	ICB	GER	15-Aug-01	30-Aug-01
0055	Regulator and relief valves	3,199,733	ICB	PRC	15-Aug-01	29-Aug-01
0056	Insulating joints and insulating ball valves	682,561	ICB	GER	14-Aug-01	30-Aug-01
0057	Filters	1,706,952	ICB	PRC	15-Aug-01	30-Aug-01
0058	Overseas training	144,948	DP	DP	12-Jul-01	27-Aug-01
0063	Remotely operated natural gas dispatching and distribution network	6,020,334	ICB	HKG	28-Nov-01	08-Dec-01
0064	Analyzers	482,286	ICB	HKG	26-Sep-01	05-Dec-01
0065	Detectors and survey mapping equipment	945,927	ICB	HKG	26-Sep-01	05-Dec-01
0066	Equipment of CNG refueling station	5,610,000	ICB	PRC	09-Nov-01	08-Dec-01
0067	Tapping and plugging equipment	1,002,208	ICB	USA	26-Sep-01	09-Dec-01
0068	Overseas training	69,820	DP	PRC	12-Jul-01	28-Nov-01
0070	Ball valves	4,961,787	ICB	PRC	31-Jan-02	22-Mar-02
0071	Equipment - laboratory of regulator detecting	1,828,587	ICB	SIN	27-Feb-02	22-Apr-02
0072	Tri-generation system of power, heating and cooling	1,815,972	ICB	HKG	27-Feb-01	15-May-02
0074	Daughter station for CNG refueling	3,053,812	ICB	HKG	04-Jan-01	08-Jul-02
0075	Mother station for CNG refueling	3,035,981	ICB	HKG	04-Jan-02	08-Jul-02
	Subtotal	59,415,424				

PCSS No.	Item	\$ Equivalent	Mode of Procurement	Country of Origin	Date of Approval	Date of Contract
Part B: Component 3: Pollution Abatement at Drinking Water Reservoirs						
0008	Monitoring and office equipment	284,354	IS	PRC	03-Feb-97	27-Dec-96
0010	Overseas Training	38,727	DP	PRC	06-Sep-96	01-Mar-97
0013	Overseas Training	35,442	DP	PRC	18-Jun-97	30-May-97
0020	Special monitoring vehicles	411,200	IS	PRC	13-Oct-97	30-Sep-97
0031	Overseas Training	72,000	DP	PRC	13-Nov-98	14-Oct-98
0032	Overseas Training	7,208	DP	PRC	13-Nov-98	14-Oct-98
0040	Overseas study tour	47,038	DP	PRC	25-Jan-99	27-Mar-97
0041	Vehicles	1,164,180	ICB	PRC	01-Mar-99	29-Apr-99
0041	Construction machineries	1,506,165	ICB	PRC	01-Mar-99	29-Apr-99
0048	Overseas Training	43,847	DP	PRC	23-Aug-00	01-Dec-00
0061	Field Instruments	1,450,629	ICB	PRC	05-Aug-01	06-Sep-01
0062	Overseas Training	45,000	DP	PRC	12-Jul-01	27-Aug-01
0069	Overseas Training	103,000	O	INO	09-Dec-99	20-Feb-02
0077	Wastewater Treatment and Reuse Equipment	845,032	ICB	PRC	05-Dec-02	27-Dec-02
0078	Soil and Water Conservation Automatic Monitoring Equipment	1,004,656	ICB	PRC	05-Dec-02	27-Dec-02
0079	Concrete Mixing Truck	675,138	ICB	PRC	05-Dec-01	27-Dec-02
	Subtotal	7,733,616				
Part C: Component 4: Relocation and Renovation of a Chemical Plant						
0003	Consultancy services	234,998	O	USA	17-Mar-00	06-Nov-96
0036	Study tour	26,614	DP	PRC	04-Feb-99	15-Dec-98
	Subtotal	261,612				
Part D: Component 6: Capacity Building of Environmental Agencies						
0019	Audio-video equipment	370,000	IS	HKG	26-Nov-97	11-Jul-97
0022	Inductively coupled plasma emission spectrometer	125,000	IS	USA	06-Nov-97	10-Sep-97
0023	Ultra filtration, reverse osmosis membrane & reverse osmosis pu	70,000	IS	USA	06-Nov-97	08-Oct-97
0024	Environmental monitoring instruments	355,000	IS	HKG	06-Jan-98	06-Nov-97
0025	Analyzing instruments and eqpt for chemical analyzing laboratory	232,000	IS	HKG	02-Mar-98	28-Dec-97
0027	Ion chromatograph	103,000	IS	HKG	16-Jun-98	28-Apr-98
0028	Water treatment experiment equipment and analytic instruments	40,000	IS	USA	17-Jun-98	22-Apr-98
0034	Environmental monitoring instruments	260,000	IS	USA	25-Jan-99	04-Dec-98
0035	Water treatment experiment equipment and analytical instrument:	100,000	IS	HKG	25-Jan-99	23-Dec-98
0044	Instruments and equipment	150,000	IS	USA	03-May-00	15-Jan-00
0073	Ambient environmental and monitoring instrument system	400,000	IS	USA	02-Oct-01	11-Oct-01
		2,205,000				
	Total	93,247,253				

AUS = Australia, CAN = Canada, PRC = People's Republic of China, CNG = compressed natural gas, DEN = Denmark, DP = direct purchase, FIN = Finland, FRA = France, GER = Germany, HKG = Hong Kong, China, INO = Indonesia, ICB = international competitive bidding, IS = international shopping, JPN = Japan, O = Others, SCADA = supervisory control and data acquisition, SIN = Singapore, USA = United States.

Source: Asian Development Bank.

FINANCIAL PERFORMANCE OF PROJECT ENTERPRISES

Table A11.1: Financial Performance of Beijing District Heating Group

(CNY million)

Year Ending December 31	1997	1998	1999	2000	2001	2002	2003
Income Statements							
Sales	594.62	692.91	769.75	904.56	1,048.76	1,213.18	1,334.23
Less: Cost of Sales	557.63	643.14	748.69	976.40	1,130.20	1,250.24	1,377.04
Operating Expenses	63.60	65.44	74.90	73.49	89.45	110.84	114.77
Operating Income	(26.61)	(15.67)	(53.84)	(145.33)	(170.89)	(147.90)	(157.58)
Less: Interest Expense	(9.55)	(5.15)	(1.99)	(1.17)	(4.30)	(3.63)	(5.91)
Nonoperating Income/(Expense)	24.12	11.65	60.37	153.87	178.72	173.27	172.25
Net Income Before Tax	7.05	1.13	8.52	9.71	12.13	29.00	20.58
Net Income After Tax	7.05	1.13	8.52	9.71	12.13	29.00	20.58
Cash Flow Statements							
Net Cash Flow from Operations	113.65	131.91	155.75	229.12	238.92	350.23	378.84
Borrowings	23.09	26.42	166.41	26.01	30.90	94.65	479.94
Equity Contributions	517.04	843.91	951.62	1,213.60	1,276.70	700.20	387.79
Total Sources of Funds	653.78	1,002.24	1,273.78	1,468.73	1,546.52	1,145.08	1,246.57
Capital Expenditures	511.60	994.82	1,164.13	1,422.70	1,303.00	976.30	1,164.59
Debt Service ^a	57.01	0.00	0.00	4.11	62.20	50.15	220.15
Dividends	5.76	0.62	2.07	2.85	2.42	5.52	8.17
Changes in Working Capital/ Others	5.55	145.20	(63.72)	(27.53)	60.30	(152.09)	(314.17)
Total Application of Funds	579.92	1,140.64	1,102.48	1,402.13	1,427.92	879.88	1,078.74
Changes in Cash	73.86	(138.40)	171.30	66.60	118.60	265.20	167.83
Changes in Cash	73.86	(138.40)	171.30	66.60	118.60	265.20	167.86
Cash Balance, Beginning of Year	464.74	538.60	400.20	571.50	638.10	756.70	1,021.90
Cash Balance, End of Year	538.60	400.20	571.50	638.10	756.70	1,021.90	1,189.76
Balance Sheets							
Current Assets	685.90	647.60	757.80	886.30	1,025.20	1,361.00	1,573.26
Cash and Deposits	538.60	400.20	571.50	638.10	756.70	1,021.90	1,189.76
Accounts Receivables	95.40	213.30	166.50	246.20	268.90	359.00	388.32
Inventories	31.70	14.10	16.00	11.90	10.50	7.10	7.21
Other Current Assets	20.20	20.00	3.80	(9.90)	(10.90)	(27.00)	(12.03)
Net Fixed Assets	1,992.60	2,902.30	3,959.70	5,151.50	6,259.00	6,741.90	7,041.10
Plant in Service	2,673.20	3,645.10	4,839.00	6,257.00	7,542.40	8,320.80	8,961.81
Less: Accumulated Depreciation	680.60	742.80	879.30	1,105.50	1,283.40	1,578.90	1,920.71
Construction in Progress	15.86	33.37	6.40	12.40	31.30	230.10	754.11
Intangibles and Deferred Assets	1.69	7.10	4.30	3.00	1.70	0.80	0.37
Other Assets	14.70	20.20	27.70	43.70	51.00	133.50	274.10
Total Assets	2,710.75	3,610.57	4,755.90	6,096.90	7,368.20	8,467.30	9,642.94
Current Liabilities	266.52	295.99	323.30	428.80	452.30	783.20	1,298.85
Accounts Payable	84.08	79.72	95.50	102.60	150.10	175.90	178.91
Short-Term Loans	0.00	60.00	60.00	60.00	50.00	200.00	620.00
Others	182.44	156.27	167.80	266.20	252.20	407.30	499.94
Long-Term Debt ^b	91.97	118.39	284.80	306.70	275.40	319.90	579.69
Equity	2,352.26	3,196.19	4,147.80	5,361.40	6,640.50	7,364.20	7,764.40
Paid in Capital	1,622.65	2,366.40	3,254.40	4,272.20	3,256.10	3,268.60	3,300.70
Surplus, Reserves, and Retained Earnings	729.61	829.79	893.40	1,089.20	3,384.40	4,095.60	4,463.70
Total Liabilities and Equity	2,710.75	3,610.57	4,755.90	6,096.90	7,368.20	8,467.30	9,642.94
Financial Indicators							
Return on Equity (%)	0.34	0.04	0.23	0.20	0.20	0.41	0.27
Debt Service Coverage Ratios ^a (times)	1.99	0.00	0.00	55.75	3.84	6.98	1.72
Debt as % of Debt and Equity (%)	3.76	3.57	6.43	5.41	3.98	4.16	6.95

Note: Accounts are for the combined operations of the company.

^a Includes payments for short-term loans. Debt service coverage ratios based on amortization of ADB loan are much higher.

^b Local long-term debt obtained for the project was eventually absorbed by the Beijing Municipal Government.

Source: Submitted financial statements of project implementing agency.

Table A11.2: Financial Performance of Beijing Gas Company
(CNY million)

Year Ending December 31	2002	2003
Income Statements		
Sales	2,684.57	3,154.43
Less: Cost of Sales	2,549.09	2,931.15
Operating Expenses	161.10	134.00
Operating Income	(25.62)	89.29
Less: Interest Expense	(7.14)	16.39
Nonoperating Income/(Expense)	81.19	120.52
Net Income Before Tax	62.72	193.42
Net Income After Tax	30.81	129.55
Cash Flow Statements		
Net Cash Flow from Operations	280.81	426.97
Borrowings	107.12	144.10
Equity Contributions	1,495.67	1,368.62
Total Sources of Funds	1,883.60	1,939.69
Capital Expenditures	1,653.28	2,078.92
Debt Service ^a	50.00	113.67
Dividends	5.96	21.67
Changes in Working Capital/ Others	(97.48)	(411.69)
Total Application of Funds	1,611.76	1,802.57
Changes in Cash	271.84	137.12
Changes in Cash	271.84	137.12
Cash Balance, Beginning of Year	514.38	786.18
Cash Balance, End of Year	786.22	923.30
Balance Sheets		
Current Assets	1,350.61	1,407.07
Cash and Deposits	786.18	923.30
Accounts Receivables	456.88	301.43
Inventories	58.89	76.02
Other Current Assets	48.66	106.32
Net Fixed Assets	4,692.74	5,803.25
Plant in Service	6,546.81	7,954.74
Less: Accumulated Depreciation	1,854.07	2,151.49
Construction in Progress	256.47	925.85
Intangibles and Deferred Assets	0.00	1.61
Other Assets	938.04	975.48
Total Assets	7,237.86	9,113.26
Current Liabilities	326.76	695.23
Accounts Payable	126.61	29.94
Short-Term Loans	0.00	350.00
Others	200.15	315.29
Long-Term Debt ^d	157.12	187.55
Equity	6,753.98	8,230.49
Paid in Capital	4,861.01	6,053.53
Surplus, Reserves, and Retained Earnings	1,892.98	2,176.95
Total Liabilities and Equity	7,237.86	9,113.26
Financial Indicators		
Return on Equity	0.51	1.73
Debt Service Coverage Ratios ^a (times)	5.62	3.76
Debt as % of Debt and Equity (%)	2.27	2.23

Note: Accounts are for the combined operations of the company.

^a Includes payments for short-term loans. Debt service coverage ratios based on amortization of ADB loan are much higher.

^b Local long-term debt obtained for the project was eventually absorbed by the Beijing Municipal Government.

Source: Submitted financial statements of project implementing agency.

FINANCIAL EVALUATION

A. General

1. The financial internal rate of return (FIRR) for the Beijing Environmental Improvement Project was calculated only for component 1 and component 2, because the other components have no material financial benefits. The FIRR was reevaluated on the basis of 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 for component 1 and 25 years for component 2, were maintained, with zero residual value. All revenues and expenditures are in constant 2004 prices¹ and exclude depreciation and interest.

B. Revenues and Operating Costs

2. Incremental revenues were calculated based on the actual heat and gas supplied to customers at the prevailing approved tariffs. Revenues realized from the start of operations and the estimates for 2004 were considered. Future revenues were projected based on the assumed growth in consumption and valued at existing approved tariffs. Operating and maintenance costs were assumed to remain at current levels, but adjusted to reflect increases in production volumes. Expected capital costs for the project are minimal and are considered in the maintenance costs. Value-added, income, and other taxes were based on actual rates and deducted from the revenue stream.

C. Financial Internal Rate of Return

3. The recalculated FIRR for component 1 is 5.9%, which is lower than the 7.3% estimated at appraisal. The lower FIRR is due to the combination of a higher investment cost and lower tariff. For component 2, the recalculated FIRR is 11.1%, which is higher than the 10.0% appraisal estimate. The higher FIRR improved the revenue profile, which offset the higher investment cost. Both FIRRs are higher than the weighted average costs of capital (WACC) of 4.6% and 4.7%, respectively.

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 Governance and Management of Investment Projects Financed by the Asian Development Bank*, 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, while 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 WACC of capital is 4.6% for component 1, compared to 4.2% estimated at appraisal and 4.7% for component 2, compared to 4.1% at appraisal. The WACC calculated at appraisal, using a different methodology, assumed varying levels for the costs of debt and equity and a higher inflation rate.

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.

Table A12.1: Financial Internal Rate of Return – Beijing District Heating Company
(CNY million)

Year	Capital Costs	Revenues	Operating Costs		Income Tax	Net Cash Flow After Tax
			Variable Costs	Fixed Costs		
1996	207.8					(207.8)
1997	686.6					(686.6)
1998	445.9					(445.9)
1999	604.0	49.7	50.4	17.5	0.0	(622.3)
2000	472.4	183.0	188.5	18.7	0.0	(496.6)
2001	525.8	317.3	279.9	21.3	0.0	(509.7)
2002	10.1	541.9	346.7	21.3	0.0	163.8
2003	0.0	555.4	386.1	22.7	0.0	146.6
2004		620.0	411.0	22.7	0.0	186.3
2005		800.0	529.2	22.7	0.0	248.1
2006		1,100.0	649.6	22.7	0.0	427.7
2007		1,100.0	649.6	22.7	84.2	343.5
2008		1,100.0	649.6	22.7	92.4	335.3
2009		1,100.0	649.6	22.7	92.4	335.3
2010		1,100.0	649.6	22.7	92.4	335.3
2011		1,100.0	649.6	22.7	92.4	335.3
2012		1,100.0	649.6	22.7	92.4	335.3
2013		1,100.0	649.6	22.7	92.4	335.3
2014		1,100.0	649.6	22.7	92.4	335.3
2015		1,100.0	649.6	22.7	92.4	335.3
2016		1,100.0	649.6	22.7	92.4	335.3
2017		1,100.0	649.6	22.7	92.4	335.3
2018		1,100.0	649.6	22.7	92.4	335.3
2019		1,100.0	649.6	22.7	92.4	335.3
2020		1,100.0	649.6	22.7	92.4	335.3
2021		1,100.0	662.9	23.4	94.3	319.4
Total	2,952.7	20,667.3	12,598.3	511.1	1,380.1	3,225.1
FIRR						5.9%

FIRR = financial internal rate of return.

Source: Asian Development Bank estimates.

Table 12.2: Financial Internal Rate of Return – Beijing Natural Gas Company
(CNY million)

Year	Capital Costs	Revenues	Operating Costs		Income Tax	Net Cash Flow After Tax
			Variable Costs	Fixed Costs		
1996	158.9					(158.9)
1997	615.8	43.8	31.0	202.5	0.0	(805.5)
1998	166.8	268.0	189.5	202.9	0.0	(291.2)
1999	522.1	565.1	399.5	204.2	0.0	(560.7)
2000	937.9	861.6	609.1	206.6	0.0	(892.0)
2001	967.1	1,418.0	943.9	229.1	18.4	(740.5)
2002	383.4	1,664.8	1,108.2	230.0	45.3	(102.1)
2003	33.1	1,855.0	1,223.2	252.2	62.8	283.7
2004		2,262.2	1,491.6	276.4	100.6	393.5
2005		2,850.3	1,879.5	276.4	166.7	527.7
2006		3,302.8	2,177.8	276.4	217.6	631.0
2007		3,567.8	2,352.5	276.4	247.4	691.5
2008		3,567.8	2,352.5	276.4	247.4	691.5
2009		3,567.8	2,352.5	276.4	247.4	691.5
2010		3,567.8	2,352.5	276.4	247.4	691.5
2011		3,567.8	2,352.5	276.4	247.4	691.5
2012		3,567.8	2,352.5	276.4	247.4	691.5
2013		3,567.8	2,352.5	276.4	247.4	691.5
2014		3,567.8	2,352.5	276.4	247.4	691.5
2015		3,567.8	2,352.5	276.4	247.4	691.5
2016		3,567.8	2,352.5	276.4	247.4	691.5
2017		3,567.8	2,352.5	276.4	247.4	691.5
2018		3,567.8	2,352.5	276.4	247.4	691.5
2019		3,567.8	2,352.5	276.4	247.4	691.5
2020		3,567.8	2,352.5	276.4	247.4	691.5
2021		3,567.8	2,352.5	276.4	247.4	691.5
2022		3,567.8	2,352.5	276.4	247.4	691.5
2023		3,567.8	2,352.5	276.4	247.4	691.5
2024		3,567.8	2,352.5	276.4	247.4	691.5
2025		3,567.8	2,352.5	276.4	247.4	691.5
Total	3,785.1	82,879.6	54,751.4	7,608.9	5,311.2	11,422.9
FIRR						11.1%

FIRR = financial internal rate of return.

Source: Asian Development Bank estimates.

ECONOMIC EVALUATION

A. General

1. The economic evaluation of the Beijing Environmental Improvement Project followed the methodology used at appraisal and was done only for components 1 and 2, since the economic benefits of the other two completed components are difficult to quantify. Incremental costs and benefits for the Project were determined. The assumed economic lives of the components, assumed at appraisal to be 20 years for component 1 and 25 years for component 2, were maintained. The residual value at the end of the economic life was assumed to be zero. All costs and benefits were expressed in 2004 constant prices.¹

B. Capital Costs, Incremental Benefits, and Operating Costs

2. Tradable goods were valued at their border prices, including transport and handling costs, while 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, have been excluded.

3. The economic benefits were valued based on cost savings resulting from the substitution of fuel (mainly coal for component 1 and coal and liquefied petroleum gas [LPG] for component 2) that would have otherwise been used by the industrial and small boilers that were replaced by the Project. The prevailing economic price of coal and the prevailing LPG price to domestic consumers were used in the calculations. Operating costs were based on actual and assumed data obtained from Beijing District Heating Company and Beijing Natural Gas Company and adjusted to their economic values. Distribution costs were considered in the analysis.

4. Other benefits identified at appraisal, which remain valid at project completion, include (i) environmental benefits from air and water quality improvements, (ii) actual availability for development of areas previously occupied by district boiler houses, (iii) actual removal of waste residues, (iv) reduced toll on coal transport and handling, and (v) increased recreational benefits from new greenbelt areas. Except for the benefits on the improvement of air quality, these benefits were not quantified at appraisal or at project completion.

C. Economic Internal Rate of Return

5. The economic internal rate of return (EIRR) for component 1 is recalculated at 16.9%, which is higher than the 12.8% estimated at appraisal. For component 2, the EIRR is 18.5%, which is higher than the 12.2% appraisal estimate. The higher benefits from the Project on account of the current high economic price of coal and LPG and the increased volume of coal savings offset the high investment costs. The recalculated EIRRs are higher than the Asian Development Bank's 12.0% hurdle rate for the economic opportunity cost of capital. If the environmental benefits resulting from reduced consumption of coal for the Project were quantified, the EIRR would be 21.9% for component 1 and 28.3% for component 2. The

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.

valuation took into account the externality costs³ for air pollutants, including total suspended particles, sulfur dioxide, nitrogen oxides, and carbon dioxide, and followed the calculation using the benefit transfer method described in the Asian Development Bank's *Economic Evaluation of Environmental Impacts—A Workbook*.⁴

³ Externality cost refers to 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 for Beijing in 2003 were CNY13,671 for total suspended particles, CNY3,207 for sulfur dioxide, and CNY3,464 for nitrogen oxide. A 5% annual growth rate was assumed. The externality cost of carbon dioxide was assumed at CNY33.95 based on United Nations Development Programme data. Average emission factors of total suspended particles, sulfur dioxide, nitrogen oxide, and carbon dioxide are 4.3, 7.0, 4.0, and 44.0 kilograms per ton of coal consumption, respectively.

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

Table A13.1: Economic Internal Rate of Return – Beijing District Heating Company
(CNY million)

Year	Capital Costs	Coal Saving Benefits	Operating Costs		Net Economic Benefits	Local Environmental Benefit	Net Economic Benefits
			Variable Costs	Fixed Costs			
1996	227.0				(227.0)		(227.0)
1997	743.6				(743.6)		(743.6)
1998	484.6				(484.6)		(484.6)
1999	655.3	137.1	49.5	17.9	(585.6)	21.3	(564.4)
2000	515.6	447.9	185.2	19.1	(272.0)	73.0	(199.0)
2001	573.3	658.7	274.2	21.7	(210.5)	112.7	(97.8)
2002	9.6	811.0	336.9	21.8	442.6	145.7	588.3
2003	0.0	899.4	376.1	23.2	500.1	169.7	669.8
2004		992.0	399.9	23.2	569.0	196.5	765.4
2005		1,251.3	514.8	23.2	713.2	260.2	973.5
2006		1,510.5	629.8	23.2	857.5	329.8	1,187.4
2007		1,510.5	629.8	23.2	857.5	346.3	1,203.9
2008		1,510.5	629.8	23.2	857.5	363.6	1,221.2
2009		1,510.5	629.8	23.2	857.5	381.8	1,239.3
2010		1,510.5	629.8	23.2	857.5	400.9	1,258.4
2011		1,510.5	629.8	23.2	857.5	421.0	1,278.5
2012		1,510.5	629.8	23.2	857.5	442.0	1,299.5
2013		1,510.5	629.8	23.2	857.5	464.1	1,321.6
2014		1,510.5	629.8	23.2	857.5	487.3	1,344.8
2015		1,510.5	629.8	23.2	857.5	511.7	1,369.2
2016		1,510.5	629.8	23.2	857.5	537.3	1,394.8
2017		1,510.5	629.8	23.2	857.5	564.1	1,421.7
2018		1,510.5	629.8	23.2	857.5	592.3	1,449.9
2019		1,510.5	629.8	23.2	857.5	621.9	1,479.5
2020		1,510.5	629.8	23.2	857.5	653.0	1,510.6
2021		1,510.5	629.8	23.2	857.5	653.0	1,510.6
Total	3,209.0	29,365.3	12,212.9	521.2	13,422.1	8,749.3	22,171.4
EIRR					16.9%		21.9%

EIRR = economic internal rate of return.

Source: Asian Development Bank estimates.

Table 13.2: Economic Internal Rate of Return – Beijing Natural Gas Company
(CNY million)

Year	Capital Costs	Coal Saving Benefits	Operating Costs		Net Economic Benefits	Local Environmental Benefit	Net Economic Benefits
			Variable Costs	Fixed Costs			
1996	169.1				(169.1)		(169.1)
1997	654.4	56.6	30.4	208.8	(837.0)	7.8	(829.2)
1998	172.7	346.3	186.0	209.2	(221.6)	50.3	(171.3)
1999	552.4	730.2	392.2	210.5	(425.0)	111.4	(313.6)
2000	955.8	1,113.2	597.9	212.8	(653.3)	178.3	(474.9)
2001	1,018.6	1,554.2	925.4	235.9	(625.7)	261.4	(364.3)
2002	427.9	1,824.7	1,086.5	236.9	73.4	322.3	395.7
2003	35.3	1,961.4	1,199.1	259.7	467.3	363.7	831.0
2004	10.0	2,391.8	1,462.2	259.7	659.9	465.8	1,125.6
2005		3,013.7	1,842.4	259.7	911.5	616.2	1,527.7
2006		3,492.1	2,134.8	259.7	1,097.5	749.7	1,847.2
2007		3,772.3	2,302.7	259.7	1,209.8	850.4	2,060.2
2008		3,772.3	2,302.7	259.7	1,209.8	892.9	2,102.7
2009		3,772.3	2,302.7	259.7	1,209.8	937.5	2,147.3
2010		3,772.3	2,302.7	259.7	1,209.8	984.4	2,194.2
2011		3,772.3	2,302.7	259.7	1,209.8	1,033.6	2,243.4
2012		3,772.3	2,302.7	259.7	1,209.8	1,085.3	2,295.1
2013		3,772.3	2,302.7	259.7	1,209.8	1,139.6	2,349.4
2014		3,772.3	2,302.7	259.7	1,209.8	1,196.5	2,406.3
2015		3,772.3	2,302.7	259.7	1,209.8	1,256.4	2,466.2
2016		3,772.3	2,302.7	259.7	1,209.8	1,319.2	2,529.0
2017		3,772.3	2,302.7	259.7	1,209.8	1,385.2	2,595.0
2018		3,772.3	2,302.7	259.7	1,209.8	1,454.4	2,664.2
2019		3,772.3	2,302.7	259.7	1,209.8	1,527.1	2,736.9
2020		3,772.3	2,302.7	259.7	1,209.8	1,603.5	2,813.3
2021		3,772.3	2,302.7	259.7	1,209.8	1,603.5	2,813.3
2022		3,772.3	2,302.7	259.7	1,209.8	1,603.5	2,813.3
2023		3,772.3	2,302.7	259.7	1,209.8	1,603.5	2,813.3
2024		3,772.3	2,302.7	259.7	1,209.8	1,603.5	2,813.3
2025		3,772.3	2,302.7	259.7	1,209.8	1,603.5	2,813.3
Total	3,996.2	88,157.4	53,608.9	7,288.3	23,264.1	27,810.4	51,074.5
EIRR					18.5%		28.3%

EIRR = economic internal rate of return.

Source: Asian Development Bank estimates.

ENVIRONMENTAL INDEXES

Table A14.1: Ambient Air Quality in Beijing Municipality

Parameter	Unit	1996	1997	1998	1999	2000	2001	2002	2003	Standard (Class II)
SO ₂	mg/m ³	0.10	0.13	0.12	0.08	0.07	0.06	0.07	0.06	0.06
NO _x	mg/m ³	0.12	0.13	0.15	0.14	0.13	0.07	0.14	0.07	0.08
TSP	mg/m ³	0.36	0.37	0.38	0.36	0.35	0.37	0.37	0.25	0.20
CO	mg/m ³	2.80	3.00	3.30	2.90	2.70	2.60	2.50	2.40	0.00
Class II	% per year	0.00	0.00	27.40	31.20	48.50	50.70	55.60	61.40	

CO = carbon monoxide, mg = milligram, m³ = cubic meter, NO_x = nitrogen oxide, SO₂ = sulfur oxide, TSP = total suspended particles.

^a Class II covers residential areas; mixed regions of commercial, traffic, and residential areas; cultural areas; industrial areas; and rural areas.

Source: Beijing Environmental Protection Bureau.

Table A14.2: Ambient Water Quality in Miyun and Huairou Reservoirs

Parameter	Unit	1997	1998	1999	2000	2001	2002	2003	Standard (Class II) ^a
Miyun Reservoir									
COD	mg/l	2.62	2.32	2.45	2.27	2.29	2.67	2.58	≤4
BOD	mg/l	—	—	—	—	1.14	1.01	0.76	≤3
Nitrates	mg/l	0.96	0.78	0.83	0.79	0.43	0.37	0.29	≤10
Phosphates	mg/l	—	—	—	—	0.01	0.01	0.02	≤0.1
Huairou Reservoir									
COD	mg/l	2.35	3.14	2.29	2.49	2.55	2.70	2.63	≤15
BOD	mg/l	—	—	—	—	1.20	1.24	1.66	≤3
Nitrates	mg/l	0.09	0.97	0.79	0.66	0.52	0.65	0.33	≤10
Phosphates	mg/l	—	—	—	—	0.03	0.01	0.01	≤0.1

≤ = less than or equal to, BOD = biological oxygen demand, COD = chemical oxygen demand, mg = milligram, l = liter.

^a Class II covers class A water resource protection areas for centralized drinking water supply, sanctuaries for rare species of fish, and spawning grounds of fishes and shrimp, etc.

Source: Beijing Environmental Protection Bureau.

RESETTLEMENT

1. For component 1, resettlement was undertaken by the Beijing District Heating Company (BDHC). A resettlement plan was prepared in June 1994. Land acquisition and resettlement commenced in the fourth quarter of 1994 and were completed in the second quarter of 1996. All the affected infrastructure facilities, e.g. electricity lines, river course, telecommunication equipment, power, and transportation facilities, have been restored or reconstructed. BDHC was responsible for the overall coordination and supervision of land acquisition and resettlement. Actual land acquisition was undertaken by the municipal administrative agency, including conducting group discussions with affected persons. The demolition work was contracted to another enterprise. BDHC allocated resettlement and compensation funds to the affected municipal and county offices. Those funds were distributed to the affected households through the municipal and county financial divisions. Actions taken on resettlement were briefly included in BDHC's quarterly progress reports and in their project completion report. BDHC concluded that resettlement and land acquisition were implemented satisfactorily, in accordance with the laws and regulations of the People's Republic of China, and the resettlement plan.

2. At appraisal, land acquisition and removal of buildings were estimated at 280 mu¹ (18.7 hectares) and 87,292 square meters (m²), respectively. At project completion, 204 mu (147.7 mu of vegetable plot, 41.5 mu of grain plot, and 14.5 mu of house plot) of land was acquired and 208,488 m² of buildings were removed. Land acquisition and housing and/or building demolition affected 519 households and establishments compared to 364 estimated at appraisal. Land compensation and resettlement costs rose from CNY187.0 million at appraisal to CNY847 million at project completion (27% of project cost), because of the increase in the cost of urban land, and the adjustment in scope—including the increase in the length of the main pipelines by 4.0 kilometers.

3. Before the Project, the farmers lived in one storey houses without piped water, sewer, toilet, gas, and central heating. The newly constructed apartment houses, provided by the government for affected households, are located near the area where the affected persons used to live and are fully equipped with social infrastructures. Neighbors among the affected households were relocated in the same apartment building to maintain social cohesion. The floor space per person was increased from 3–5 m² to 10–15 m². For income restoration, all affected persons received a one-time cash compensation amounting CNY30,000 per person. Those who changed status from farmer to urban worker to obtain jobs in Beijing or suburban areas were assisted by the local social security bureau. Temporary employment that benefited some of the affected persons was provided for more than 7,000 persons during project construction. Others obtained jobs in light industry factories, building construction companies, and food industry establishments, while a few obtained permanent jobs under the project. The operation of the project facilities created permanent employment in BDHC and Beijing Natural Gas Company (BNGC) for about 3,000 people for the entire network, about 40% of them were female.

4. For component 2, appraisal estimates were for 163 mu (10.9 hectares) of land to be acquired and 3,880 m² of buildings to be demolished. During project execution, the responsibility for land acquisition along the pipeline route was taken over by the municipal government as the component's construction activities coincided with the road expansion project. Similarly, the responsibility for acquiring the land required for the construction of the storage and regulating stations were taken over by a land developer as the component formed part of the overall municipal land development program. No resettlement costs were passed on to BNGC and accordingly, no details on the resettlement actions could be obtained from the enterprise.

¹ Mu is a unit of measure commonly used in the People's Republic of China, 15 mu = 1 hectare.

TRAINING PROVIDED UNDER THE PROJECT

Training Title	Location	Number of Participants	Duration
Beijing District Heating Group			
Technical and Management Training			
Training 1	Denmark, Finland, Germany	12	15 days
Training 2	United States (US)	6	49 days
Training 3	Finland, Germany	6	42 days
Training 4	Australia, New Zealand	6	42 days
Training 5	US	12	49 days
Training 6	Australia, New Zealand	6	42 days
Training 7	Australia, New Zealand	12	35 days
Training 8	Germany	12	28 days
Staff Training on New Plant Processes and Equipment	People's Republic of China	355 ^a	varied
Beijing Gas Group			
Combined Cooling, Heating and Power	US	9	21 days
Natural Gas Metering and Sales	Belgium, France, Germany	6	24 days
Compressed Natural Gas Station Security Management	Canada	6	16 days
Natural Gas Pipe Network Security	Australia	6	16 days
Natural Gas Regulator Station Operation	US	6	16 days
Natural Gas Pipe Network Equipment	Italy	4	16 days
Natural Gas Pipe Network Relevant Technology	United Kingdom (UK)	4	16 days
Natural Gas Pipe Network Strategy and Plan	France, UK	6	16 days
Beijing Water Authority			
Water Source Protection, Mountain Flood and Debris Control in Germany and Austria	Austria, Germany	10	24 days
Soil Erosion Theory, Soil and Water Conservation Technology in US	US	2	6 months
Water and Land Resources Protection and Utilization in Canada and US	Canada, US	12	24 days
Control Planning and Technology of Mountain Flood and Debris Flow in France and Switzerland	France, Switzerland	8	23 days

Training Title	Location	Number of Participants	Duration
Water Source Protection and Wastewater Control in Australia and New Zealand	Australia, New Zealand	11	21 days
Soil and Water Conservation Monitoring Techniques and Equipment in US	US	8	15 days
Water Source Protection and Wastewater Control in Norway and Spain	Norway, Spain	7	12 days
Water Source Protection and Wastewater Control in Sweden and UK	Sweden, UK	7	12 days
Water Resource Management in Germany and France	France, Germany	6	12 days
Introduction to Water Source Protection and Sustainable Development (Training 1)	Beijing	30	5 days
Introduction to Water Source Protection and Sustainable Development (Training 2)	Beijing	30	5 days
Beijing Solid Waste Management Center			
Capacity Building on Solid Waste Management	Hong Kong, China; US	8	19 days
Beijing Environmental Protection Monitoring Center			
Environmental Monitoring Technology and Instrumentation	UK	20	2 weeks
Beijing Municipal Environment Protection Bureau			
Capacity Building on Pollution Control and Management	UK	4	8 weeks
Environmental Management	Belgium, Holland, UK	7	2 weeks

^a Total person-hours = 14,228.

Source: Project implementing agencies and project files.