

PROJECT COMPLETION REPORT

ON THE

POWER AND DISTRICT HEATING REHABILITATION PROJECT
(Loan 1443-KGZ[SF])

IN

THE KYRGYZ REPUBLIC

August 2004

CURRENCY EQUIVALENTS

Currency Unit – som (Som)

		At Appraisal	At Project Completion
		30 April 1996	28 November 2002
Som1.00	=	\$0.0862	\$0.0210
\$1.00	=	Som11.60	Som47.72

ABBREVIATIONS

ADB	–	Asian Development Bank
BHS	–	Bishkek Heating System
DANIDA	–	Danish International Development Agency
EIB	–	European Investment Bank
IDA	–	International Development Association
KNEHC	–	Kyrgyz National Energy Holding Company
NDF	–	Nordic Development Fund
PIU	–	project implementation unit
TACIS	–	Technical Assistance for the Commonwealth of Independent States
TES1	–	Bishkek Thermal Energy Station No. 1
USAID	–	United States Agency for International Development
WACC	–	weighted average cost of capital

WEIGHTS AND MEASURES

Gcal	(gigacalorie)	–	1 billion calories
GWh	(gigawatt-hour)	–	1 million kWh
km	(kilometer)	–	1,000 meters
kV	(kilovolt)	–	1,000 volts
kWh	(kilowatt-hour)	–	1,000 watt-hours
MW	(megawatt)	–	1,000 kilowatts
t	(metric ton)	–	1,000 kilograms
Tcal	(teracalorie)	–	1 trillion calories
toe	(ton of oil equivalent)	–	common energy unit

NOTE

- (i) The fiscal year of the Government ends on 31 December.
- (ii) In this report, "\$" refers to US dollars.

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BASIC DATA

A. Loan Identification

1.	Country	Kyrgyz Republic
2.	Loan Number	1443-KGZ(SF)
3.	Project Title	Power and District Heating Rehabilitation Project
4.	Borrower	Kyrgyz Republic
5.	Executing Agency	Kyrgyz National Energy Holding Company
6.	Amount of Loan	SDR20,483,000
7.	PCR Number	PCR: KGZ 840

B. Loan Data

1.	Appraisal	
	– Date Started	4 September 1995
	– Date Completed	21 September 1995
2.	Loan Negotiations	
	– Date Started	25 March 1996
	– Date Completed	29 March 1996
3.	Date of Board Approval	6 June 1996
4.	Date of Loan Agreement	18 July 1996
5.	Date of Loan Effectiveness	
	– In Loan Agreement	16 October 1996
	– Actual	24 April 1997
	– Number of Extensions	Two
6.	Closing Date	
	– In Loan Agreement	30 June 2000
	– Actual	31 March 2002
	– Number of Extensions	One
7.	Terms of Loan	
	– Interest Rate	1%
	– Maturity (number of years)	40
	– Grace Period (number of years)	10
8.	Terms of Relending	
	– Interest Rate	7%
	– Maturity (number of years)	15
	– Grace Period (number of years)	4
	– Second-Step Borrower	Kyrgyz National Energy Holding Company

9. Disbursements

a. Dates

Initial Disbursement	Final Disbursement	Time Interval
30 Sep 1997	14 Mar 2002	53 months
Effective Date	Original Closing Date	Time Interval
24 Apr 1997	30 Jun 2000	38 months

b. Amount (\$ million)

No.	Category	Original Allocation	Last Revised Allocation	Amount Disbursed	Amount Disbursed (Million SDR)
01A	Equipment (District Heating)	10.13	7.78	7.78	5.65
01B	Equipment (Transmission and Distribution)	14.90	17.95	17.95	13.34
02A	Consulting Services (District Heating)	0.20	0.48	0.48	0.36
02B	Consulting Services (Transmission and Distribution)	0.30	0.82	0.82	0.60
02C	Consulting Services (Audit)	0.00	0.45	0.45	0.33
03	Unallocated	4.47			
	Total	30.00	27.48	27.48	20.28

Source: Asian Development Bank.

C. Project Data

1. Project Cost (\$ million)

Cost	Appraisal Estimate	Actual
Foreign Exchange Cost	72.4	70.2
Local Currency Cost	26.0	9.7
Total	98.4	79.9

Source: ADB

2. Financing Plan (\$ million)

Item	Appraisal Estimate	Actual
Implementation Costs		
Borrower-Financed	2.3	3.5
ADB-Financed	30.0	27.5
Other External Financing		
IDA	20.0	17.2
DANIDA	8.6	8.2
NDF	6.8	5.2
Government of Switzerland	4.5	4.6
KNEHC	15.2	7.8
Total	87.4	74.0
IDC Costs		
Borrower-Financed	11.0	5.9
ADB-Financed	0.0	0.0
Other External Financing	0.0	0.0
Total	98.4	79.9

ADB = Asian Development Bank; IDA = International Development Association; DANIDA = Danish International Development Agency; KNEHC = Kyrgyz National Energy Holding Company; NDF = Nordic Development Fund.

3. Cost Breakdown by Project Component (\$ million)		
Component	Appraisal Estimate	Actual
Part A: Bishkek TES1 ¹	17.9	20.6
Part B: District Heating ²	25.6	23.3
Part C: Transmission and Distribution	25.6	28.3
Part D: Technical Support and Training ³	4.1	1.8
Contingencies	14.2	0.0
Interest During Construction	11.0	5.9
Total	98.4	79.9

¹ Does not include the additional works financed under supplementary financing by the International Development Agency (para. 9).

² Includes \$3.5 million estimated for completion of the installation of the remaining pipes.

³ Actual cost of Part D does not include the disbursement of IDA funds.

Source: ADB estimates.

4. Project Schedule		
Item	Appraisal Estimate	Actual
Date of Contract with Consultants		
Part A Consulting Services	Jul 1996	Jun 1997
Part B Consulting Services	Jul 1996	Aug 1997
Part C Consulting Services	Jul 1996	Aug 1997
Part D Consulting Services (Audit of 1996 Accounts)		Aug 1997
Part D Consulting Services (Capacity-Building and Management Support to the PIU)		Sep 1998
Part D Consulting Services (Financial Management Improvement)		Mar 1999
Part D Consulting Services (Audit of 1997 Accounts)		Dec 1998
Part A: Bishkek TES1 Rehabilitation		
Preparation of Tender Documents	Dec 1996	Dec 1997
Tender and Contract Award	Mar 1997	Aug 1998
Rehabilitation of Boilers	Sep 1999	Dec 2001
Installation of Equipment	Sep 1999	Dec 2001
Part B: District Heating Rehabilitation		
Preparation of Tender Documents	Dec 1996	Jan 1997
Tender and Contract Award	Mar 1997	Oct 1997
Rehabilitation of Pipe Network	Sep 1999	Ongoing
Rehabilitation of Pumping Stations	Jun 1997	Oct 2000
Rehabilitation of Substations	Sep 1999	Oct 2001
Installation of Automatic Control System	Jun 1997	Ongoing
Testing and Commissioning	Dec 1999	Ongoing

Item	Appraisal Estimate	Actual
Part C: Power Transmission and Distribution Reinforcement		
Preparation of Tender Documents	Dec 1996	Jan 1997
Tender and Contract Award	Jun 1997	Aug 1997
Construction of Substations and Installation of Transformers and other Substation Equipment	Dec 1999	Orto-Alysh: Jul 2000 Ala-Archa: Aug 2000 Chuiskaya: Aug 2000 Novo-Troitskaya: Oct 2000
Part D: Technical Support and Training		
Project Management Consulting Assistance	Dec 1999	Dec 2000
Billing and Collection Improvement	Sep 1997	Nov 1998
Studies on Organization and Petroleum Exploration Promotion	Sept 1997	
Training	Dec 1999	
Dates		
First Procurement	Mar 1997	Jun 1997
Last Procurement	Jun 1997	Mar 1999
Completion of Equipment Installation	Dec 1999	Oct 2000
Start of Operations	Dec 1999	Oct 2000

5. Project Performance Report Ratings

Implementation Period	Ratings	
	Development Objectives	Implementation Progress
From 30 November 1998 to 31 December 1998	S	S
From 31 January 1999 to 30 June 1999	S	PS
From 31 July 1999 to 31 December 1999	S	PS
From 31 January 2000 to 30 June 2000	S	PS
From 31 July 2000 to 31 December 2000	S	PS
From 31 January 2001 to 30 June 2001	S	S
From 31 July 2001 to 31 December 2001	S	S
From 31 January 2002 to 30 June 2002	S	S

D. Data on Asian Development Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-Days	Specialization of Members ^a
Fact-Finding	17–28 Apr 1995	3	36	a, b, d
Appraisal	4–21 Sep 1995	5	90	a, b, c, d, e
Inception	26–30 Aug 1996	1	5	b
Review 1	7–13 Oct 1997	1	7	a
Review 2	21–27 Jan 1999	1	7	b
Review 3	9–18 Jun 1999	1	10	a
Review 4	21–26 Feb 2000	2	12	a, f
Review 5	10–13 Apr 2001	2	8	a, f
Project Completion Review ^b	19–29 Nov 2002	3	44	a, b, f

^a a = engineer, b = financial analyst, c = counsel, d = economist, e = procurement consultant or specialist, f = analyst.

^b The project completion report was prepared by X. Humbert, Energy Specialist and Mission Leader; H. Y. Hong, Financial Analyst; and P. T. Canlas, Operations Analyst.

I. PROJECT DESCRIPTION

1. The Kyrgyz economy is in transition from a planned to a market system. The breakup of the former Soviet Union in 1991 disrupted regional trade and contributed to the decline of economic activity. As a result, the consumption of electricity and heat by industrial consumers dropped sharply from 40% of national consumption in 1991 to 14% in 2002. Energy consumption by residential consumers¹ increased from 29% to 50% of national consumption over the same period, because more residential consumers switched to cheaper and indigenously produced electricity for heating and cooking and moved away from imported and expensive fuel sources. The poor condition² of district heating systems in major urban areas also led to increased electricity consumption during winter heating months. This resulted in overloaded³ power transmission and distribution facilities. Reliable and efficient power and heat infrastructure is an important basic requirement for the Government's macroeconomic stabilization and economic transformation efforts. Given the urgent need to overcome power and heat supply constraints and to increase the efficiency of supplying, transporting, and using energy, priority was given to retrofit and rehabilitate existing energy facilities.

2. The Bishkek district heating system is the largest and accounts for 80% of the centralized heat supply network in the country. The Bishkek combined heat and power plant, or Thermal Energy Station Number 1 (TES1), is the main source of heat⁴ for this network. However, most of the TES1 boilers were close to the end of their economic life causing maintenance problems and frequent shut down. In the medium term, the Government has identified refurbishment of TES1 as the least cost option to maintain supply of power and heat to the city of Bishkek. The Government had also identified reinforcement and rehabilitation work on key sub-stations in power transmission and distribution network to reduce losses and improve the power network reliability. A project preparatory study funded by United States Agency for International Development (USAID) and the Technical Assistance for the Commonwealth of Independent States (TACIS) reviewed the Government proposal and found it to be feasible. The Project's primary objective was to support the economic growth of the Kyrgyz Republic through rehabilitation and upgrading of power and heat supply infrastructure facilities. The Project also aimed to enhance the institutional and management capability of Kyrgyz National Electric Holding Company (KNEHC) in the Project implementation, billing and collection and, financial management.

3. The Project had four parts:-

- (i) **Part A: Bishkek Thermal Energy Station Number 1(TES1) Rehabilitation:** Refurbish 7 of 23 old boilers and selected turbine components; install an additional 90-megawatt (MW) turbo-generator; upgrade plant instrumentation and control equipment; retrofit essential auxiliary systems and, install sulphur dioxide and nitrogen oxides emission monitoring devices. The estimated cost was \$17.9 million.
- (ii) **Part B: District Heating Rehabilitation.** Replace the most dilapidated pipes, install variable speed pumps at selected heat sub-stations for converting to

¹ 100% urban households and 99% of rural households are electrified.

² The losses in the district heating system amounted to 25%.

³ Kyrgyz Republic was a net exporter of electricity but had inadequate transmission and distribution capacity.

⁴ In cogeneration mode, TES1 has 558 MW of electricity and 1,290 MW (1,157 Gcal/hr) of heat capacity.

variable flow operation; install associated automatic control system and meters. The estimated cost was \$25.6 million.⁵

- (iii) **Part C: Power Transmission and Distribution Reinforcement.** Reinforce and rehabilitate distribution facilities, control equipment, and 110/35/10-kilovolt (kV) and 35/10 kV substations; construct two new 220/110 kV substations and install 100,000 electricity meters. The estimated cost was \$25.6 million.
- (iv) **Part D: Technical Support and Training.** Under this part, consulting services were to be provided to assist KNEHC in project implementation and to strengthen its general and financial management. The estimated cost was \$4.1 million.

4. In June 1996, the Asian Development Bank (ADB) approved a \$30 million loan from ADB's special funds resources. The ADB loan was to finance parts B and C only. The loan had a 40-year repayment period, including a 10-year grace period, and carried a service charge of 1% per annum. Loan proceeds were re-lent to the Executing Agency (KNEHC). This loan had a 15-year repayment period, including a 4-year grace period, and carried a service charge of 7% per annum. The Government bears the foreign exchange risk. The Project was cofinanced by Danish International Development Agency, Government of Switzerland, International Development Association (IDA), and Nordic Development Fund, which contributed \$8.6 million, \$4.5 million, \$20.0 million, and \$6.8 million, respectively.

II. EVALUATION OF DESIGN AND IMPLEMENTATION

A. Relevance of Design and Formulation

5. At appraisal, ADB's country operational strategy in the Kyrgyz Republic was focused on upgrading the basic infrastructure necessary for economic growth. ADB's assistance for the power sector was intended to (i) contribute to economic recovery, (ii) enable fuel import savings, (iii) improve transmission and distribution systems, (iv) strengthen institutional and human resources development in the power and heat, and (v) support sector policy reforms. The Project was highly relevant to the Government's and ADB's power sector strategies at appraisal and remained relevant at completion in overcoming constraints associated with electricity and heat supply. The Project addressed these issues, and main objectives were met through (i) infrastructure rehabilitation; (ii) pollution reduction, as a result of sector activities; (iii) electricity and heat tariff levels rationalization; and (iv) energy sector reform.

6. The Project's components were implemented without major deviations from the design adopted at appraisal. The appraisal design to replace the most dilapidated network sections to eliminate leaks and reduce corrosion under Part B is still relevant, but the non-availability of counterpart funds in a timely manner has seriously constrained the progress of pipe installations under Part B (para 11). The level of performance reached by KNEHC before unbundling (para. 22) demonstrated the appropriateness of the design of project components.

⁵ The district heating system provides three different services to consumers: (i) hot water for domestic use, (ii) hot water flowing through radiators for space heating, and (iii) steam for industrial applications. All three services are provided by waste heat from TES1, using insulated pipes, and regulation is done from heat substations located near buildings.

B. Project Outputs

7. The Project's components were implemented as envisaged. Three of four parts were completed by December 2000, with delays ranging from 9 to 14 months. The loan was closed on 31 March 2002, 21 months after the original closing date of 30 June 2000, because of implementation delays. A total of \$27.48 million in loan funds was disbursed and \$0.26 million was canceled. The chronology of major events in the implementation of the Project is given in Appendix 1.

1. Part A: Bishkek Thermal Energy Station Number 1 Rehabilitation

8. Under this part, all targeted output were achieved. As estimated at Appraisal, seven selected old boilers were rehabilitated together with selected turbine components. A 90 MW steam turbine (Turbine 11) that was in storage since 1993 was installed; new generator for this turbine was procured under the Project. The completion certificate for the seven boilers and the new turbine-generator was issued on 15 September 2000, and the operational acceptance certificate was issued on 22 December 2000. Plant instrumentation and control systems were upgraded, and essential auxiliary systems, such as coal supply, make-up water, and compressed air were also retrofitted. Monitoring devices for sulfur dioxide and nitrogen oxides emissions were installed, and a nondestructive metal testing laboratory was set up.

9. In 1998, IDA approved a supplementary financing of \$15 million for some additional rehabilitation works. The additional works included rehabilitation of the remaining boilers of TES1, replacing the control system, and upgrading the coal conveyors system. The second rehabilitation followed the satisfactory achievement under the first rehabilitation, indicating the successful attainment of the Project output. The second rehabilitation will extend improvements to cover all sources of district heating supply in Bishkek.

2. Part B: District Heating Rehabilitation

10. As estimated at Appraisal, the Bishkek district heating system was modernized by converting to variable flow operation, through the installation of variable speed pumps in 2,230 heat substations. An automatic control system that optimizes the benefits of variable flow operation was also supplied and commissioned. The heat substations were upgraded to adapt to variable flow operation, and energy control valves and meters were installed as per Appraisal estimates.

11. Part B also included the replacement of the most dilapidated district heating pipes. Procurement of pipes was carried out in accordance with the appraisal estimates. However, due to lack of counterpart funds, the rate of pipe installation has been slow. Between 1998 and 2002, 5.5 kilometers (km) of previously insulated pipes and 0.8 km of in situ insulated pipes were installed compared to 17.6 km and 21.4 km of pipes procured under the Project, respectively. In 2003, an additional 1.6 km of in situ insulated pipes were laid. The Government has prioritized installation of the remaining pipes but considering the slow rate of pipe installation so far and the estimated cash flow, the pipe installation is estimated to be completed by 2008. The replacement schedule is based on the priority of heat use and condition of existing pipes. Appendix 2 provides the status of completed works and a list of remaining works.

3. Part C: Power Transmission and Distribution Reinforcement

12. All components of this part were completed as planned and achieved the designed performance level. High-priority reinforcement and rehabilitation works were carried out on key substations in the power transmission and distribution systems, which reduced energy losses and improved reliability. Essential equipment in 12 selected power substations were retrofitted. Selected substations were rehabilitated. Two new 220/110 kV substations were constructed (the Ala-Archa substation near Bishkek and the Naryn substation in the Naryn Region). About 100,000 electricity meters were procured and installed. These meters helped improve KNEHC's billing and collection.

4. Part D: Technical Support and Training

13. As per the appraisal estimate, ADB was not to finance this part of the Project. However, on the Government's request, the ADB loan savings were utilized to finance a consulting services component for auditing KNEHC's annual financial statements. The ADB-financed component was started in August 1997 and completed in March 1998. The IDA-financed financial audits for fiscal years 1997 and 1998 started in September 1997 and December 1998 and ended in February 1999 and December 2000, respectively. IDA also financed the Financial Management Improvement Program, which was started in December 1998 and ended in October 2000, and the Capacity-Building and Management Support to the project implementation unit (PIU), which started in September 1998 and ended in October 2000. All the consulting services and training components were accomplished as estimated at Appraisal.

C. Project Costs

14. At appraisal, the total project cost, including contingencies and interest during construction, was estimated at \$98.4 million, of which \$72.4 million (73.6%) was for foreign currency costs and \$26.0 million (26.4%) was for local currency costs. The actual project cost was \$79.9 million, of which \$70.2 million (88%) was for foreign currency costs and \$9.7 million (12%) was for local currency costs. Table 1 summarizes project costs, and details are provided in Appendix 3.

Table 1: Comparison of Project Costs
(\$ million)

Component	Appraisal Estimate			Actual		
	Foreign	Local	Total	Foreign	Local	Total
A. Base Cost						
1. Part A ¹	14.60	3.30	17.90	17.60	2.96	20.56
2. Part B ²	20.10	5.50	25.60	17.80	5.50	23.30
3. Part C	22.80	2.80	25.60	27.10	1.24	28.34
4. Part D ³	3.70	0.40	4.10	1.80	0.00	1.80
Subtotal	61.20	12.00	73.20	64.30	9.70	74.00
B. Contingencies	9.90	4.30	14.20	0.00	0.00	0.00
C. Interest during Construction	1.30	9.70	11.00	5.90	0.00	5.90
Total	72.40	26.00	98.40	70.20	9.70	79.90

¹ Does not include the additional works financed under supplementary financing by the International Development Association.

² Includes \$3.5 million estimated for the completion of the installation of the remaining pipes.

³ Actual cost of Part D does not include the disbursement of IDA funds.

15. The actual project foreign currency cost is 97% of the appraisal estimate, while local currency cost is 37%. While the actual base cost for the project has a cost overrun of \$0.8 million, this was off set by provision of \$14.20 contingencies resulting in net cost underrun of \$13.4 million before interest during construction (IDC). The actual IDC has a underrun of \$5.1 million as the Government did not borrow to cover interest during construction. These cost deviations led to a net cost underrun of \$18.5 million.

16. As agreed at appraisal, ADB loan proceeds were re-lent to KNEHC at an interest rate of 7% per annum, repayable over 15 years. The agreement includes a 4-year grace period, with the Government assuming the foreign exchange risk.

17. After the breakup of KNEHC, each newly established company was asked to repay its portion of the ADB loan under the same terms and conditions. The loan's distribution is shown in Table 2.

Table 2: Share of Loan Proceeds

Company	Loan Amount (\$ Million)
National Electrical Grid	17.38
Bishkek Heating Systems	8.20
Sever Electro	0.68
Vostok Electro	0.41
Osh Electro	0.40
Jalalabad Electro	0.30
JSC Electro Power Stations	0.11
Total	27.48

JSC = Joint Stock Company

Source: Ministry of Finance.

D. Disbursements

18. Disbursement under the loan commenced in September 1997 with the payment to the implementation consulting services contract under Part B. The loan was expected to be fully disbursed in 38 months (on 30 June 2000), but project implementation took longer than expected, mainly because of the unavailability of counterpart funds and KNEHC's restructuring. The financial difficulties of the Executing Agency were compounded by poor collections from its customers. The final disbursement took place on 14 March 2002, almost 2 years after the original loan closing date, because of a dispute under one Part C contract. A summary of disbursements is given in Appendix 4.

E. Project Schedule

19. Appendix 5 shows the project implementation schedule as originally planned and as actually executed. The physical implementation of the Project at appraisal was scheduled to commence in mid-1996 and be completed in 42 months.

20. Project implementation was delayed by more than 1 year, mainly due to (i) project scope changes during contract negotiations for Part C⁶ and the Executing Agency's lack of knowledge of ADB's procedures and guidelines, (ii) counterpart funds not being available in a timely manner, and (iii) KNEHC restructuring and unbundling. Despite these problems, most works (Part A, Part C, and Part D) were completed and commissioned by the end of 2000.

21. Under Part B, all works related to variable flow operations and retrofitting of 2,230 heat substations were completed by the end of 2001 compared to estimated completion by September 1999. However, the pipe replacement under the Bishkek Heating System (BHS) has been much slower than the Appraisal estimate (para. 11). About 20% of the pipes (in terms of value) were installed, and the remaining pipes will be installed in 5 years.⁷

F. Implementation Arrangements

22. KNEHC was the Executing Agency at appraisal and after loan signing. A PIU was established in December 1996, 6 months after loan approval. However, due to KNEHC's reorganization in 1999 and unbundling in 2001, the Project was distributed between seven different companies.⁸ BHS, Electro Power Stations (responsible for power generation), Jalalabad Electro (partly responsible for power distribution), National Electrical Grid (responsible for the transmission grid), Osh Electro (partly responsible for power distribution), Sever Electro (partly responsible for power distribution), and Vostok Electro (partly responsible for power distribution). An organization chart of the present energy sector is given in Appendix 6. KNEHC's PIU continued to coordinate the Project. Electro Power Stations established a separate PIU in 2001, while the other companies did not.

G. Conditions and Covenants

23. All financial covenants were achieved, except the accounts receivable and operating ratio covenants. A loan covenants summary is given in Appendix 7. In terms of KNEHC's financial covenants, its revenues (i) covered its cash operating expenses in 1996 and achieved an operating ratio of 91%, and (ii) almost covered its total operating expenses, including depreciation, by 31 December 1996. The operating ratio deteriorated in 1997 and 1998, primarily due to recognizing impairment loss on investment, in compliance with international accounting standards.⁹ Operating ratios of 76% and 65% were realized in 1999 and 2000, respectively, sufficiently covering KNEHC's total operating expenses.

24. Reducing its accounts receivable to the equivalent of 60 days of billing was KNEHC's most challenging task. The rapid increase in electricity and heat tariffs and difficult economic conditions were key factors leading to high accounts receivable (6.6 months at the highest, in 1997, and 3.2 months at the lowest, in 1999). In 2000, accounts receivable slightly increased to 4.0 months. The cumulative annual average increase in the electricity tariff during 1999–2001 was estimated at 36% in nominal prices and 20% in real prices. Similarly, heat tariff billing rose

⁶ Tender was issued as a turnkey contract. During contract negotiations, however, KNEHC requested that the contract be changed into one for supply and supervision of construction, because this change would enable KNEHC to use its internal resources for construction, which would help reduce project cost. ADB approved this change.

⁷ Additional 27.12 million Som was spent on the installation of pipes in 2003. To complete the pipe installation, \$3.5 million is estimated to complete the works during 2004–2008.

⁸ The successor companies are registered as joint stock companies.

⁹ International Accounting Standard 36 requires an impairment loss to be recognized when the carrying amount of an asset exceeds its recoverable amount. Consequent adjustments amounting to \$132.5 million and \$120.0 million were made in 1997 and 1998, respectively.

by 24% in nominal prices and 10% in real prices. Despite continuous increases, the electricity tariff was \$0.017 per kilowatt-hour (kWh) and the heat tariff was \$8.00 per gigacalorie, which were far below international prices. To improve accounts receivable, the Government appointed in July 2002 a domestic commercial bank as the single billing and collection agent. This settlement system is still new, and its results are yet to be evaluated.

25. KNEHC continued to meet a self-financing ratio of 30%, except in 1997, when it reported a net loss of \$178 million. Furthermore, KNEHC revalued its fixed assets in 1996 and 1997.

26. KNEHC reported operating profits in 1999 and 2000, as a result of the Government's tariff increases, but reported profits weakened the resolve to further increase tariffs. The heat tariff was last increased in April 2001, and the electricity tariff was increased only once, in March 2002.

27. A comparison of performance with the covenants was discontinued after 2001, with the reorganization of KNEHC into successor companies, as this comparison would have involved a fresh review of financial projections of all seven companies at the closing stages of the Project.

H. Consultant Recruitment and Procurement

28. Consultants for the implementation of Part B and Part C and the audit of KNEHC's 1996 annual financial statements and project account were engaged under ADB financing, based on ADB's *Guidelines on the Use of Consultants*.

29. The procurement of goods financed by ADB was carried out in accordance with ADB's *Guidelines for Procurement*. All contracts were procured through international competitive bidding. Three supply contracts covered pipe materials for Part B, and energy meters and substation equipment for Part C. A detailed procurement list, including consultant recruitment, is provided in Appendix 8.

I. Performance of Consultants, Contractors, and Suppliers

1. Consultants

30. Consultants recruited under Part A and Part B performed satisfactorily.

31. KNEHC assessed the implementation consultant's performance under Part C to be unsatisfactory, because the consultant was unable to resolve the contractors' claims in a timely manner. KNEHC used in-house experts to discuss the technical issues with the contractor. Eventually, a mediator was engaged to resolve claims related mainly to delays in procurement and implementation of civil works for Ala-Archa substation. However, ADB staff members were unable to fix responsibility for the contractual disputes on the consultant, so the consultant's performance was found satisfactory.

32. The auditors performed well, except for 1 year, when a different auditor was recruited under IDA funds. The audited financial statements provided by this Russia-based auditor were not consistent with those of the previous year.

2. Contractors and Suppliers

33. Contractor and supplier performance was generally satisfactory. The materials and equipment furnished were in accordance with the contract's provisions. The supply was generally delivered on schedule.

J. Performance of the Borrower and the Executing Agencies

1. The Borrower

34. The Borrower's performance was generally satisfactory, however, the KNEHC unbundling was done without prior consultation with ADB. The Government's compliance with the loan covenants has been generally satisfactory except with non-compliance on two key issues – operating ratio and account receivable of KNEHC. Inadequate counterpart fund availability mainly on Part B - a core component of the Project, also suggests lack of full ownership by the Government.

2. The Executing Agencies

a. Kyrgyz National Energy Holding Company

35. After some initial delays, mostly due to the time needed to learn the guidelines and procedures of the five project financing organizations and the unavailability of counterpart funds, KNEHC performed satisfactorily. The audited project account and audited financial statements were, however, submitted with an average delay of 6–12 months. KNEHC gave higher priority to the implementation of Part A and Part C, as opposed to Part B, which was considered a reasonable approach in view of the larger financial impact of the early rehabilitation of TES1 and power transmission and distribution substations. As given in Appendix 10, the net financial benefit was \$21.82 million for Part A, \$90.70 million for Part C, and \$13.90 million for Part B.

b. National Electric Grid

36. After KNEHC was split, National Electric Grid was responsible for completing Part C. Its performance was satisfactory. National Electric Grid had administrative control of the PIU that jointly coordinated the Project, but the documentation was very brief for the components implemented by other companies.

c. Electric Power Station

37. The performance of Electric Power Station was not relevant, as Part A was almost complete when the company was established. Its PIU was responsible for implementing the second rehabilitation under supplementary financing by IDA.

d. Bishkek Heating System

38. BHS's performance was less than satisfactory. It did not establish a PIU or report in time its financial difficulties, which resulted in incomplete works. For the installation of pipes, BHS has now provided a detailed implementation schedule showing that installation will be completed by 2008. The latest financial statements show that performance improved in 2002, compared with 2001. The operating ratio ranged from 78% to 72%. The working ratio ranged

from 78% to 72%. And, accounts receivable ranged from 7.0 to 2.3 months. Cash flow also improved. BHS generated Som118 million from operating activities in 2002, compared with a negative cash flow of Som686 million in 2001.

39. In November 2003, the Borrower and BHS agreed to (i) revise relending terms and conditions, to enable BHS to have additional cash flow for completing the installation of pipes;¹⁰ (ii) establish a PIU; and (iii) submit audited financial statements and annual progress reports up to the completion of the works. With the relief in debt servicing, BHS will be able to complete the installation of pipes, and this will help increase sales revenue and reduce losses in the heating system.

e. Distribution Companies

40. The four distribution companies are now responsible for energy meters. However, the installation was completed before the unbundling of KNEHC. The assessment of their respective performance was therefore not relevant.

K. Performance of the Asian Development Bank

41. ADB gave approvals related to procurement and disbursement of funds promptly, and the Executing Agency appreciated the level of support provided by ADB's missions. ADB's performance, however, was partly satisfactory, because of its failure to foresee the counterpart funds provision problem for the installation of pipes under Part B. This failure partly resulted from the frequent rotation of project officers. Five different project officers were successively involved, which disconcerted the Executing Agency. A more consistent approach would have helped expedite the revision of the subsidiary loan agreement.

42. The number of review missions was appropriate, while the time allocated to such missions was sometimes too short to carry out site visits.

III. EVALUATION OF PERFORMANCE

A. Relevance

43. The Project's rationale—to prioritize overcoming power and heat constraints and increase the efficiency of the energy supply through retrofitting and rehabilitating existing energy facilities—was sound. The rationale supported the Government's sector objective of reducing technical losses in transmission and distribution networks while increasing electricity and steam generation on a least-cost basis. The Project helped overcome a shortage of electricity supply that would have constrained economic growth and development. Improved heat and hot water supply for the residential sector (footnote 5) prevented consumers from switching to electricity, which would have increased the winter season power demand and had a higher economic cost.

B. Efficacy in Achievement of Purpose

44. The Project was less than satisfactory in achieving its development objective of meeting Bishkek's power and heat demands. Implementation was delayed, which resulted in the

¹⁰ The addendum to the subsidiary agreement stipulates an extended grace period of 8 years and a 20-year term of the BHS loan. It will free up about \$2.8 million, which will be used for the installation of the pipelines.

postponement of full project benefits. The Project contributed to an increase in tariffs for heat and power but did not improve billing and revenue collection. Construction of new power substations significantly increased the reliability and availability of electricity. However, the heating pipe network improvements have been slow and still needs to be completed.

45. Under Part C, due to the limited capacity of the Frunzeskaya-Ala-Archa 220 kV transmission line, the two new 125 megavolt-ampere transformers cannot operate at full capacity. This is due to the unanticipated rapid shift from industrial to residential demand. A new transmission line or reinforcement of existing line will be required to bring more power to the Ala-Archa substation.

C. Efficiency in Achievement of Outputs and Purpose

46. KNEHC's financial performance improved steadily. Revenue from energy sales increased by 92% in 1999 and 60% in 2000, because of tariff increases. Financial performance from 1996 to 2000 is summarized in Appendix 9. The unbundling of KNEHC in 2001 makes assessing the Project's overall output from the financial reports of the successor companies difficult.

47. The financial internal rates of return of Part A, Part B, and Part C were calculated at 11.1%, 5.3%, and 10.7%, respectively (Appendix 10). The combined project FIRR was 9.6%, which is much lower than appraisal estimate of 17.2% but exceeds the weighted average cost of capital (WACC), reevaluated as 4.6%. The WACC was derived according to the *Guidelines for the Financial Governance and Management of Investment Projects Financed by ADB*, using the actual capital mix. Table 3 below presents the comparison of FIRR at completion and their estimate at Appraisal.

Table 3: Financial Internal Rate of Return at Appraisal and at Project Completion
(%)

Subproject	FIRR at Appraisal	FIRR at PCR
Part A: Bishkek TES1 Rehabilitation	23.3	11.1
Part B: District Heating Rehabilitation	17.2	5.3
Part C: Power Transmission and Distribution Reinforcement	13.8	10.7
Complete Project	17.2	9.6

Source: ADB estimates.

48. In the economic analysis, the incremental benefits and costs were reevaluated using the appraisal methodology. Appropriate border prices of fuels were used for calculating economic fuel costs. The complete analysis is presented in Appendix 11. The economic internal rates of return for Part A, B and C were reevaluated at 13.1%, 11.3% and 17.3% respectively. The combined project EIRR is 14.8% compared to the appraisal estimate of 26.5%. The reevaluated EIRR are lower than the previously envisioned appraisal figures, mainly due to implementation delays resulting in delayed benefits in initial years. Table 4 presents the comparison of EIRRs at completion and at Appraisal.

Table 4: Economic Internal Rate of Return at Appraisal and at Project Completion (%)

Subproject	EIRR at Appraisal	EIRR at PCR
Part A: Bishkek TES 1 Rehabilitation	24.1	13.1
Part B: District Heating Rehabilitation	25.6	11.3
Part C: Power Transmission and Distribution Reinforcement	28.5	17.3
Complete Project	25.6	14.8

Source: ADB estimates.

D. Preliminary Assessment of Sustainability

49. The rehabilitation of TES1 and the construction and expansion of power transmission and distribution facilities under the Project are sustainable investments. Progressive installation of new pipes by BHS will ensure the sustainability of Part B. However, considering the part installation so far, the Project was rated as likely sustainable.

E. Environmental, Sociocultural, and Other Impacts

50. The Project had no significant adverse environmental impacts. The rehabilitation of TES1 and the district heating network had positive environmental impacts because of the improvement in efficiency and lower fuel use. The dismantled equipment was properly recycled and non-recyclable parts were moved to special dumps. Emission monitoring equipment and the rehabilitation of boilers contributed to the reduction of air pollutants. The new transmission lines pass mostly through unpopulated areas. Overall, 6.3 hectares of land were acquired for the Project.¹¹

51. Reliability and delivery of power services to consumers were improved. For commercial and industrial users, the improvements increased productivity and extended the life of machines. For the residential sector, the improvements allowed greater use of electrical appliances that provide comfort and entertainment and help improve quality of life.

52. The rehabilitation of the district heating network increased the efficiency of the system by variable flow operation. The system is now responsive to daily changes, which saves energy and contributes to greater comfort.

IV. OVERALL ASSESSMENT AND RECOMMENDATIONS

A. Overall Assessment

53. The Project has mixed outcome. Part A and C have been completed as designed, supporting the economic growth in Kyrgyz Republic by providing direct benefits: (i) additional capacity of 90 MW in TES1; (ii) lower power, water, and heat losses, which resulted in fuel import savings of \$2.2 million per year; (iii) reduced number of power outages, which had an economic cost saving of \$6.1 million per year; (iv) operation and maintenance cost savings of

¹¹ The Executing Agency was unable to indicate the number of people affected by the Project, because the records could not be retrieved from successor companies. However, the Executing Agency did confirm that farmers were duly compensated for crops (Som1.9 million).

\$0.8 million per year; and (v) extended life of the rehabilitated assets. Only part implementation of Part B thus far, has slowed the full attainment of the Project objectives and benefits. However, considering that Project has achieved most of its targeted benefits, the Project has been assessed as successful on overall evaluation of its relevance, efficacy, efficiency, sustainability, and impact on institutional development.

B. Lessons Learned

54. Unbundling KNEHC was considered necessary by development partners to reform the energy sector. However, the unbundling resulted in a lack of initiative to complete the remaining components. After the split of KNEHC, the PIU became a part of National Electrical Grid, but the PIU was unable to enforce effective control over the implementation and monitoring of three parts of the Project. BHS had the most implementation problems. The loan proceeds were used to procure pipes before KNEHC was unbundled, but BHS inherited incomplete works and debt service obligations. The remaining pipelines account for \$6.2 million of the new pipes, or 8% of the total project cost. For future projects, a special mission should review the financial viability of successor companies and assess their capability to implement projects prior to the unbundling of executing agencies. When problems are foreseen, agreements should be reached with borrowers to take corrective measures.

55. Due to the rapid shift from industrial to residential power demand, the existing transmission line is congested, and the new transformers provided under the Project cannot be fully used (para. 45). Such a trend is common in transition economy countries and needs to be considered in demand forecasts and transmission planning.

56. The Project was financed by several organizations, each having different set of rules and procedures for procurement. This resulted in a longer learning period, and project implementation was delayed at the beginning. For future projects with new executing agencies and several financing organizations, special procurement training should be arranged during the project preparation stage.

C. Recommendations

1. Project-Related

57. **Further Actions or Follow-Up.** ADB will need to regularly monitor the progress of pending pipe installation and the financial health of BHS. While the company allocates resources from its cash flow for laying pipes, the Government will need to provide further assistance if difficulties are reported.

58. **Timing of Project Performance Audit Review Preparation.** The infrastructure investments in generation, transmission, distribution, and heat substations have already benefited Bishkek's residents, but the full benefit of district heating will only be achieved after all TES1 boilers are rehabilitated and the high priority pipes are installed. Therefore, the project performance audit review of the entire project should be carried out in 2006, when TES1 works under IDA's supplementary financing will also be complete.

2. General

59. The low tariffs for electricity and heat would make it difficult to recover the cost of any future investment in a new project. The financial situation of the newly created companies can

be improved by developing an automatic tariff adjustment mechanism that would be implemented by the State Energy Agency. Future assistance in the Kyrgyz energy sector needs to focus on regulatory capacity building, to ensure a financially viable and sustainable energy sector.

60. Development partners are now pursuing options for the privatization of one of the power distribution companies. This is expected to provide funds for new projects and improve management. This will be closely monitored by ADB, and where necessary, suitable advice will be offered to the Government to achieve desirable results.

61. The Project and IDA-funded second rehabilitation will substantially increase the heat output capacity of TES1. The Bishkek district heating network needs to expand further to derive the full benefits of the refurbishment. A project feasibility for expanding the Bishkek district heating network is being considered by the Government.

CHRONOLOGY OF MAJOR EVENTS

A. Project Processing

17–28 April 1995	Fact-Finding Mission
4–21 September 1995	Appraisal Mission
25–29 March 1996	Loan negotiations
6 June 1996	Loan approval
18 July 1996	Loan Agreement and signing
16 October 1996	Original date of loan effectiveness
24 April 1997	Actual date of loan effectiveness

B. Implementation

1. Part A: Bishkek TES 1 Rehabilitation

a. Equipment and Materials

19 December 1997	Tender documents issued
17 March 1998	Tender documents prepared
18 May 1998	Closing date of tender
25 May 1998	Finalization of evaluation report
3 August 1998	Contract signed
15 December 2000	Guarantee tests successfully completed
5 January 2001	State acceptance certificate issued
31 March 2001	Completion certificate issued

b. Consultancy Services (project implementation)

10 January 1997	Invitations issued
11 March 1997	Proposals opened
9 June 1997	Consultancy contract signed

2. Part B: District Heating Rehabilitation

a. Materials for Pipe Network

27 January 1997	Draft bid documents received
13 February 1997	Asian Development Bank (ADB) approved and sent comments on bid documents
3 April 1997	Tenders started
3 June to 15 July 1997	Tenders opened
11 September 1997	Evaluation report received
1 October 1997	ADB approved evaluation
1 December 1997	Contract signed with supplier
9 December 1997	ADB received signed contract
31 May 1999	Delivery of pipe materials completed

b. Pumps and Supervisory Control and Data Acquisition (SCADA)

7 July 1997	Bid documents issued
22 September 1997	Bids opened
23 September 1997	Bid evaluation report received by Nordic Development Fund
24 October 1997	Bid evaluation approved
9 December 1997	Contract signed with supplier
17 October 1999	Installation of pumps completed
31 October 2000	Installation of SCADA system completed

c. Modernization of District Heating Substations

14 May 1997	Bid documents issued
30 July 1997	Bids opened
23 October 1997	Bid evaluation approved
20 February 1998	Contract signed with supplier
15 May 1999	Start of Works on district heating substations
September 2001	Completion of rehabilitation works

d. Consultancy Services (project implementation)

14 July 1997	Proposals approved
5 August 1997	Contract signed
11 August 1997	Signed contract received
17 December 1999	Addendum #1 to the contract signed
31 December 2000	Contract completed

3. Part C: Power Transmission and Distribution Reinforcement

a. Substation Reinforcement

2 October 1996	Prequalification document sent to ADB
December 1996	Preparation of tender documents
26 December 1996	ADB approved tender documents
27 December 1996	Evaluation report on prequalification sent to ADB
18 February 1997	ADB approved prequalification
3 March 1997	Tendering started
12 June 1997	Tenders opened
25 August 1997	Evaluation report sent to ADB
8 October 1997	ADB approved evaluation
8 December 1997	Contract signed
17 February 1998	Letter of credit signed
10 April 1998	Advance payment made to supplier
25 July 2000	Orto Alysh substation commissioned
18 August 2000	Chuiskaya substation commissioned
18 August 2000	Ala-Aroha substation commissioned
20 October 2000	Novo-Troitskaya substation commissioned

b. Meters and Other Equipment

15 March 1997	Tender documents issued
15 May 1997	Tenders opened
23 June 1997	ADB approved evaluation
22 July 1997	ADB approved evaluation
13 August 1997	Contract signed
25 August 1997	ADB received signed contract
30 October 1998	All good delivered

c. Retrofitting of 123-kilovolt Circuit Breakers

25 April 1997	Bid documents issued
25 June 1997	Bids opened
26 September 1997	Contract signed with supplier

d. Procurement of 123-kilovolt to 245-kilovolt Circuit Breakers

26 February 1998	Bid documents issued
15 April 1998	Bids opened
25 May 1998	Approval of bid evaluation report
10 July 1998	Contract signed

C. Consultancy Services (project implementation)

22 April 1997	Proposals opened
4 August 1997	Contract approved
4 September 1997	Signed contract received
20 August 1997	Consultancy contract for project supervision signed
3 November 1999	Addendum to the contract issued to consultants
17 August 2000	Original consultancy contract completion
31 December 2000	Consultancy contract completed

STATUS OF COMPLETED WORKS

Table A2.1: Summary of Contract Packages

PCSS No.	Item	Mode of Procurement	Date of Contract	Contract Amount (\$)	Amount Disbursed (\$)
0001	Consulting Services (District Heating)	ICB	5 Aug 1997	476,748	476,748
0002	Energy Meters and Other Equipment	ICB	13 Aug 1997	2,292,347	2,292,347
0003	Consulting Services (Transmission and Distribution)	ICB	20 Aug 1997	476,748	476,748
0004	Consulting Services (Audit Consultancy)	ICB	26 Aug 1997	450,000	450,000
0005	Equipment (District Heating)	ICB	1 Dec 1997	7,783,587	7,783,587
0006	Power Transmission and Distribution Reinforcement	ICB	12 Aug 1997	1,563,136	1,563,136
0007	Power Transmission and Distribution Reinforcement	ICB	28 Jan 1998	15,652,685	15,652,685

ICB = international competitive bidding; PCSS = Procurement Contract Summary Sheet.
Source: Asian Development Bank.

Table A2.2: Status of Equipment Not Installed for Part B (as of 1 November 2002)

Diameter	Pre-insulated Pipes (linear meters)	Pipes Without Insulation (linear meters)	Insulating Equipment (linear meters)
Φ = 50mm	0	24	24
Φ = 70mm	660	0	48
Φ = 80 mm	6,624	0	48
Φ = 100mm	4,716	0	24
Φ = 125 mm	156	0	0
Φ = 150 mm	7	12	24
Φ = 200 mm	0	0	168
Φ = 250 mm	0	24	72
Φ = 300 mm	12	192	0
Φ = 400 mm	24	0	0
Φ = 500 mm	0	11,540	5,777
Φ = 700 mm	0	8,941	7,490
Φ = 1,000 mm	0	0	243
Total to be Installed	12,199	20,733	13,918
Total Supplied under the Loan	17,624	21,443	14,744

Φ = diameter; mm = millimeter.
Source: Bishkek Heating System.

Table A2.3: Works Carried Out From 1998 to 2002
(linear meters)

Item	1998	1999	2000	2001	2002	Total
Preinsulated Pipes						
Φ = 50 mm		108.00	72.00	524.00	424.40	1,128.40
Φ = 70 mm		48.00	444.00	252.00	264.00	1,008.00
Φ = 80 mm		0.00	156.00	312.20	324.00	792.20
Φ = 100 mm		192.00	708.00	276.00	384.00	1,560.00
Φ = 125 mm		0.00	180.00	72.00	0.00	252.00
Φ = 150 mm		540.00	0.00	0.00	60.00	600.00
Φ = 200 mm		0.00	0.00	28.00	56.50	84.50
		0.00	0.00	0.00	0.00	0.00
Total Laid		888.00	1,560.00	1,464.20	1,512.90	5,425.10
Insulating Materials						
Φ = 500 mm	21.25		49.46	77.28	77.28	225.27
Φ = 700 mm	31.60	81.47	98.44	225.67	163.04	600.22
Total Installed	52.85	81.47	147.90	302.95	240.32	825.49

Φ = diameter; mm = millimeter.
Source: Bishkek Heating System.

PROJECT COST AND FINANCING PLAN
(\$ million)

Item	Financing Source	As Appraised			Actual		
		Foreign	Local	Total	Foreign	Local	Total
A. Bishkek TES1							
1. Equipment and Materials	IDA	13.9	3.0	16.9	16.6	3.0	19.6
2. Consulting Services	IDA	0.7	0.3	1.0	1.0	0.0	1.0
Subtotal (A)		14.6	3.3	17.9	17.6	3.0	20.6
B. District Heating							
1. Pipe and Network Materials ^a	ADB	10.1	5.0	15.1	7.8	4.6	12.4
2. Substations	DANIDA	7.4	0.0	7.4	8.2	0.7	8.9
3. Pumps and SCADA	NDF	2.4	0.0	2.4	1.3	0.2	1.5
4. Consulting Services	ADB	0.2	0.5	0.7	0.5	0.0	0.5
Subtotal (B)		20.1	5.5	25.6	17.8	5.5	23.3
C. Transmission and Distribution							
1. New Substations	ADB	12.2	1.0	13.2	15.7	0.7	16.4
2. Naryn Substation	Swiss	3.5	1.0	4.5	4.4	0.3	4.7
3. Circuit Breakers	NDF	3.7	0.5	4.2	3.4	0.2	3.6
4. Meters and Other Equipment	ADB	2.3	0.0	2.3	2.3	0.0	2.3
5. Consulting Services	ADB	0.7	0.3	1.0	0.8	0.0	0.8
6. Consulting Services for Naryn S/S	Swiss	0.4	0.0	0.4	0.5	0.0	0.5
Subtotal (C)		22.8	2.8	25.6	27.1	1.2	28.3
D. Technical Support and Training							
1. Consulting Services	IDA	2.8	0.4	3.2	1.1	0.0	1.1
2. Petroleum Exploration Promotion Study	IDA	0.3	0.0	0.3	0.0	0.0	0.0
3. Training	EIB	0.6	0.0	0.6	0.7	0.0	0.7
Subtotal (D)^b		3.7	0.4	4.1	1.8	0.0	1.8
Total Base Cost		61.2	12.0	73.2	64.3	9.7	74.0
CONTINGENCIES							
Physical		6.0	1.2	7.2	0.0	0.0	0.0
Price		3.9	3.1	7.0	0.0	0.0	0.0
Subtotal		9.9	4.3	14.2	0.0	0.0	0.0
Total Before IDC		71.1	16.3	87.4	64.3	9.7	74.0
Interest During Construction		1.3	9.7	11.0	5.9	0.0	5.9
Total		72.4	26.0	98.4	70.2	9.7	79.9

ADB = Asian Development Bank; Govt. = Government of Kyrgyz Republic; IDA = International Development Association; EIB = European Investment Bank; NDF = Nordic Development Fund; DANIDA = Danish International Development Agency; SCADA = Supervisory Control and Data Acquisition; S/S = substation; TES1 = Bishkek Thermal Energy Station No. 1.

^a Includes \$3.5 million equivalent estimated for completion of the installation of the pipes.

^b Actual cost of Part D does not include the disbursement of IDA funds.

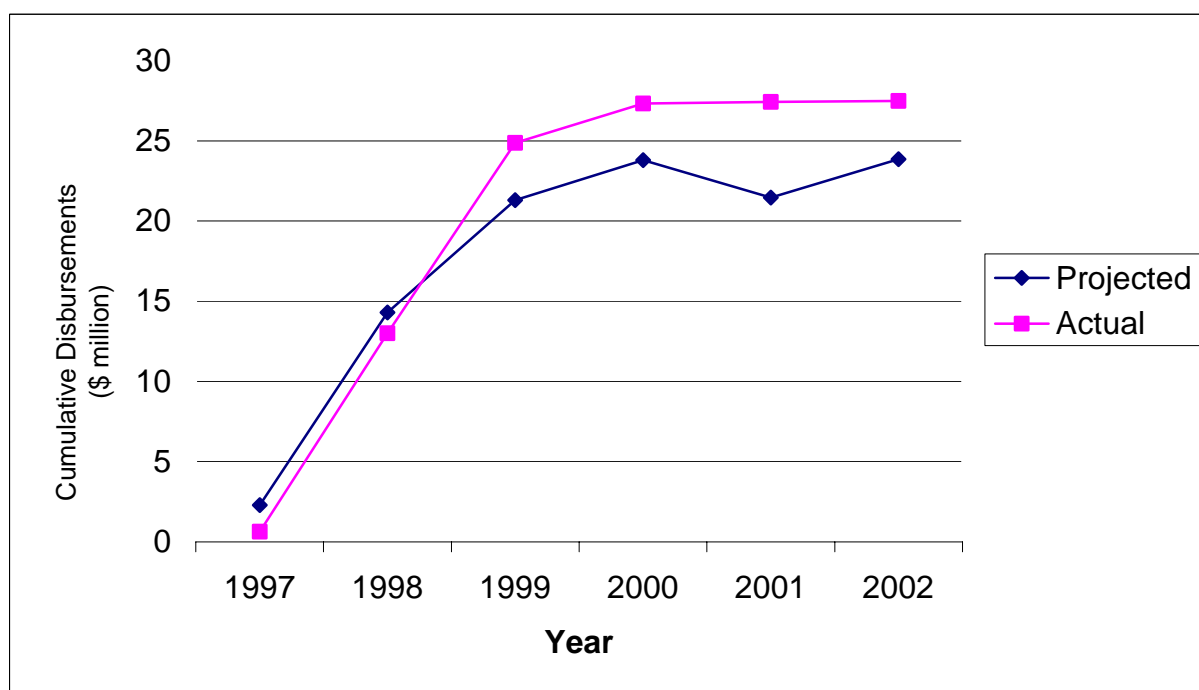
Source: Asian Development Bank.

PROJECTED AND ACTUAL DISBURSEMENTS, 1997–2002
(\$ million)

Table A4: Disbursement Schedule

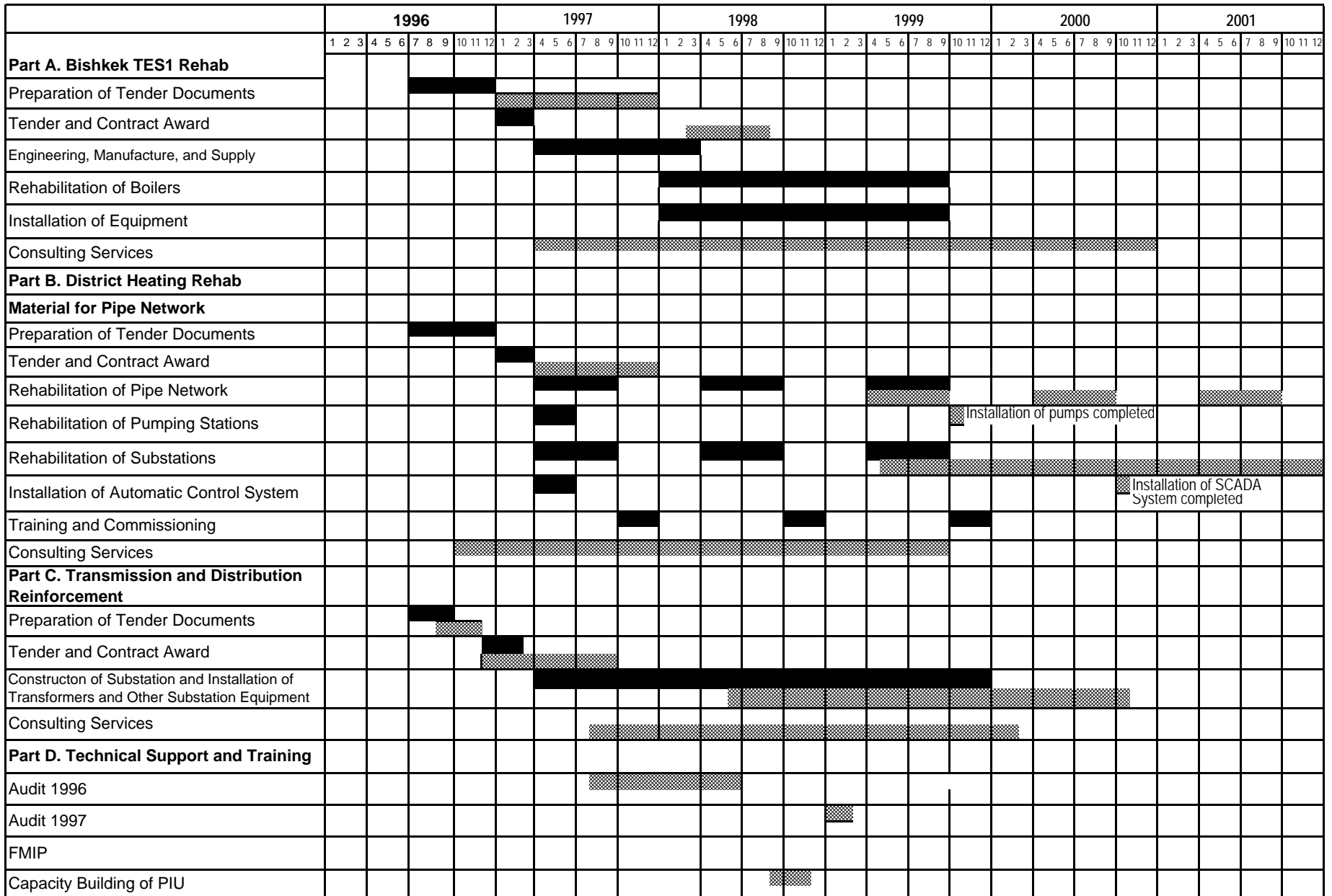
Year	For the Year		Cumulative		
	Projected	Actual	Projected	Actual	% of Loan
1997	2.30	0.64	2.30	0.64	2
1998	12.00	12.37	14.30	13.00	47
1999	7.00	11.87	21.30	24.87	91
2000	2.50	2.45	23.80	27.32	99
2001	0.16	0.11	21.46	27.42	100
2002	0.05	0.05	23.85	27.48	100
Total	24.00	27.48			

Figure A4: Cumulative Disbursements



Source: Kyrgyz National Energy Holding Company.

PROJECT IMPLEMENTATION SCHEDULE



Planned
 Actual

THE KYRGYZ ENERGY SECTOR

Figure A6.1: Organization Chart of the Kyrgyz Energy Sector

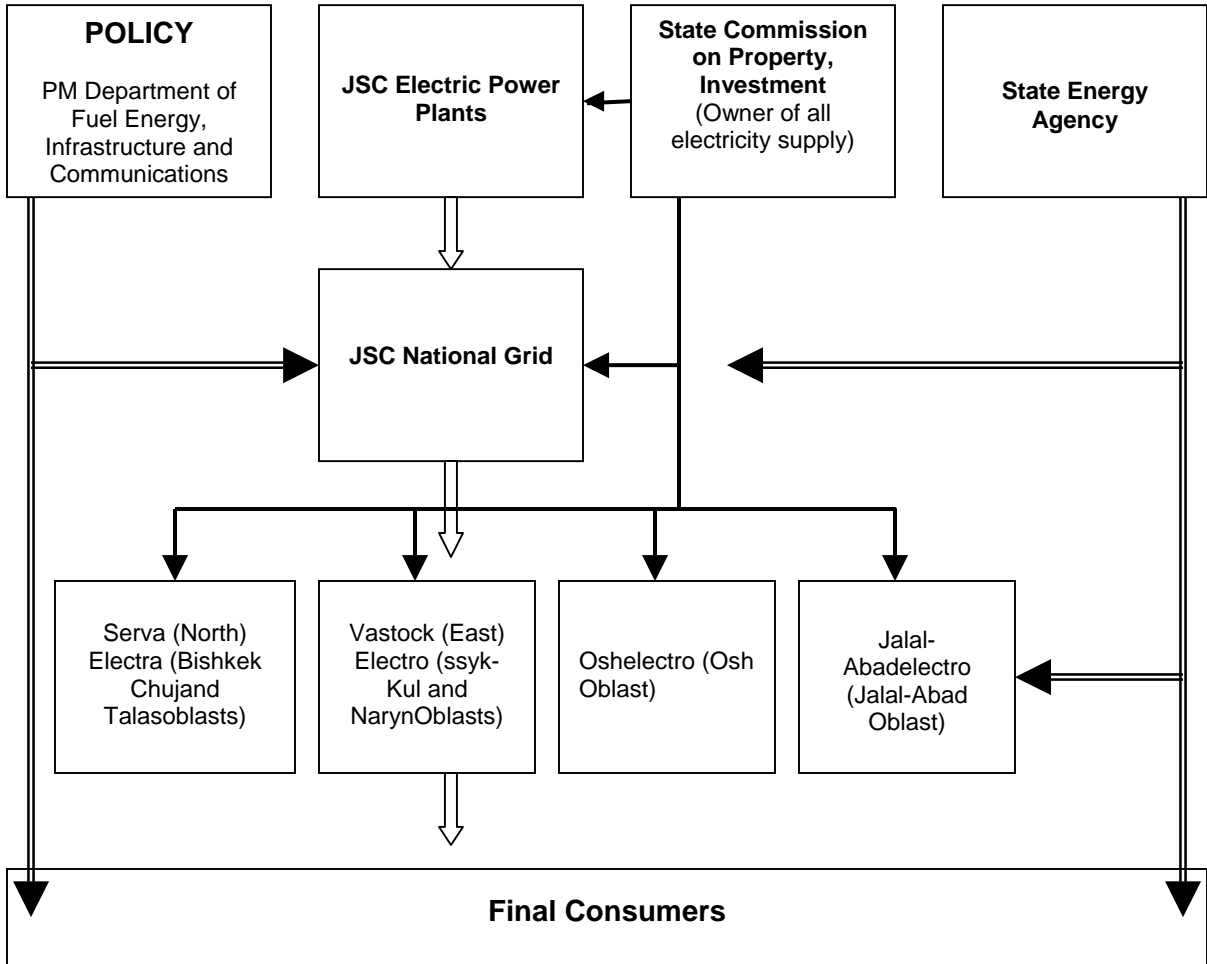
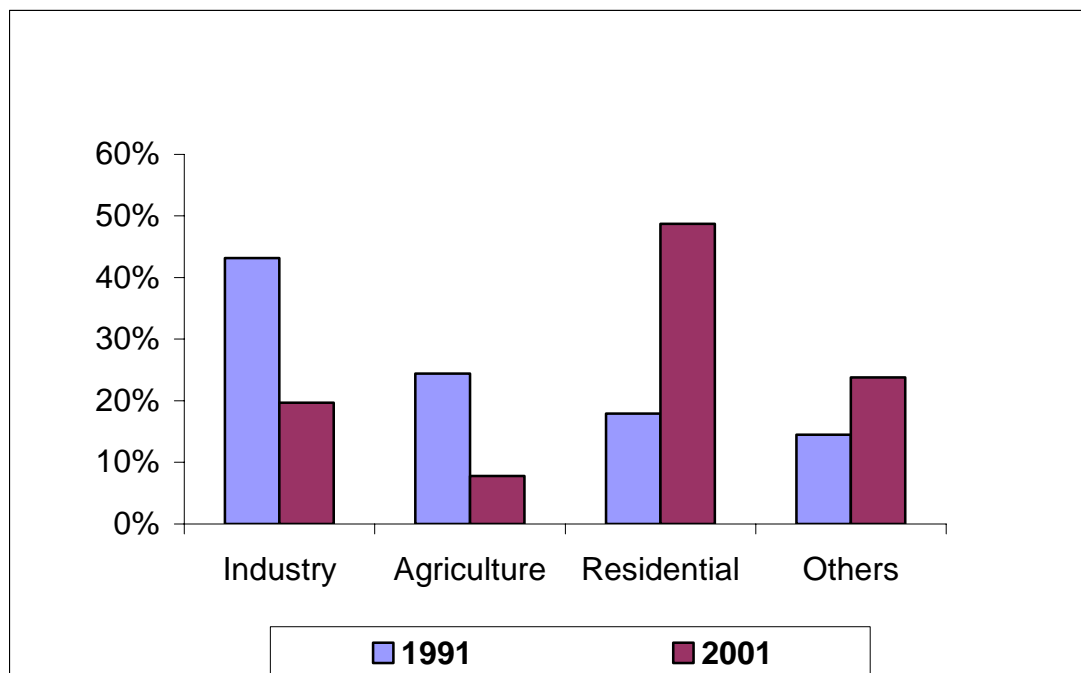


Table A6.1: Electricity and Heat Tariffs

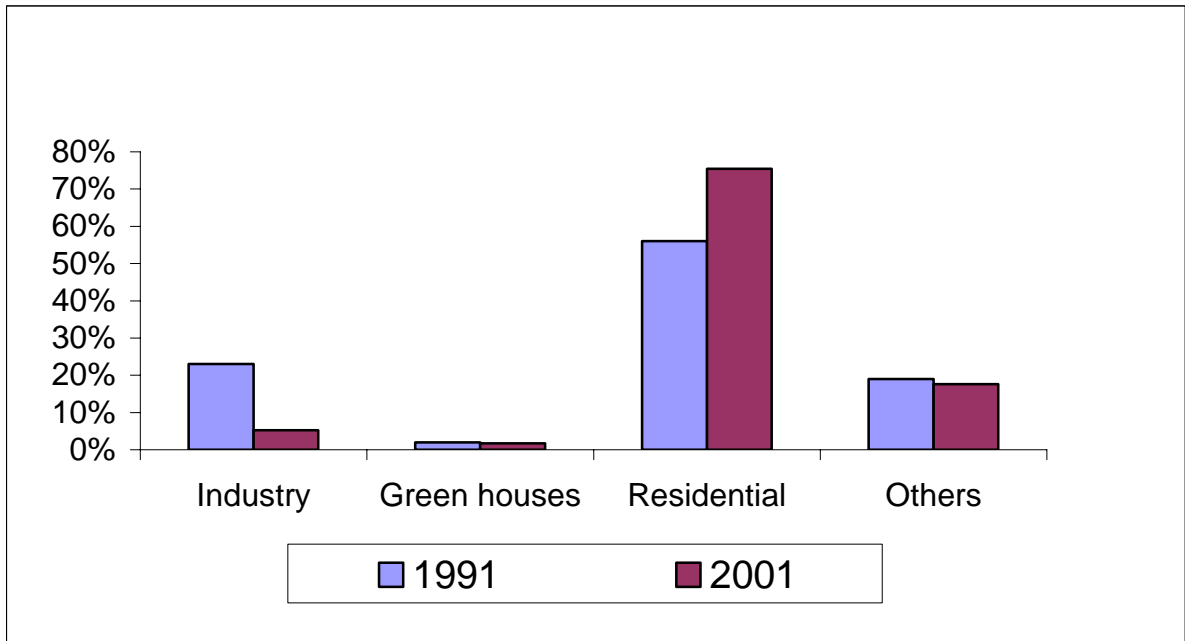
Item	Unit	1996	1997	1998	1999	2000	2001	2002
Electricity								
Base Tariff								
Industrial Consumers	Tyin/kWh	20.00	20.00	23.00	34.50	52.00	60.00	80.00
	c/kWh	1.75	1.20	1.30	1.15	1.08	1.25	1.66
Residential Consumers	Tyin/kWh	10.00	12.00	14.00	18.20	21.00	21.00	43.00
	c/kWh	0.87	0.72	0.79	0.62	0.44	0.44	0.90
Heat								
Base Tariff								
Industrial Consumers	Som/Gcal	207.0	207.0	252.0	377.0	452.0	534.0	534.0
Residential Consumers	Som/Gcal	75.0	100.0	115.0	173.0	260.0	390.0	390.0
Hot Water	Som/Gcal	8.0	10.6	22.0	30.0	40.0	57.6	57.60
Exchange Rate	\$/Som	12.8	17.4	20.8	39.0	47.7	48.0	48.0

Tyin/kWh = 0.01 Som per kilowatt-hour; c/kWh = US cent per kilowatt-hour; Som/Gcal = Som by gigacalorie.
Source: State Energy Agency.

Figure A6.2: Electricity Consumption Profiles (1991–2001)

Source: State Energy Agency.

Figure A6.3: Heat Consumption Profiles (1991-2001)



Source: State Energy Agency.

COMPLIANCE WITH LOAN COVENANTS

Covenant	Reference of Loan Document	Status of Compliance
1 Kyrgyz National Energy Holding Company (KNEHC) will be responsible for the planning, implementation, management, supervision, and coordination of the Project.	Loan Agreement (LA), Schedule 6, para. 1	Not complied with. A new agency was formed and we were not consulted.
2 A project implementation unit will be established to carry out procurement, operations, coordination, reporting, and disbursement for all project components.	LA, Schedule 6, para. 2	Complied with.
3 Steps will be taken, in consultation with the Asian Development Bank, to abolish special discount rates for certain categories of consumers.	LA, Schedule 6, para. 3	Complied with.
4 Steps will be taken, in consultation with the Asian Development Bank, to establish a social safety net program for supplying subsidized energy to low-income households.	LA, Schedule 6, para. 4	Complied with.
5 The power and heat tariff setting mechanism developed under Asian Development Bank technical assistance will be implemented, including elimination of cross subsidies in energy consumption and indexation of tariffs to the cost of fuel, inflation rate, and exchange rate.	LA, Schedule 6, para. 5	The State Energy Agency had developed tariff models that gradually eliminate subsidies for domestic heat and electricity tariffs.
6 All necessary actions, including implementation of approved tariff adjustments, will be taken to ensure that revenues will	Project Agreement (PA), Schedule 1, para. 1	
(i) cover cash operating expenses, and		Complied with.
(ii) cover total operating expenses, including depreciation.		Not complied with. (2000 revenues covered only 65% of total operating costs.)

Covenant	Reference of Loan Document	Status of Compliance
7 Appropriate measures will be taken to produce, for each fiscal year, funds from internal sources equivalent to not less than 30% of annual expenditures incurred for that year.	PA, Schedule 1, para. 2	Complied with.
8 Steps will be taken to reduce total accounts receivable to the equivalent of 60 days of billings.	PA, Schedule 1, para. 3	Not complied with. (Accounts receivable in 2000 equaled 120 days of billings.)
9 Fixed assets will be revalued, and the corresponding depreciation charges will be included in the balance sheet, for income tax purposes.	PA, Schedule 1, para. 4	Complied with.
10 KNEHC shall ensure that the Project conforms at all times with internationally acceptable environmental and safety standards.	PA, Schedule 1, para. 5	Complied with.
11 KNEHC shall ensure that no polychlorinated biphenyls (PCB) or asbestos or toxic compounds will be used for project facilities.	PA, Schedule 1, para. 6	Complied with.
12 KNEHC shall ensure that no materials contaminated with PCB or asbestos or toxic compounds will be reused or recycled for the Project and that all other materials identified for reuse will be properly cleaned.	PA, Schedule 1, para. 7	Complied with.
13 KNEHC shall ensure that materials contaminated with PCB or asbestos or toxic compounds will be properly identified, labeled, packed, and disposed of in a secured landfill. KNEHC shall also ensure that the secured landfill's site, design, and maintenance will be included in the project design.	PA, Schedule 1, para. 8	Complied with.
14 KNEHC shall ensure that all personnel involved in the decommissioning of materials contaminated with asbestos will be briefed on the dangers and proper handling of asbestos contaminated materials and provided with appropriate safety clothing and equipment.	PA, Schedule 1, para. 9	Complied with.

**PROCUREMENT DETAILS OF
ASIAN DEVELOPMENT BANK-FINANCED CONTRACTS**

Description of Goods	Mode of Procurement	Supplier/Country of Procurement	Contract Amount	
			Forex	\$ Equivalent
Ordinary and Pre-Insulated Pipe Materials, Fittings	ICB	Barmek Dis Ticaret Ve Elektrik Sanayi AS Turkey	\$ 7,783,587	\$ 7,783,587
Energy Meters & Other Equipment	ICB	Barmek Dis Ticaret Ve Elektrik Sanayi AS Turkey	£ 262,622 \$ 1,861,575	\$ 430,772 \$ 1,861,575
220/110kV Substation Equipment	ICB	Clemessy SA France	\$15,653,136	\$15,653,136
Consultancy for Part B	ICB	SwedPower-Carl Bro Sweden/Denmark	\$ 490,000	\$ 490,000
Consultancy for Part C	ICB	Fichtner Germany	\$ 821,400	\$ 821,400
Consultancy – Audit of 1996 Accts. Price Waterhouse, Kazakhstan	ICB	Price Waterhouse Kazakhstan	\$ 450,000	\$ 450,000

ICB = international competitive bidding.

Source: Asian Development Bank.

FINANCIAL PERFORMANCE OF KYRGYZ NATIONAL ENERGY HOLDING COMPANY

Table A9.1: Income Statement
(Som '000)

Item	1996	1997	1998	1999	2000
Revenues					
Sales of Electricity and Heat	1,761,593	2,545,492	2,208,865	4,242,972	6,785,216
Other Operating Revenue (Net)			54,625	37,194	66,124
Total Revenue	1,761,593	2,545,492	2,263,490	4,280,166	6,851,340
Operating Costs					
Production and Distribution	1,153,898	1,560,314	1,687,997	1,713,258	2,946,202
Depreciation	217,442	450,709	683,975	545,810	547,924
General and Administrative Expenses	275,824		655,520	1,044,642	854,946
Impairment Loss on Investments ^a		2,312,526	2,521,762		180,702
Loss on disposal of PPE			31,420	65,685	113,906
Other	181,596	48,317	165,050	450,184	383,643
Total Operating Costs	1,828,760	4,371,866	5,745,724	3,819,579	5,027,323
Non Operating Income	14,707	148,612	103,746	174,130	208,233
Income Before Monetary Effects and Income Tax	(52,460)	(1,677,761)	(3,378,488)	634,717	2,032,250
Monetary Effects					
Interest Expense (Net)	36,331	17,491	28,613	19,988	22,797
Exchange Loss (Net)	162,057	118,545	245,666	1,114,708	43,830
Income Before Income Tax	(250,848)	(1,813,796)	(3,652,767)	(499,979)	1,965,623
Income Tax					
Current Income Tax Expense	(10,490)	25,722	(3,478)		402,211
Deferred Income Tax Expense (Benefit)			(546,195)	(169,154)	197,315
Extraordinary Income	81,776				
Net Income	(158,582)	(1,839,519)	(3,103,094)	(330,825)	1,366,097
Ratios					
Operating Ratio ^b (%)	104	172	254	89	73
Working Ratio ^c (%)	91	154	224	76	65
Accounts Receivable (months)	5.0	6.6	4.3	3.2	4.0

^a IAS 36 requires an impairment loss to be recognized immediately whenever the carrying amount of an asset exceeds its recoverable amount.

^b Total operating expenses as a percentage of total revenues.

^c Total cash operating expenses as a percentage of total revenues.

Source: Kyrgyz National Energy Holding Company (audited accounts).

Table A9.2: Cash Flow Statement
(Som '000)

Item	1997	1998	1999	2000
Operating Activities				
Net Income	(1,839,519)	(3,103,094)	(330,825)	1,366,097
Adjustments	2,750,325	3,010,531	2,070,980	2,025,656
Changes in Working Capital	(248,033)	(33,930)	(956,779)	(2,129,135)
Income Tax Paid				(5,312)
Interest Paid		(68,652)	(112,762)	(170,403)
Net Cash from Operating Activities	662,773	(195,145)	670,614	1,086,903
Investing Activities				
Proceeds from Sales of Property, Plant and Equipment	1,093,264	15,937	40	866
Purchase of Property, Plant, Equipment	(1,832,973)	(703,065)	(2,120,477)	(1,816,888)
Purchase of Investment	(7,326)		(46)	(91)
Dividends and Interests	4,781	10,437	73	
Net Cash from Investing Activities	(742,254)	(676,691)	(2,120,410)	(1,816,113)
Financing Activities				
Proceeds from long-term debt	130,200	1,038,448	1,624,493	1,101,421
Repayment of long-term debt	(45,655)	(164,208)	(168,323)	(356,616)
Net Cash from Financing Activities	84,545	874,240	1,456,170	744,805
Net Increase in Cash	5,064	2,404	6,374	15,595
Cash at Beginning of Year	11,192	16,256	18,660	25,034
Cash at End of Year	16,256	18,660	25,034	40,629
Ratios				
Debt Service Ratio ^a (times)	14.52		2.79	2.39
Self Financing Ratio ^b (%)	36.16		31.63	59.82

^a Ratio of net internal cash generation to debt service requirement.

^b Ratio of self-financing fund to average capital expenditure.

Source: Kyrgyz National Energy Holding Company (audited accounts).

Table A9.3: Balance Sheet
(Som '000)

Item	1996	1997	1998	1999	2000
Assets					
Non-Current Assets					
Property, Plant and Equipment (Net)	7,251,521	16,247,366	13,775,849	15,504,131	16,872,857
Long-term Receivables (Kumto Operating Co.)			718,380	965,292	895,499
Long-term Investments	11,412	198,596	198,596	198,642	18,031
Total Non-Current Assets	7,262,933	16,445,962	14,692,825	16,668,065	17,786,387
Current Assets					
Inventories	266,368	764,235	706,465	988,148	954,479
Accounts Receivable and Other Current Assets (Net)	727,578	1,409,791	808,718	1,158,498	2,256,493
Current Portion of Long-term Receivables			96,000	148,463	162,411
Short-term Investments		585	665	2,714	1,090
Cash	11,192	16,256	18,660	25,034	40,629
Total Current Assets	1,005,138	2,190,867	1,630,508	2,322,857	3,415,102
Total Assets	8,268,071	18,636,829	16,323,333	18,990,922	21,201,489
Liabilities and Shareholders' Equity					
Current Liabilities					
Current Portion of Long-term Debt	96,962	92,998	182,941	696,199	1,455,841
Accounts Payable	354,099	1,563,617	1,301,890	1,549,777	733,188
Other Accounts Payable and Accrued Liabilities	290,720	343,178	252,541	315,496	880,371
Total Current Liabilities	741,781	1,999,793	1,737,372	2,561,472	3,069,400
Non-Current Liabilities					
Long-term Debt	539,541	941,161	1,909,746	4,271,717	4,674,674
Deferred Tax Liabilities		2,931,694	2,400,420	1,545,910	1,743,225
Deferred Income			499,571	481,068	462,565
Total Non-Current Liabilities	539,541	3,872,855	4,809,737	6,298,695	6,880,464
Shareholders' Equity					
Share Capital	89,696	89,696	89,696	89,696	89,696
Revaluation Surplus	6,553,521	9,714,403	9,714,403	9,714,403	9,655,072
Retained Earnings	343,532	2,960,082	-27,875	326,656	1,506,857
Total Shareholders' Equity	6,986,749	12,764,181	9,776,224	10,130,755	11,251,625
Total Liabilities and Shareholders' Equity	8,268,071	18,636,829	16,323,333	18,990,922	21,201,489
Ratios					
Rate Base ^a	7,251,521	11,749,444	15,011,608	14,639,990	16,188,494
Return on Net Fixed Assets ^b (%)					8.66

^a Average of beginning and end of year net fixed assets.

^b Net income before financial expenses as a percentage of rate base.

Source: Kyrgyz National Energy Holding Company (audited accounts).

FINANCIAL EVALUATION

1. The financial evaluation was conducted by identifying and estimating incremental benefits and costs directly related to each project component from available data sources and assumptions reviewed by the subsequent companies. The financial internal rate of returns (FIRR) for the subprojects have been reassessed using the same methodology applied in the appraisal. Project costs are based on the actual numbers provided by the relevant companies and the costs are translated in 2001 constant US dollar terms. Likewise, all incremental revenues and expenditures are adjusted to reflect real US dollar prices, for the majority of investment costs have been disbursed in US dollars and additionally for the ease of comparison with the appraisal results stated in the same currency. Incremental benefits considered for the Rehabilitation of Bishkek Thermal Power Plant (Part A) were savings as a result of reduced fuel consumption and operating costs, and increased electrical capacity where appropriate quantifications allowed objective judgments. Considerations such as reduced system losses, consumer losses and fuel consumption were analyzed for the Rehabilitation of the District Heating Network (Part B). For the Power Transmission and Distribution Rehabilitation (Part C), reduced system outages, network expansion potential and transmission losses were quantified for the reassessment. The financial and economic life for each component was assumed to be the same as projected in the appraisal; 15 years for Parts A and B, and 24 years for Part C after attaining full operation.

2. The FIRRs of the three parts were reevaluated as 11.1% for Part A, 5.28% for Part B, and 10.72% for Part C, and the combined FIRR was reevaluated as 9.57%. The FIRR results at appraisal were higher than the outcome derived in the project completion, which were 23.3%, 17.2%, and 13.8%, respectively, and 17.2% for the Project. None of the parts has experienced overrun of investment costs. However, the impact of incremental benefits has been lesser in degree. This is especially true for Part B because there was incomplete laying of pipes and Bishkek Heating System (BHS) did not have enough funds to complete the installation works. Under the normal circumstance, the works would have been financed and completed within the implementation timeframe. A lower increase in electricity and heat tariffs compared to appraisal also suppressed the FIRRs. The recent operating profits generated by Kyrgyz National Energy Holding Company (KNEHC) have reduced the Government's will to further implement appropriate tariff policy. Effective electricity tariff has risen by an annual average of 20% in real terms during 1999–2001 and heat tariff by 10%. Despite the fact, the average electricity tariff remains low at \$0.016 per kWh and heat tariff at \$8.00 per Gcal. Average long-run incremental costs of electricity supply is estimated at \$0.0366 per kWh. Full cost recovery is yet to be achieved and the tariff should be further increased, for improvement in financial viability and stability of the companies.

3. The FIRRs of the Project is above the weighted average cost of capital (WACC). For BHS, a new action plan has been drawn up and signed by Ministry of Finance (MOF) to complete the remaining installation works by 2008. It is expected that the FIRR for Part B will further improve upon completion of the pipe installation.

4. The Project's WACC has been recalculated in real terms using the actual capital mix. The real interest costs of foreign loans and domestic loans were considered. Incomes tax was assumed at 30% and average domestic inflation of 19% was assumed. The WACC of 4.58% was applied for assessments.

**Table A10.1: Financial Internal Rate of Return
Total Project
(\$)**

With Project						
Year	Incremental Benefit ^b	ADB Project	Capital Cost Other Rehabilitation Project ^c	Total	Incremental Cost	Net Benefit ^a
1997		0.20	1.51	1.71		(1.71)
1998		11.16	7.83	19.00		(19.00)
1999		11.02	12.39	23.41		(23.41)
2000	2.49	2.41	17.51	19.92	0.58	(18.01)
2001	6.86	0.11	5.08	5.18	1.37	0.30
2002	8.88	0.05		0.05	1.88	6.95
2003	9.38		0.52	0.52	1.88	6.99
2004	9.63		0.63	0.63	1.88	7.13
2005	9.92		0.64	0.64	1.88	7.41
2006	10.25		0.64	0.64	1.88	7.73
2007	10.64		0.64	0.64	1.88	8.12
2008	11.07		0.65	0.65	1.88	8.55
2009	11.58				1.88	9.70
2010	11.77				1.88	9.89
2011	11.97				1.88	10.10
2012	12.19				1.88	10.31
2013	12.41				1.88	10.53
2014	12.65				1.88	10.77
2015	12.89				1.88	11.02
2016	10.46				1.88	8.59
2017	7.40				0.87	6.53
2018	7.65				0.87	6.78
2019	7.65				0.87	6.78
2020	7.65				0.87	6.78
2021	7.65				0.87	6.78
2022	7.65				0.87	6.78
2023	7.65				0.87	6.78
2024	7.65				0.87	6.78
Total	236.01	24.95	48.03	72.98	37.07	125.96
FIRR						9.57%

^a Excludes 30% tax on net income.

^b Incremental benefits include increased electrical capacity of 90 MW, reduced operating cost of \$0.8 million per year, and 313 Tcal per year fuel savings. Financial fuel cost of \$6 Gcal was used.

^c Som27.12 million was spent on the remaining installation of pipelines and additional \$3.5 million is estimated to complete the works.

Source: Staff estimates.

Table A10.2: Financial Internal Rate of Return
Subproject A: Rehabilitation of Bishkek Thermal Power Plant
 (\$)

Year	Incremental Benefit ^b	ADB Project	With Project		Incremental Cost	Net Benefit ^a
			Capital Cost Other Rehabilitation Project	Total		
1997			0.08	0.08		(0.08)
1998			2.00	2.00		(2.00)
1999			4.88	4.88		(4.88)
2000	1.34		9.62	9.62		(8.28)
2001	2.69		3.27	3.27		(0.58)
2002	2.69					2.69
2003	2.69					2.69
2004	2.69					2.69
2005	2.69					2.69
2006	2.69					2.69
2007	2.69					2.69
2008	2.69					2.69
2009	2.69					2.69
2010	2.69					2.69
2011	2.69					2.69
2012	2.69					2.69
2013	2.69					2.69
2014	2.69					2.69
2015	2.69					2.69
Total	41.68		19.86	19.86		21.82
FIRR						11.10%

^a Excludes 30% tax on net income.

^b Incremental benefits include increased electrical capacity of 90 MW, reduced operating cost of \$0.8 million per year, and 313 Tcal per year fuel savings. Financial fuel cost of \$6 Gcal was used.

Source: Staff estimates.

**Table A10.3: Financial Internal Rate of Return
Subproject B: Rehabilitation of the District Heating Network
(\$)**

Year	Incremental Benefit ^b	With Project			Incremental Cost ^c	Net Benefit ^a
		ADB Project	Capital Cost Other Rehabilitation Project	Total		
1997		0.071	0.00	0.07		(0.07)
1998		6.109	1.24	7.35		(7.35)
1999		1.106	3.75	4.86		(4.86)
2000		0.173	5.58	5.75		(5.75)
2001	1.67	0.062	1.80	1.86	0.50	(0.69)
2002	3.34	0.003	0.00	0.00	1.01	2.33
2003	3.34		0.52	0.52	1.01	1.81
2004	3.34		0.63	0.63	1.01	1.70
2005	3.34		0.64	0.64	1.01	1.69
2006	3.34		0.64	0.64	1.01	1.69
2007	3.34		0.64	0.64	1.01	1.69
2008	3.34		0.65	0.65	1.01	1.68
2009	3.34				1.01	2.33
2010	3.34				1.01	2.33
2011	3.34				1.01	2.33
2012	3.34				1.01	2.33
2013	3.34				1.01	2.33
2014	3.34				1.01	2.33
2015	3.34				1.01	2.33
2016	3.34				1.01	2.33
Total	51.75	7.520	16.09	23.61	15.62	12.52
FIRR						5.28%

^a Excludes 30% tax on net income.

^b Incremental benefits include reduction in heat loss and consumer wastage. Financial District Heating cost is reassessed at \$13.6 per Gcal.

^c Lost revenue from reduced consumer wastage is estimated to be around \$1 million per year.

Source: Staff estimates.

Table A10.4: Financial Internal Rate of Return
Subproject C: Power Transmission and Distribution Rehabilitation
 (\$)

Year	Incremental Benefit ^b	With Project			Incremental Cost ^c	Net Benefit ^a
		ADB Project	Capital Cost Other Rehabilitation Project	Total		
1997		0.13	1.43	1.56		(1.56)
1998		5.05	4.59	9.64		(9.64)
1999		9.92	3.76	13.67		(13.67)
2000	1.14	2.24	2.30	4.54	0.58	(3.98)
2001	2.50	0.04	0.01	0.06	0.87	1.57
2002	2.85	0.05	0.00	0.05	0.87	1.93
2003	3.36				0.87	2.49
2004	3.61				0.87	2.74
2005	3.89				0.87	3.03
2006	4.23				0.87	3.36
2007	4.61				0.87	3.74
2008	5.05				0.87	4.18
2009	5.55				0.87	4.68
2010	5.74				0.87	4.87
2011	5.95				0.87	5.08
2012	6.16				0.87	5.29
2013	6.38				0.87	5.51
2014	6.62				0.87	5.75
2015	6.86				0.87	6.00
2016	7.12				0.87	6.25
2017	7.40				0.87	6.53
2018	7.65				0.87	6.78
2019	7.65				0.87	6.78
2020	7.65				0.87	6.78
2021	7.65				0.87	6.78
2022	7.65				0.87	6.78
2023	7.65				0.87	6.78
2024	7.65				0.87	6.78
Total	142.59	17.43	12.09	29.52	21.45	91.62
FIRR						10.72%

^a Excludes 30% tax on net income.

^b Incremental benefits include new sales revenue, outage reduction and transmission loss reduction. Outage cost was assumed to be \$0.20 per kWh, willingness to pay at \$0.05 per kWh.

^c Incremental costs consist of additional operational and maintenance costs and new energy costs as a result of network expansion.

ECONOMIC EVALUATION

1. The economic assessment was undertaken by comparing incremental economic benefits and costs linked to the with- and without- project scenarios, which were carried out following the methodology adopted in the appraisal. The general assumptions used in the economic analyses are (i) fuel cost savings valued at border price for each type of fuel consumed: fuel oil at \$100 per ton, natural gas \$40 per 1000 m³ and coal \$25 per ton¹, (ii) estimated weighted average willingness to pay for electricity of \$0.05 per kWh, energy not served savings valued at \$0.20 per kWh and the long run marginal costs (LRMC) of electricity and heat generation are considered for the economic re-evaluations. All revenues and expenditures for economic analyses are expressed in 2001 constant US dollar terms. Additionally, it has been assumed that fuel prices will not increase in real terms during the economic life of the Project.
2. The investment costs of the three parts were mostly foreign costs. Non-tradable item was limited to local labor costs, which were insignificant in comparison with the total project costs spent on the respective parts. Therefore, conversion factors were ignored for the purpose of calculating economic investment costs.
3. The economic internal rate of return (EIRR) is estimated to be 13.07% for Part A, 11.31% for Part B, and 17.32% for Part C. The combined Project EIRR is 14.76%, indicating that the overall Project is economically viable (Tables A11.1 to A11.4.). The parts had lower EIRRs than estimated during appraisal, which was 24.1% for Part A, 25.6% for Part B, 28.5% for Part C, and 26.5% for the combined Project. The lower EIRRs are primarily due to reduced impact from the assumed incremental benefits, implementation delays, and higher incremental costs associated with the relevant project components.

¹ Prices based on import costs for fuels from Central Asia.

**Table A11.1: Economic Internal Rate of Return
Total Project
(\$)**

Year	Incremental Benefit ^a	With Project Capital Cost			Incremental Cost	Net Benefit
		ADB Project	Other Rehabilitation Project	Total		
1997		0.20	1.51	1.71		(1.71)
1998		11.16	7.83	19.00		(19.00)
1999		11.02	12.39	23.41		(23.41)
2000	5.98	2.41	17.51	19.92	1.75	(15.69)
2001	13.73	0.11	5.08	5.18	3.20	5.34
2002	15.50	0.05		0.05	3.20	12.24
2003	16.65		0.52	0.52	4.07	12.06
2004	16.65		0.63	0.63	4.07	11.95
2005	16.65		0.64	0.64	4.07	11.94
2006	16.65		0.64	0.64	4.07	11.93
2007	16.65		0.64	0.64	4.07	11.93
2008	16.65		0.65	0.65	4.07	11.93
2009	16.65				4.07	12.58
2010	16.65				4.07	12.58
2011	16.65				4.07	12.58
2012	16.65				4.07	12.58
2013	16.65				4.07	12.58
2014	16.65				4.07	12.58
2015	16.65				4.07	12.58
2016	13.66				4.07	9.59
2017	10.12				4.07	6.05
2018	10.12				4.07	6.05
2019	10.12				4.07	6.05
2020	10.12				4.07	6.05
2021	10.12				4.07	6.05
2022	10.12				4.07	6.05
2023	10.12				4.07	6.05
2024	10.12				4.07	6.05
Total	346.23	24.95	48.03	72.98	97.73	175.51
EIRR						14.76%

^a Incremental benefits include increased electrical capacity of 90 MW, reduced operating cost of \$0.8 million per year and 313 Tcal per year fuel savings. Economic fuel cost was calculated at \$7 per Gcal.
Source: Staff estimates.

**Table A11.2: Economic Internal Rate of Return
Subproject A: Rehabilitation of Bishkek Thermal Power Plant
(\$)**

Year	Incremental Benefit ^a	With Project			Incremental Cost	Net Benefit
		ADB Project	Other Rehabilitation Project	Total		
1997			0.08	0.08		(0.08)
1998			2.00	2.00		(2.00)
1999			4.88	4.88		(4.88)
2000	1.49		9.62	9.62		(8.13)
2001	2.98		3.27	3.27		(0.28)
2002	2.98					2.98
2003	2.98					2.98
2004	2.98					2.98
2005	2.98					2.98
2006	2.98					2.98
2007	2.98					2.98
2008	2.98					2.98
2009	2.98					2.98
2010	2.98					2.98
2011	2.98					2.98
2012	2.98					2.98
2013	2.98					2.98
2014	2.98					2.98
2015	2.98					2.98
Total	46.26		19.86	19.86		26.40
EIRR						13.07%

^a Incremental benefits include increased electrical capacity of 90 MW, reduced operating cost of \$0.8 million per year, and 313 Tcal per year fuel savings. Economic fuel cost was calculated at \$7 per Gcal.
Source: Staff estimates.

**Table A11.3: Economic Internal Rate of Return
Subproject B: Rehabilitation of the District Heating Network
(\$)**

Year	Incremental Benefit ^a	With Project Capital Cost			Incremental Cost ^b	Net Benefit
		ADB Project	Other Rehabilitation Project	Total		
1997		0.071	0.00	0.07		(0.07)
1998		6.109	1.24	7.35		(7.35)
1999		1.106	3.75	4.86		(4.86)
2000		0.173	5.58	5.75		(5.75)
2001	1.77	0.062	1.80	1.86		(0.09)
2002	3.55	0.003	0.00	0.00		3.54
2003	3.55		0.52	0.52		3.03
2004	3.55		0.63	0.63		2.92
2005	3.55		0.64	0.64		2.91
2006	3.55		0.64	0.64		2.90
2007	3.55		0.64	0.64		2.90
2008	3.55		0.65	0.65		2.90
2009	3.55					3.55
2010	3.55					3.55
2011	3.55					3.55
2012	3.55					3.55
2013	3.55					3.55
2014	3.55					3.55
2015	3.55					3.55
2016	3.55					3.55
Total	54.96	7.520	16.09	23.61		31.35
EIRR						11.31%

^a Economic District Heating cost of \$14.5 per Gcal was used to quantify incremental benefits, which included heat loss reduction and consumer wastage reduction.

^b Incremental costs included lost revenue from the reduction in consumer wastage.

Source: Staff estimates.

**Table A11.4: Economic Internal Rate of Return
Subproject C: Power Transmission and Distribution Rehabilitation
(\$)**

Year	With Project					
	Incremental Benefit ^a	Capital Cost			Incremental Cost ^b	Net Benefit
		ADB Project	Other Rehabilitation Project	Total		
1997		0.13	1.43	1.56		(1.56)
1998		5.05	4.59	9.64		(9.64)
1999		9.92	3.76	13.67		(13.67)
2000	4.48	2.24	2.30	4.54	1.75	(1.81)
2001	8.97	0.04	0.01	0.06	3.20	5.71
2002	8.97	0.05	0.00	0.05	3.20	5.72
2003	10.12				4.07	6.05
2004	10.12				4.07	6.05
2005	10.12				4.07	6.05
2006	10.12				4.07	6.05
2007	10.12				4.07	6.05
2008	10.12				4.07	6.05
2009	10.12				4.07	6.05
2010	10.12				4.07	6.05
2011	10.12				4.07	6.05
2012	10.12				4.07	6.05
2013	10.12				4.07	6.05
2014	10.12				4.07	6.05
2015	10.12				4.07	6.05
2016	10.12				4.07	6.05
2017	10.12				4.07	6.05
2018	10.12				4.07	6.05
2019	10.12				4.07	6.05
2020	10.12				4.07	6.05
2021	10.12				4.07	6.05
2022	10.12				4.07	6.05
2023	10.12				4.07	6.05
2024	10.12				4.07	6.05
Total	245.01	17.43	12.09	29.52	97.73	117.76
EIRR						17.32%

^a New sales revenue and reduction in transmission loss and outage costs are recalculated. Average long run incremental costs of electricity supply to consumers were estimated at \$0.0366/kWh.

^b Incremental costs included additional operational and maintenance costs and new energy costs as a result of network expansion.

Source: Staff estimates.