

PROJECT COMPLETION REPORT

ON THE

ENERGY CONSERVATION PROJECT
(Loan 1492-MON [SF])

IN

MONGOLIA

December 2002

CURRENCY EQUIVALENTS

Currency Unit – togrog (MNT)

		At Appraisal (June 1996)	At Project Completion (June 2002)
MNT1.00	=	\$0.0017	\$0.0009
\$1.00	=	MNT601.70	MNT 1,100.00

ABBREVIATIONS

ADB	–	Asian Development Bank
EA	–	Energy Authority
EIRR	–	economic internal rate of return
FIRR	–	financial internal rate of return
O&M	–	operation and maintenance
SDR	–	special drawing rights

WEIGHTS AND MEASURES

c/kWh	–	cents per kWh
km	–	Kilometer
kWh (kilowatt-hour)	–	1,000 watt-hours
Gcal (gigacalorie)	–	1,000,000 kilocalories
GWh (gigawatt-hour)	–	1,000,000 kWh
Tcal (teracalorie)	–	1,000,000 kilocalories

NOTES

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

CONTENTS

	Page
BASIC DATA	ii
I. PROJECT DESCRIPTION	1
II. EVALUATION OF DESIGN AND IMPLEMENTATION	1
A. Relevance of Design and Formulation	1
B. Project Outputs	2
C. Project Costs and Financing Plan	3
D. Disbursements	4
E. Project Schedule	4
F. Implementation Arrangements	4
G. Conditions and Covenants	5
H. Consultant Recruitment and Procurement	5
I. Performance of Consultants, Contractors, and Suppliers	5
J. Performance of the Borrower and the Executing Agency	6
K. Performance of Asian Development Bank	6
III. EVALUATION OF PERFORMANCE	6
A. Relevance	6
B. Efficacy in Achievement of Purpose	6
C. Efficiency in Achievement of Outputs and Purpose	7
D. Preliminary Assessment of Sustainability	9
E. Environmental, Sociocultural, and Other Impacts	9
IV. OVERALL ASSESSMENT AND RECOMMENDATIONS	10
A. Overall Assessment	10
B. Lessons Learned	10
C. Recommendations	11
APPENDIXES	
1. Chronology of Major Events	12
2. Calculation of Project Benefits	13
3. Energy Conservation Under Demonstration Project	15
4. Project Costs and Financing Plan	16
5. Summary of Contracts	17
6. Loan Disbursements	18
7. Implementation Schedule	19
8. Change in Project Scope	20
9. Status of Compliance With Loan Covenants	21
10. Financial Internal Rate of Return	22
11. Electricity and Heat Tariffs	23
12. Income Statements of Energy Authority	24
13. Balance Sheets of Energy Authority	25
14. Cash Flow Statements of Energy Authority	26
15. Restructured Electricity Industry	27
16. Economic Internal Rate of Return	28
17. Quantitative Assessment of Overall Project Performance	29

BASIC DATA

A. Loan Identification

1.	Country	Mongolia
2.	Loan Number	Loan 1492-MON
3.	Project Title	Energy Conservation Project
4.	Borrower	Government of Mongolia
5.	Executing Agency	Energy Authority
6.	Amount of Loan	\$10 million (SDR6,944,000)
7.	Project Completion Report Number	PCR: MON 699

B. Loan Data

1.	Appraisal	
	– Date Started	17 June 1996
	– Date Completed	27 June 1996
2.	Loan Negotiations	
	– Date Started	15 October 1996
	– Date Completed	18 October 1996
3.	Date of Board Approval	26 November 1996
4.	Date of Loan Agreement	11 August 1997
5.	Date of Loan Effectiveness	
	– In Loan Agreement	11 November 1997
	– Actual	26 January 1998
	– Number of Extensions	None
6.	Closing Date	
	– In Loan Agreement	31 June 2001
	– Actual	31 August 2001
	– Number of Extensions	None
7.	Terms of Loan	
	– Service Charge	1% per annum on the amount of the loan withdrawn from the loan account
	– Maturity (number of year)	40
	– Grace Period (number of years)	10
8.	Terms of Relending	
	– Interest Rate	Variable rate applicable to multicurrency loans from the Asian Development Bank's ordinary capital resources
	– Maturity (number of years)	24
	– Grace Period (number of years)	4

9. Disbursements

a. Dates

Initial Disbursement	Final Disbursement	Time Interval
22 June 1998	10 August 2001	3 years, 2 months
Effective Date	Original Closing Date	Time Interval
26 January 1998	30 June 2001	3 years, 5 months

b. Amount (\$)

Category or Subloan	Original Allocation	Last		Undisbursed Balance
		Revised Allocation	Amount Disbursed	
01A Eqpt – Heat Meters Including Calibration	3,739,919	2,520,172	2,388,128	132,405
01B Eqpt – DH Pipe Replacement	1,680,588	2,098,745	2,136,579	-37,834
01C Eqpt – Section Valve Replacement	740,207	741,276	759,612	-18,336
01D Eqpt – DH Pump Replacement at TES 3	760,369	714,872	701,066	13,807
01E Eqpt – DH Demonstration Project	240,495	221,350	145,100	76,250
01F Eqpt – Electric Meters at Power Plants	169,931	436,771	452,032	-15,262
01G Eqpt – Electric Meters at Distribution Substations	809,332	1,321,085	1,129,340	191,745
01H Eqpt – Calibration Equipment for Electric Meters	159,850	214,490	222,483	-7,993
02 Consulting Services	400,346	528,064	517,797	10,267
03 Service Charge	159,850	144,667	116,736	27,931
04 Unallocated	1,139,113	345,689	0	345,689
Total	10,000,000	9,287,183	8,568,873	718,310^a

DH = district heating, TES = Thermal Energy Station No. 3.

^a An undisbursed loan amount of SDR565,870 was canceled on 31 August 2001.

10. Local Costs (Financed)

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

C. Project Data

1. Project Cost (\$ million)

Cost	Appraisal Estimate	Actual
Foreign Exchange Cost	10.00	8.57
Local Currency Cost	3.19	1.09
Total	13.19	9.66

2. Financing Plan (\$ million)

Cost	Appraisal Estimate			Actual		
	Foreign	Local	Total	Foreign	Local	Total
Implementation Costs						
ADB-Financed	9.84	0	9.84	8.45	0	8.45
Borrower-Financed	0	2.22	2.22	0	1.09	1.09
Other External Financing	0	0	0	0	0	0
Total	9.84	2.22	12.06	8.45	1.09	9.54
IDC Costs						
ADB-Financed	0.16	0	0.16	0.12	0	0.12
Borrower-Financed	0	0.97	0.97	0	0	0
Other External Financing	0	0	0	0	0	0
Total	10.0	3.19	13.19	8.57	1.09	9.66

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

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

Component	Appraisal Estimate			Actual		
	Foreign	Local	Total	Foreign	Local	Total
A. Base Costs^a						
District Heating Network	7.16	1.78	8.94	6.13	0.67	6.80
Electricity Network	1.14	0.07	1.21	1.80	0.28	2.08
Consulting Services	0.40	0.10	0.50	0.52	0.05	0.57
Project Implementation Unit Office and Management Costs	0	0	0	0	0.09	0.09
Subtotal	8.70	1.95	10.65	8.45	1.09	9.54
B. Contingencies						
Physical	0.87	0.20	1.07	0	0	0
Price	0.27	0.07	0.34	0	0	0
Subtotal	1.14	0.27	1.41	0	0	0
C. Interest During Construction						
Total	10.00	3.19	13.19	8.57	1.09	9.66

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

^a Base costs reflect prices at the end of 1993.

4. Project Schedule

Item	Appraisal Estimate	Actual
1. Heat and Flow Meters		
Bid Period	Oct 1996–Nov 1996	Jan 1998–Mar 1998
Award	Dec 1996–Feb 1997	Apr 1998–Oct 1998
Design	Mar 1997–Nov 1997	Oct 1998–Feb 1999
Manufacture, Transport	May 1997–May 1998	Jan 1999–Jul 1999
Installation	Jul 1997–Sep 1997	May 1999–Sep 1999
	Jun 1998–Sep 1998	May 2000–Sep 2000
	Jun 1999–Sep 1999	
	Jun 2000–Sep 2000	
2. Pipes, Valves, Pumps, Demonstration Project		
Bid Period	Oct 1996–Nov 1996	Dec 1996–Feb 1997
Award	Dec 1996–Feb 1997	Oct 1997–Apr 1998
Design	Mar 1997–Nov 1997	May 1998–Sep 1998
Manufacture, Transport	May 1997–Jun 1998	Jul 1998–Oct 1998
		Feb 1999–Jun 1999
Installation	Jul 1997–Sep 1997	Aug 1998–Sep 1998
	Jul 1998–Sep 1998	Apr 1999–Sep 1999
	Jun 1999–Sep 1999	Mar 2000–Jul 2000
	Jun 2000–Sep 2000	Nov 2000–Jan 2001
3. Electric Meters		
Bid Period	Feb 1997–Mar 1997	Sep 1997–Nov 1997
Award	Apr 1997–Jun 1997	Dec 1997–May 1998
Design	Jul 1997–Sep 1997	Jun 1998–Aug 1998
Manufacture, Transport	Sep 1997–Jan 1998	Jul 1998–Nov 1998
Installation	Feb 1998–Dec 1998	May 1999–Sep 1999
		Jun 2000–Nov 2000
		Feb 2001–Jun 2001
4. Pipe Insulation		
Bid Period	Sep 1996–Oct 1996	Mar 1997–Apr 1997
		Mar 1998–Apr 1998
Award	Nov 1996–Jan 1997	May 1997–Jun 1997
		May 1998–Jun 1998
Design	Feb 1997–Apr 1997	Jul 1997–Aug 1997
		Jul 1998–Aug 1998
Manufacture, Transport	May 1997–Jul 1997	Jul 1997–Sep 1997
		Jul 1998–Sep 1998
Installation	Jul 1997–Sep 1997	Aug 1997–Oct 1997
	Jul 1998–Sep 1998	Aug 1998–Oct 1998
	Jun 1999–Sep 1999	Jul 1999–Sep 1999
	Jun 2000–Sep 2000	
5. Engineering Services		
Invitation for Proposals	Aug 1996–Sep 1996	Oct 1996–Nov 1996
Award	Oct 1996–Dec 1996	Dec 1996–Jan 1997
Services and Training	Jan 1997–Dec 1998	Feb 1997–Nov 1997
	May 1999–Sep 1999	Jan 1998–Sep 1998
	Jun 2000–Dec 2000	Apr 1999–Sep 1999
		Jul 2000–Oct 2000
		Apr 2001–Jun 2001
Operation and Maintenance Training		May 1999–Oct 1999
		Jan 2001–Mar 2001

5. Project Performance Report Ratings

Implementation Period	Ratings			
	Development Objectives		Implementation Progress	
	Last	Current	Last	Current
From 30 Sept 1998	S	S	S	S
From 1 Oct 1998 to 31 Mar 1999	S	S	S	HS
From 1 Apr 1999 to 31 Dec 1999	S	S	HS	HS
From 1 Jan 2000 to 30 Sep 2000	S	S	HS	HS

HS = highly satisfactory, S = satisfactory.

D. Data on Asian Development Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-Days	Specialization of Members
Fact Finding	22 Feb–8 Mar 1996	5	75	a, d, g, j, k
Appraisal	17–27 June 1996	5	55	a, b, c, d, g
Review 1	25 May 1997	1	1	a
Review 2	26–28 Nov 1997	1	3	a
Review 3	12–16 Oct 1998	2	10	a, i
Review 4	22–26 May 1999	2	10	a, i
Review 5	9–12 Nov 1999	2	8	a, i
Review 6	24–27 Oct 2000	2	8	a, i
Review 7	18–21 Jun 2001	2	8	a, i
Project Completion Review ^a	25–29 Jun 2002	2	10	f, i
	21–26 Jun 2002	1	6	k

a = engineer, b = financial analyst, c = counsel, d = economist, e = procurement consultant or specialist, f = control officer, g = programs officer, h = young professional, i = assistant or senior assistant, j = environmental specialist, k = staff consultant.

^a The Mission comprised S. Hasnie, Energy Specialist (Mission Leader); S. Zaidi, staff consultant; and C. B. Africa, Assistant Project Analyst.

I. PROJECT DESCRIPTION

1. The Project's strategic objectives were to (i) meet the basic needs of the population and support economic recovery; and (ii) promote sector efficiency. The direct objectives of the Project were to (i) improve district heating reliability and reduce district heating losses by rehabilitating critical sections of the district heating system in Ulaanbaatar; (ii) encourage end-use energy conservation through improved metering and through demonstration projects; and (iii) improve district heating system operation and maintenance through on-the-job training and technical support.

2. The Project provided for the following items at appraisal:

(i) District heating network:

- (a) Replace about 6 kilometers (km) of heating pipes in poor condition.
- (b) Install 10 flow meters at the pump stations, 57 heat meters at major block substations, about 1,200 meters on the premises of directly connected customers and also provide meter calibration equipment.
- (c) Replace 39 leaking section valves in the network.
- (d) Replace two old district heating pumps at Thermal Energy Station Number 3.
- (e) Implement a demonstration project on energy conservation in selected residential buildings.
- (f) Replace 18 km of pipe insulation.
- (g) Provide on-the-job training in hardware operation and maintenance (O&M).

(ii) Electricity network:

- (a) Install about 50 electronic meters at the combined heat and power plants and at key points of the transmission network.
- (b) Install about 2,000 electricity meters at distribution substation.
- (c) Set up meter calibration facilities and install meter testing units in four provinces.
- (d) Provide on-the-job training in O&M.
- (e) Provide consulting services to supervise project implementation and training in O&M.

3. The Government of Mongolia was the Borrower and the Energy Authority was the Executing Agency. The District Heating Company was established by Government decree (Decree Number 164) on 9 August 2001, following completion of the Project. To avoid confusion, the report refers only to the Energy Authority. Appendix 1 presents a chronology of the major events in implementing the Project.

II. EVALUATION OF DESIGN AND IMPLEMENTATION

A. Relevance of Design and Formulation

4. Heating is essential for survival in Ulaanbaatar, the world's coldest capital, where temperatures can be below minus 40° centigrade for as long as 8 months of the year. Ulaanbaatar's district heating system is more than 40 years old: it was put into operation in 1959 using then current technology. Under this system heat levels are adjusted by changing the temperature of water fed into the district heating networks at the combined heat and power

plants. Individual consumers have no control over the volume of heat delivered to their homes, and the only way they can control excessive heating is by opening the windows, thereby wasting valuable energy.

5. Energy Authority, the entity responsible for providing heating to the city, lacked adequate funds for spare parts so that it could properly maintain the district heating system. Inadequate maintenance, poor insulation, and leaks throughout the district heating system caused excessive losses of heat and hot water. Major rehabilitation was the only way to ensure efficient and reliable heat supplies.

6. Energy Authority needed to stop energy losses by rehabilitating critical sections of the heat distribution facilities and installing meters for heat and electricity. The Project was designed to (i) reduce the significant heat losses and water leakage in the district heating system, and (ii) introduce heat and electricity meters to encourage energy conservation.

7. The Project was part of a least-cost development program needed to improve the efficiency and reliability of the heat supply in Ulaanbaatar and the electricity supply in the main grid. It was designed to complement the electricity and heat system rehabilitation measures under implementation at that time with assistance from the Asian Development Bank (ADB).¹ The Project was also designed as a step toward the achievement of an economically efficient energy sector.

B. Project Outputs

8. The Project was implemented successfully as planned. The critical sections of the district heating network have been fully rehabilitated: 6 km (5 km underground and 900 meters above ground) of heating pipes have been replaced, 7 flow meters have been installed at the pump stations, 57 heat meters have been installed at major block substations, 1,182 meters have been installed for directly connected customers, 61 leaking section valves have been replaced, 2 old district heating pumps have been changed at Thermal Energy Station Number 3, and 18 km of pipe insulation have been replaced. Following the rehabilitation the district heating system has improved its ability to supply reliable heating to customers.

9. Energy Authority increased heat delivery by 14 percent by stopping leaks of hot water. Heat delivery in the district heating system increased from 3,211 teracalories (Tcal) in 1998 to 3,658 Tcal in 2001. Energy Authority can now maintain a constant flow of hot water in the pipeline for supply to consumers as leakage of water has reduced. Amount of freshwater used in the overall operation of the district heating network is also reduced from 5.1 million tons in 1998 to about 3.9 million tons in 2001, a saving of 1.2 million tons, an important improvement considering high cost of water treatment, the heat losses through loss of hot water, and scarcity of freshwater in Mongolia. The replacement of district heating pipe insulation and the provision of protective pipe coverings has saved another 854 Gcal per year in radiation losses.

10. Following the installation of flow meters at strategic points along the district heating network and of heat meters in block substations in apartment buildings and premises of large customers, Energy Authority can now accurately bill customers for their energy consumption and provide the incentive to consumers to save heating. Appendix 2 quantifies the Project's benefit in terms of heat and electricity sales.

¹ ADB. 1994. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to Mongolia for the Power Rehabilitation Project*. Manila.

11. An important element of the Project was the actual demonstration of improved efficiency at the end-user level to provide guidance to consumers on opportunities to save heat, which is now accurately billed to each building due to improved metering. The demonstration project involved four apartment buildings. The Building 1 was not modified and served as a baseline comparator. Simple energy conservation measures, such as repairing of leaks, adjusting hot water flows at the substation, and weather stripping windows and doors, were provided in the Building 2. In Building 3, in addition to the measures adopted in the Building 2, the radiator system in each apartment was converted to permit individual control of heat consumption. In the Building 4 the energy conservation measures in the Building 3 were extended to include the modification of pipes and heat exchangers to enable hot water to be produced efficiently in the building instead of at the substation.

12. The total heat (energy) savings during 13 December 1999 to November 2000 in apartment Building 3 compared with apartment Building 2 were measured at 930 kilowatt-hours (kWh). Similarly, the heat (energy) savings during the same period in apartment Building 4 compared with apartment Building 3 were measured at 900 kWh. These measurements indicated that total energy savings of 1,830 kWh were realized under the demonstration component of the Project, or 13% energy savings if all measures are implemented. The 13% savings validates the appraisal estimate of—13.8%—100 GWh (or 86 Gcal) potential annual savings by domestic customers if the energy conservation measures are implemented. The results are presented in Appendix 3.

C. Project Costs and Financing Plan

13. At appraisal, the total project cost, including service charges and interest during construction, was estimated at \$13.19 million equivalent, of which \$10.00 million (76%) was the foreign currency cost and \$3.19 million equivalent (24%) was the local currency cost. The actual project cost was \$9.66 million equivalent, \$8.57 million (89%) in foreign currency and \$1.09 million equivalent (11%) in local currency cost. Table 1 summarizes project costs, with details provided in Appendix 4.

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

Component	Appraisal Estimate			Actual		
	Foreign	Local	Total	Foreign	Local	Total
A. Base Costs^a						
District Heating Network	7.16	1.78	8.94	6.13	0.67	6.80
Electricity Network	1.14	0.07	1.21	1.80	0.28	2.08
Consulting Services	0.40	0.10	0.50	0.52	0.14	0.66
Subtotal	8.70	1.95	10.65	8.45	1.09	9.54
B. Contingencies						
Physical	0.87	0.20	1.07	0	0	0
Price	0.27	0.07	0.34	0	0	0
Subtotal	1.14	0.27	1.41	0	0	0
C. Interest During Construction	0.16	0.97	1.13	0.12	0.00	0.12
Total	10.00	3.19	13.19	8.57	1.09	9.66

^aBase costs reflect prices at the end of 1993.

14. The actual project cost was \$3.53 million (or 27%) less than the appraisal estimate, and resulted from overall lower equipment costs of about \$2.52 million (including provision for

contingencies). The cost of equipment varied significantly compared with the appraisal estimate, for example, for the district heating network costs were 24% lower, while for the electricity network they were 72% higher. Intense competitive bidding for Package 1² (seven companies bid, with their bids ranging from \$1.95 million to \$3.98 million) resulted in a lower than anticipated price, and the contract was awarded for \$2.23 million. This indicates that the original appraisal estimate of \$3.70 million was relatively high. For Package 2,³ the electricity network, the contract was of relatively smaller size and only one bidder out of six quoted a price below the estimated cost at appraisal.

15. ADB provided a loan of SDR6.94 million (\$10 million equivalent) from its Special Funds resources to finance the entire foreign currency cost of the Project. The Energy Authority provided all the local currency costs. Appendix 5 summarizes the contracts financed by ADB.

D. Disbursements

16. Appendix 6 presents projected and actual disbursements. Total disbursement amounted to SDR6.38 million (\$8.57 million), compared with the approved amount of SDR6.94 million (\$10 million). SDR0.566 million was canceled on 31 August 2001.

E. Project Schedule

17. Appendix 7 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-1997 and to be completed in 42 months (by the end of December 2000) but the actual physical completion took 48 months and was completed in June 2001. Although awarding of the contract for heat and flow meters (Package 1) and for the manufacture and installation of electricity meters (Package 3) experienced significant delays, overall project completion was delayed by only 6 months. This was possible, because the schedules for Package 1 and Package 3 had sufficient slack time, and it was Package 5 that was on the critical path. The loan was closed on 31 August 2001. Appendix 8 describes changes in the Project's scope.

F. Implementation Arrangements

18. The Energy Authority, the Executing Agency, was responsible for overall supervision and coordination of the Project. The Project Steering Committee established under the Power Rehabilitation Project (see footnote 1) continued to provide guidance to the new Project Implementation Unit established for this Project. As agreed, the Project Steering Committee undertook to (i) review all technical plans and designs; (ii) oversee and coordinate all activities, including liaison among the agencies involved; and (iii) serve as a forum for problem resolution.

19. The Project Implementation Unit was responsible for day-to-day implementation of the Project, and was staffed by members from the Energy Authority and the Building and Public Company, a state-owned corporation responsible for supplying electricity and heat to 43 percent of all buildings in Ulaanbaatar. The Building and Public Company's participation facilitated the installation of heat meters in the demonstration buildings, and the company was responsible for creating awareness of energy conservation measures.

² Heat meters and calibration equipment: design, supply, and installation.

³ Piping, valves, pumps and demonstration project: design, supply and installation.

G. Conditions and Covenants

20. The Government was required to pursue three sets of measures under the project – Action Plan for Energy Sector Restructuring, Action Plan for Energy Conservation, and Financial Action Plan for Energy Authority. The major achievement under the Action Plan for Energy Sector Restructuring was the enactment of the Energy Law in January 1996 and preparation of a time-bound action plan for commercialization of Energy Authority in June 1997. The electricity industry in Mongolia has been significantly restructured since the Project was initiated. Under the Action Plan for Energy Conservation a number of the technical targets were achieved as result of the Project. Although the Government and the Energy Authority generally complied with the loan covenants they did not meet the key financial covenants under the financial action plans—working ratios of not more than 60% from Jan 98. Energy Authority has been running at a loss and failed to generate enough cash to meet its operational expenses. Even though the Government did not regularly submit the semi-annual status report as required by the loan covenants, it updated ADB staff on a broad range of issues during each review mission. Appendix 9 shows the status of compliance with the loan covenants.

H. Consultant Recruitment and Procurement

1. Consultants

21. As work on the Project could only be carried out during the summer months (June–September), when weather conditions are favorable and the district heating system is shut down, on 10 June 1996 ADB approved advance action for procurement activities under the Project and for the procurement of the implementation consultants. This facilitated the commencement of site activities during the summer of 1997. The Energy Authority carried out advance recruitment of international implementation consultants as scheduled and in accordance with ADB's *Guidelines on the Use of Consultants*.

2. Procurement

22. The Project was implemented on a turnkey contract basis. The contractor was selected on the basis of international competitive bidding using ADB's *Guidelines on Procurement*.

I. Performance of Consultants, Contractors, and Suppliers

1. Consultants

23. The international implementation consultants provided project management support and assisted the Project Implementation Unit and the Energy Authority with preparing contract documents, tendering, evaluating bids, supervising installation, and commissioning equipment. Overall, the international implementation consultants performed satisfactorily.

2. Contractors and Suppliers

24. The performance of the contractors and suppliers was satisfactory. The contracts were awarded following ADB's bidding procedures, and the materials, maintenance services, and equipment furnished were in accordance with the provisions specified in the contract. The items were generally delivered on schedule.

J. Performance of the Borrower and the Executing Agency

25. The Borrower executed the loan and project agreements in about 9 months and it took almost 13 months for the loan to become effective following Board approval. Project implementation started promptly following loan effectivity. The Borrower also provided adequate local funds on a timely basis to facilitate project implementation without major delays. The Project was implemented following the arrangements envisaged at appraisal. The Energy Authority had little difficulty following ADB's *Guidelines for Procurement*, because it was already familiar with them as this was the Energy Authority's second ADB-financed energy sector project.

26. The Executing Agency, however, did not develop baseline data for household classification, income levels, before or during Project implementation as required. As a result, calculation of the actual number of poor households that received electricity or heat under the Project was not possible. The training provided under the Project enabled the Energy Authority to operate, maintain and improve the project facilities in a systematic manner.

K. Performance of the Asian Development Bank

27. ADB's performance in completing the Project was satisfactory. The implementation arrangements were appropriate to the Project's needs. The number of review missions was adequate, the necessary approvals were given promptly, and the Energy Authority appreciated the level of support provided by ADB missions.

III. EVALUATION OF PERFORMANCE

A. Relevance

28. ADB's medium-term strategy for Mongolia's energy sector has concentrated on rehabilitating existing facilities, promoting energy conservation, undertaking sector reform, and strengthening sector institutions. The Project's rationale to help the Government meet the population's basic human needs was sound, and was based on the urgent need to rehabilitate the facilities to provide essential energy services in Ulaanbaatar. Failure to address this problem would have increased the heat losses in the system ultimately threatening the operation of the district heating system, which would have had a severe impact on the residents of Ulaanbaatar. The project was appropriately designed for the priority needs of Mongolia and it showed that a small, well-designed project that is correctly focused could create a large impact on the life of its beneficiaries.

B. Efficacy in Achievement of Purpose

29. The Project, as conceived during appraisal, was successfully and timely implemented and fully met the design objectives. Considering the sound project implementation, financing arrangements, and coordination among all parties concerned and the Government's reform program in the sector, the Project was completed successfully and should serve as a model for similar projects with other energy sector entities in Ulaanbaatar.

30. The results of the demonstration component of the Project showed that energy saving initiatives in Mongolia, if properly implemented, would not only help households to conserve energy and lower their heating bills, it could defer building of expensive generation capacity to

meet demand. The Project will continue to provide better living conditions during the harsh winter months to Ulaanbaatar's residents.

C. Efficiency in Achievement of Outputs and Purpose

1. Financial Performance

31. The Project achieved the expected benefits. The financial internal rate of return (FIRR) of 14.6 percent is achieved, which is higher than the 13.0 percent calculated at appraisal (Appendix 10). Higher than expected electricity loss reduction; higher heat tariff; and a 27% lower project cost than expected at appraisal (paragraph 14) contributed to the higher FIRR. Table 2 shows the forecast financial benefits of the Project at appraisal.

Table 2: Forecast Financial Benefits at Appraisal

Benefits	Savings	\$ million (NPV)
Heat Loss Reduction, Tcal	79	0.6
Consumer Heat Wastage, Tcal	80	0.6
Technical Loss (electricity), GWh	20	1.2
Nontechnical Loss (electricity), GWh	10	0.6

GWh = gigawatt-hour, Tcal =teracalorie.

32. The actual benefits achieved from heat loss reduction and consumers' cost savings as a result of the Project are captured as increased heat sales and shown graphically in Appendix 2. The analysis assumes that 20 percent of the incremental heat sales are a direct result of the Project's efforts to reduce heat losses. Table 3 shows the actual heat generated compared with the linear trend line using actual data from 1994 to 1997.

Table 3: Comparison of Actual Heat Generated with Trend Line, 1998–2001

Year	Trend Line (Tcal)	Actual Heat Generated (Tcal)	Incremental Heat Sales	
			Project related (%)	(Tcal)
1998	3,211	3,197	5	1
1999	3,336	3,254	10	8
2000	3,629	3,310	15	48
2001	3,658	3,366	20	58

Tcal = teracalorie.

33. The assumption is that the benefits will continue for the remaining life of the Project, that is, until 2018, at the level of 58 Tcal per year. The benefits were valued assuming that current tariffs will be maintained in real terms. If tariffs are increased in real terms the benefits will be larger.

34. Figure A2.4 of Appendix 2 shows the reduction in the volume of water required to replenish the system. At appraisal the total volume required was estimated to be 4.1 million tons, which the appraisers considered very high compared to normal losses in well-maintained district heating systems of similar design. The losses climbed to 5.1 million tons in 1998, but subsequently fell to 3.9 million tons in 2001. Pipe replacement will keep the losses at this sustainable level by arresting the degradation of the pipes. The network's heat losses have also been reduced following the replacement of about 18 km of insulation on district heating pipes. The estimated Weighted Average Cost of Capital (WACC), post-tax, in real terms was derived

using actual capital mix of funds. The real WACC for the project is low as it was financed by 87% debt and 13% equity. The post-tax real WACC is calculated as 4.26% applying the minimum rate test of 4% for cost of debt as per the Guidelines for the Financial Governance and Management of Investment Projects Financed by ADB—and 12% cost of equity. The revised FIRR of the project remains above the WACC.

35. With reference to electricity, the calculations are shown in Table A2.1 of Appendix 2. The average losses were reduced from 25.6 percent in 1996–1998 (Table 4) to 21.4 percent by 2000 or 4.0 percent net savings on average. This represents roughly 90 GWh per year of electricity savings. The benefit attributed to the Project is assumed to be 45%—based on Energy Authority’s estimates—of the net reduction in electricity losses or about 40 GWh per annum, which coincides with the appraisal estimates for loss reduction: 25 GWh for technical loss and 15 GWh for non-technical loss.

Table 4: Reduction of Electricity Losses, 1996–2000

Item	1996	1997	1998	1999	2000
Generation (GWh)	1,912	2,015	2,079	2,228	2,293
Sales (GWh)	1,427	1,526	1,512	1,699	1,802
Loss (%)	25	24	27	24	21
Average Loss (%)	25.6				

GWh = gigawatt-hour.

36. The Energy Authority’s financial performance continues to be weak, with insufficient revenues to cover operating expenses, despite steady growth of electricity sales. This resulted from higher operating expenditure than forecast at appraisal. Accounts receivable remains a problem. The accounts receivable at the end of 2000 were \$25 million or the equivalent of 3.1 months of gross billings, which has more than doubled from 1.4 months in 1995. Although the current average electricity tariff of 4.1 c/kWh is lower than the forecast of 6.6 c/kWh for 2001 at appraisal, the tariff increase made over the last few years in local currency terms is a considerable achievement for the Government. Although the financial performance of the Project is satisfactory, the overall financial performance of the Energy Authority is not adequate as a result of lower tariffs in real US\$ terms. Electricity and heat tariffs are shown in Appendix 11. Despite substantial tariff increases of about 200 percent, significant depreciation of the togrog has resulted in only about 30 percent increase in US dollar terms. Appendixes 12, 13, and 14 present past financial statements of the Energy Authority.

37. As noted earlier, the financial analysis assumes that the benefits will continue until the end of 2018, the original expected life of the project components. The electricity and heat sector in Mongolia has been significantly restructured since the Project was initiated (see Appendix 15). The restructuring and eventual privatization of the industry (privatization is scheduled to take place in the next few years), is likely to improve maintenance and extend the Project’s life.

2. Economic Performance

38. The economic evaluation of the Project was carried out following the methodology used in the appraisal. Incremental costs and benefits were determined for calculating the net benefit stream. The economic life of the project was assumed to be 20 years—as per appraisal estimate—and no residual value at the end of the economic life. Actual capital costs were used in the calculation of the Project’s economic internal rate of return (EIRR) following the approach taken during appraisal. The economic benefits were valued using the same willingness to pay estimates for the electricity and heat energy saved by reduction of: (i) heat loss, (ii) consumer

heat wastage, (iii) technical loss of electricity, and (iv) non-technical loss of electricity. Table A2.1 in Appendix 2 shows detailed assumptions used for calculation of project benefits and the EIRR calculation is in Appendix 16. The estimates used were 5.9 c/kWh for electricity and 1.1 c/kWh for heat. The EIRR was calculated as 33.3% compared with the appraisal forecast of 28.6%. The key driver for the higher EIRR was the lower project cost compared to appraisal.

D. Preliminary Assessment of Sustainability

39. The overall financial health of the Energy Authority was below the expected level. The main reason was the operating expenses were higher than expected at appraisal. In 2000, the total operating expenses were 41% more than the appraisal forecast—due primarily to increase in cost of fuel by 60% and expenses for salaries and administration by 54%. Two key items contributed to the difference between the expected cost of fuel and the actual cost of fuel. In 2000 the actual coal price in MNT was 10% higher than at appraisal and the factor for coal conversion—grams of coal required to produce 1 kWh of electricity—was 16% per cent higher than appraisal estimate of 418 grams per kWh. Energy sales and average tariff forecast at appraisal was close to the actual outcome—forecast revenue was only 3.5% lower than forecast of MNT 89,810 million for 2000. The expected \$223 million—to be spent on capital expenditure between 1998 and 2000—was not spent, the actual capital expenditure over the same period amounted to be about \$135 million equivalent, which highlight the poor condition of the overall power generation facilities. Despite this, the facilities provided under the Project are expected to last the projected economic life. The rehabilitated facilities for the district heating system in Ulaanbaatar under the Project are well maintained and kept in service order. The training provided for O&M staff under each contract package and the on-the-job training provided by consultants during project implementation have prepared the staff to maintain the rehabilitated facilities in the future. Given the technical skills of Energy Authority's staff of and the rehabilitation nature of the Project, the project components were carefully selected to be simple to operate and provide the greatest energy savings. The O&M manual prepared by the consultants will facilitate the continued proper maintenance of the project facilities. These provisions will help ensure that the Project's benefits are sustained.

E. Environmental, Sociocultural, and Other Impacts

1. Environment

40. The Project has a net positive impact on the environment in terms of energy conservation and savings of freshwater, mainly groundwater, which is a scarce resource in Mongolia, in the amount of 1.7 million tons per year. These savings of freshwater are the Project's main environmental benefit. The Project is not expected to have any adverse environmental impacts in the future.

2. Sociocultural Impact

41. Virtually all households in Ulaanbaatar are connected to electricity, but the district heating system serves only 60% of the population, that is, those living in apartments. The remaining 40% percent of the population lives in *gers* and depends on coal and wood as the primary source of heating. Approximately one third of Mongolia's population subsists below the official poverty line, whether calculated in cash or in kind.⁴ More than one fifth of the population is considered ultrapoor, that is, having an income of less than 40 percent below the poverty line. The project through improvement of the reliability and efficiency of the supply of electricity and heat will benefit the entire population in Ulaanbaatar.

⁴ MNT23,600 income per person per month in urban areas and MNT18,200 per person per month in rural areas.

42. To avoid any adverse impact on the poor and on vulnerable groups,⁵ the electricity tariff increase was structured to have no impact on the poor. The tariff for the first 100 kWh of electricity per month, the lifeline level of electricity consumption, was increased only minimally. For district heating, unlike for electricity, individual households are not metered and they are charged based on floor area. Thus making provisions for a lifeline tariff for heat was not technically feasible but in general the better off customers live in the apartment buildings.

IV. OVERALL ASSESSMENT AND RECOMMENDATIONS

A. Overall Assessment

43. The Project was highly relevant, timely, and highly efficacious. It achieved its main objective of improving the efficiency and reliability of heat and electricity supply. It was completed satisfactorily with little delay. No major adverse environmental impacts have occurred. The demonstration component of the Project showed consumers that cost-effective technical changes could generate substantial energy savings.

44. A review of the Project's relevance, efficacy, efficiency, and institutional and development impact indicates that it was successful. Appendix 17 provides a quantitative assessment of project success according to the criteria ADB uses to rate projects. Even though the desired level of tariff increases was not achieved and better financial health was expected during appraisal, the Project's benefits and development impacts are sustainable.

B. Lessons Learned

45. Mongolia's harsh winter and relatively short summer present a unique set of challenges for major construction activities, made worse by the limited number of consultants and contractors experienced in working in such climatic conditions. This factor must be taken into account in designing any project implementation plan for Mongolia. Logistics issues are equally challenging, as Mongolia is land-locked and most items have to be transported overland through the People's Republic of China. Special arrangements for reducing the time for tax and customs-related processing must be addressed at the project design stage to avoid delays that might result in not being able to take full advantage of the short summer. Project related staffs are usually on fixed term contract that terminates immediately after project completion. The project implementation consultants are also difficult to trace. These can create a vacuum in project related knowledge even within the Executing Agency. Executing Agencies lack financial skills and often their accounting systems may be different from international practices; careful consideration is required in developing effective action plans that are deliverable and measurable within the specified timeframe.

46. Because of the Energy Authority's experience in undertaking ADB-funded projects, no significant difficulties were encountered in engineering and physical implementation. The Energy Authority could benefit from assistance in economic analysis and socioeconomic assessment.

⁵ The Government defines vulnerable groups to include the elderly, members of single-headed households with many children, dependents whose source of support has died, the disabled, pregnant and lactating women, orphans, and those who are unable to work.

C. Recommendations

1. Project Related

47. Project related staff should be retained at least up to the period of completion of the Project Completion Report (PCR) to ensure that project implementation knowledge is available for at least the preparation of the PCR. ADB's capacity building training and other initiatives should be targeted to these individuals to maximize project benefits.

48. Action plans need to be short and meaningful, and Executing Agency staff must understand the need for individual items of the plan and buy into the concept. The capacity of the Executing Staff in relation to their training and system needs should be assessed separately to ensure the authority's ability to comply with the covenants.

49. The implementation consultants and the Energy Authority should be regularly made aware of their ongoing obligations to meet data collection and reporting requirements.

2. General

50. The Energy Authority's financial health could be improved by developing a new automatic tariff adjustment mechanism to be implemented by the newly established Energy Regulatory Authority. Future assistance in the Mongolian energy sector should focus on regulatory capacity building to ensure a financially viable, efficient, and sustainable electricity industry.

51. The Government also urgently needs assistance in reorganizing the power sector in general, and the Energy Authority in particular.

CHRONOLOGY OF MAJOR EVENTS

1995

26 Jun Preparatory SSTA 2350-MON: Energy Conservation Project approved

1996

22 Feb – 8 Mar	Fact-Finding Mission fielded
10 Jun	MRM held where advance action for procurement and recruitment of consultants was approved
17-27 Jun	Appraisal Mission fielded
15-18 Oct	Loan negotiations held
27 Sep	SRC held
26 Nov	ADB approved the loan for SDR 6,944,000

1997

3 Jan	Contract for implementation consulting services awarded to COWI Consulting Engineers
25 Mar	Energy Authority's (EA) request for a minor change in scope for Package 3: Electricity Meters
12 May	ADB approved EA's request for a minor change in scope for Package 3: Electricity Meters
25 May	Review Mission 1 fielded
11 Aug	Loan agreements signed
21 Aug	ADB approved rebidding for Package 1: Heat Meters as requested by EA
8 Oct	Contract for Package 2 awarded to Inner Mongolia Autonomous Region
6 Nov	Subsidiary Loan Agreement signed
26-28 Nov	Review Mission 2 fielded

1998

26 Jan	Loan became effective
30 Mar	Contract for Package 3 awarded to MCS International Co., Ltd.
18 Sep	ADB approved contract award to China State Construction Engineering Corporation for Package 1
12-16 Oct	Review Mission 3 fielded
15 Oct	Schlumberger discussed with concerned ADB staff its complaint regarding bid evaluation for Package 1
7-11 Nov	Review Mission 3 fielded

1999

16 Mar	ADB approved reallocation of funds to cover additional costs of various contracts and additional work undertaken by implementation consultants
22-26 May	Review Mission 4 fielded
12 Aug	Consulting services contract for Y2K Contingency and Readiness Plans for the Energy Sector awarded to MCS International Co. Ltd.
7 Dec	ADB approved a minor change in scope to employ consultants for Y2K activities and reallocated funds from the unallocated category to consulting services category for the purpose
9-12 Nov	Review Mission 5 fielded

2000

20 Jul	ADB approved a minor change in scope consisting of procurement of additional equipment under Package 3
24-27 Oct	Review Mission 6 fielded

2001

18-21 Jun	Review Mission 7 fielded
31 August	Cancellation of the undisbursed portion of the loan

Table A2.1 – Calculation of Project Benefits

Item	Unit	1997	1998	1999	2000	2001	2002	2003	2004	2005	2018
DH Loss Reduction											
Distribution Loss	Tcal			8	48	58	58	58	58	58	58
Consumer Wastage	Tcal			43	65	86	86	86	86	86	86
Electricity Loss Reduction											
T&D Technical	GWh			25	25	25	25	25	25	25	25
T&D Non-technical	GWh			15	15	15	15	15	15	15	15
Benefit Values											
Real Heat Tariff	\$/Gcal	3.6	4.0	8.8	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Real Power Tariff	c/kWh	4.5	4.7	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
WTP Heat	\$/Gcal	13.4									
WTP Power	c/kWh	5.9									

c/kWh = cents per kilowatt-hour, Gcal = gigacalorie, GWh = Gigawatt-hour, Tcal = teracalorie, WTP = Willingness to pay, T&D = transmission and distribution.

Figure A2.1: Increased Heat Delivery, 1994—2001

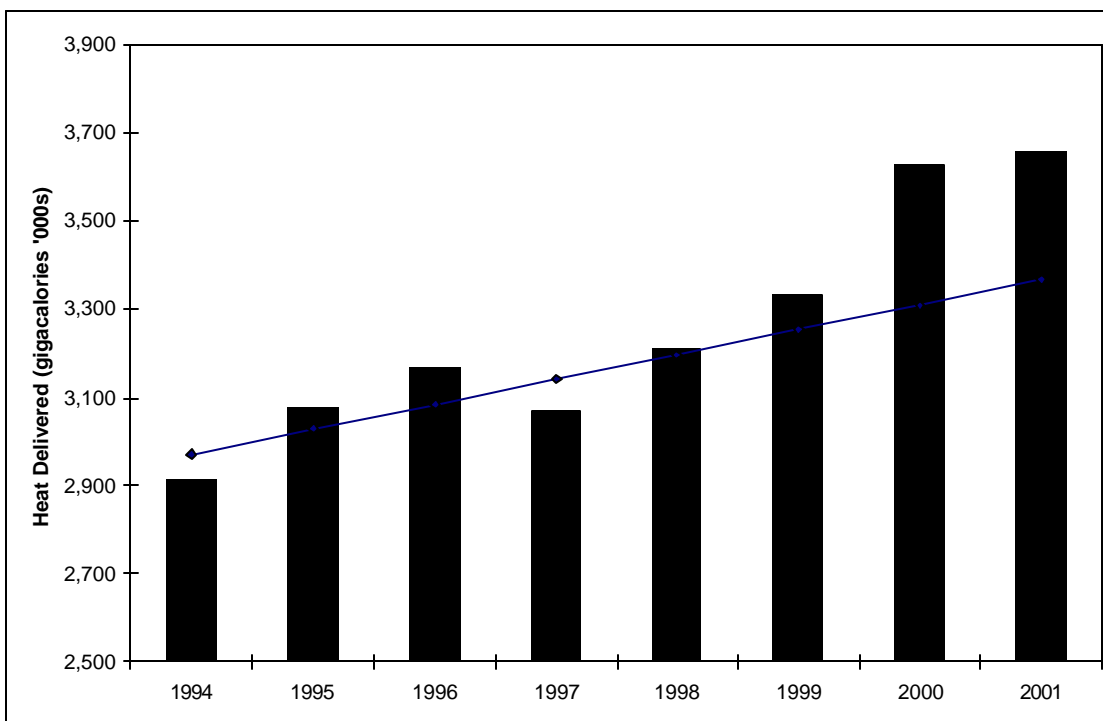


Figure A2.2: Temperature Difference between Supply and Return Water, 1994—2001

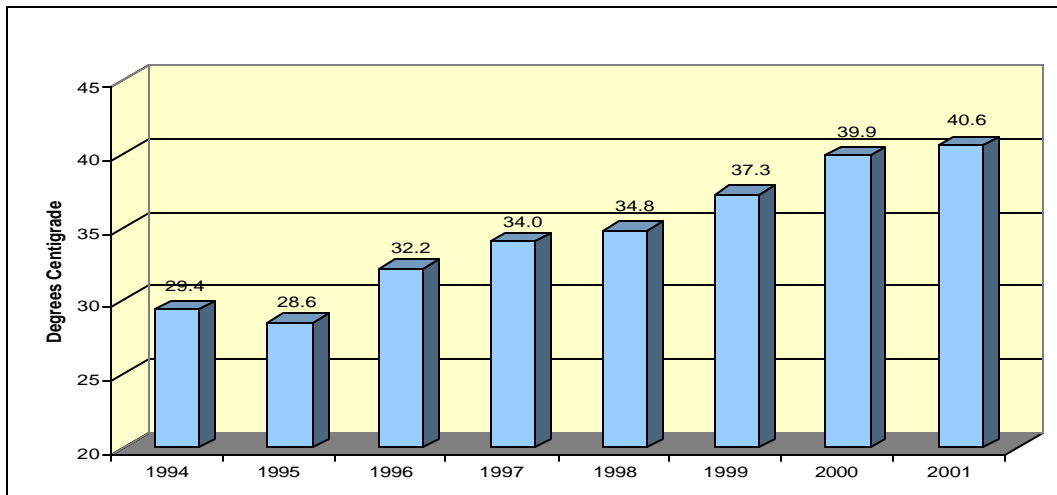


Figure A2.3: Hot Water Required to Deliver 1 Gigacalorie of Heat, 1994—2001

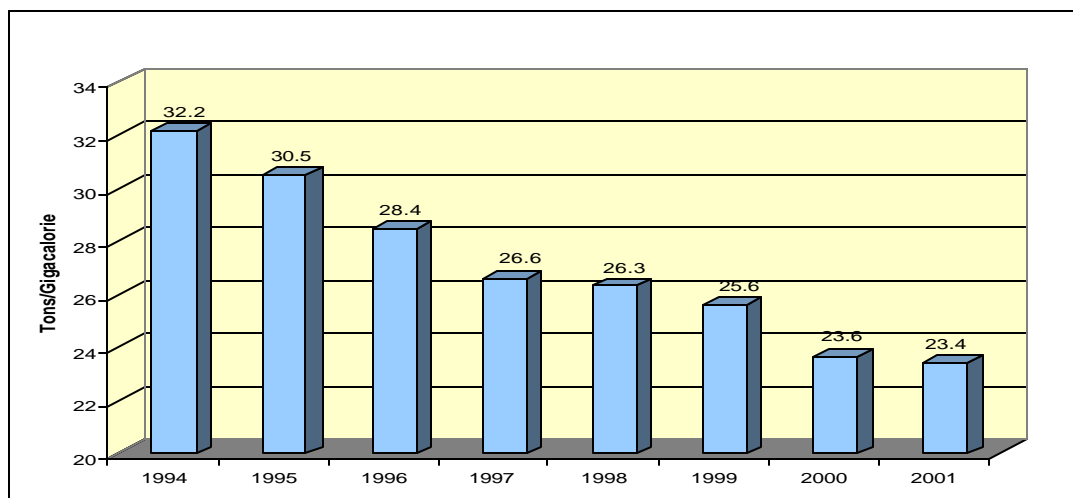
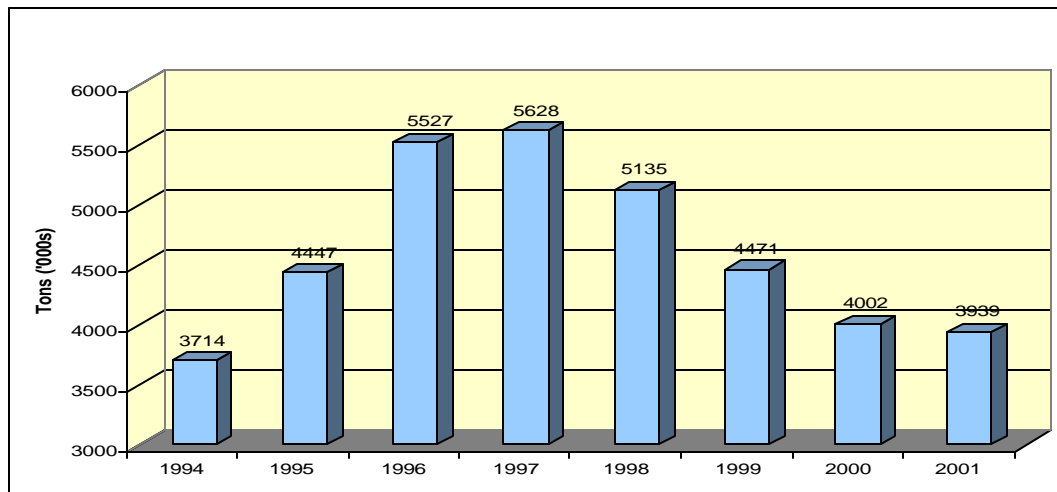


Figure A2.4: Freshwater Replenishment



ENERGY CONSERVATION UNDER DEMONSTRATION PROJECT
(kWh)

Period	Heat (Energy) Consumption			Heat (Energy) Savings		
	Apartment Building 2	Apartment Building 3	Apartment Building 4	(Building 2- Building 3)	(Building 3- Building 4)	(Building 2- Building 4)
19–28 Dec 1999	1,890	1,870	1,830	20	40	60
7–6 Jan 2000	2,200	2,170	2,130	30	40	70
2–11 Feb 2000	2,050	1,990	1,970	60	20	80
20–29 Mar 2000	1,390	1,360	1,210	30	150	180
1–11 Apr 2000	1,260	1,240	1,170	20	70	90
12– 21 Apr 2000	1,330	1,300	1,130	30	170	200
15–24 Sep 2000	1,090	890	670	200	220	420
1–10 Oct 2000	890	820	820	70	0	70
11–20 Oct 2000	1,730	1,470	1,430	260	40	300
14–23 Nov 2000	2,500	2,290	2,140	210	150	360
Total				930	900	1,830

Note: Total savings for 91 days were about 1,830 kWh or about 7,340 kWh per year. This represents almost 13 percent of the energy consumed in the most efficient building. About 48 families live each of these apartments with an average of 6 people per family.

PROJECT COSTS AND FINANCING PLAN

Table 1: Project Financing Plan
(\$ million)

Source	Appraisal Estimate			Actual		
	Foreign	Local	Total	Foreign	Local	Total
Implementation Costs						
ADB-Financed	9.84	0	9.84	8.45	0	8.45
Borrower-Financed	0	2.22	2.22	0	1.09	1.09
Other External Financing	0	0	0	9.00	0	0
Total	9.84	2.22	12.06	8.45	1.09	9.54
Interest During Construction Costs						
ADB-Financed	0.16	0	0.16	0.12	0	0.12
Borrower-Financed	0	0.97	0.97	0	0	0
Other External Financing	0	0	0	0	0	0
Total	10.00	3.19	13.19	8.57	1.09	9.66

ADB = Asian Development Bank.

SUMMARY OF CONTRACTS

Contract Number	Description	Procurement Mode	Amount (\$ million)
Category 1A: – Equipment			
0004	Heat meters including Calibration Equipment	ICB	2.388
Category 1B – 1E: Equipment			
0002	DH pipe replacement	ICB	2.136
	Section valve replacement		0.760
	DH Pump Replacement at Thermal Energy Station No. 3		0.701
	DH demonstration Project		0.145
Category 1F– 1H: Equipment			3.742
0003	Electric meters at power plants	ICB	0.452
	Electric meters at distribution substations		1.129
	Calibration equipment for electric meters		0.222
Category 02: Consulting Services			1.803
0001	Implementation consultancy services	ICB	0.501
8801	Services on year 2000 readiness and contingency plans	Direct purchase/ single tender	0.015

DH = District heating, ICB = International Competitive Bidding.

LOAN DISBURSEMENTS

Year	Quarter	Projected (\$ million)	Actual		% of Loan
			Quarterly Disbursement (\$ million)	Cumulative Disbursement (\$ million)	
1995	I	0.000	0.000	0.000	0.0
	II	0.160	0.000	0.000	0.0
	III	2.960	0.461	0.000	0.0
	IV	0.100	0.000	0.461	1.2
	Subtotal	3.220	0.461		
1996	I	0.000	1.210	1.671	4.5
	II	2.100	0.132	1.803	4.9
	III	3.300	4.607	6.410	17.4
	IV	7.300	5.713	12.123	32.8
	Subtotal	12.700	11.662		
1997	I	2.400	3.760	15.883	43.0
	II	4.200	1.969	17.852	48.3
	III	4.200	3.582	21.434	58.0
	IV	4.200	2.613	24.047	65.1
	Subtotal	15.000	11.924		
1998	I	1.000	1.583	25.630	69.4
	II	0.500	0.788	26.418	71.5
	III	1.500	0.325	26.743	72.4
	IV	1.500	2.826	29.569	80.1
	Subtotal	4.500	5.522		
1999	I	1.800	1.837	31.406	85.0
	II	1.800	0.066	31.472	85.2
	III	1.800	0.000	31.472	85.2
	IV	1.800	0.695	32.167	87.1
	Subtotal	7.200	2.598		
2000	I	0.900	0.855	33.022	89.4
	II	0.900	0.327	33.349	90.3
	III	0.900	0.811	34.160	92.5
	IV	0.900	1.655	35.815	97.0
	Subtotal	3.600	3.648		
2001	I	0.820	0.776	36.591	99.1
	II	0.350	0.340	36.931	100.0
	III	0.000	0.000	36.931	100.0
	IV	0.000	0.000	36.931	100.0
	Subtotal	1.170	1.116		
Total			36.931		

CHANGE IN PROJECT SCOPE

Original Scope	Change in Scope
<p>Since November 1998, EA has been monitoring and coordinating activities on the Y2K issue. A Y2K survey in May 1999 established that (i) 33 percent of the personal computers used were non-Y2K compliant, (ii) about 20 percent of the existing boilers/turbines and load dispatch systems, which were automated, needed to be tested for Y2K compliance, and (iii) internal communication systems connecting the main dispatch center and the power plants and distribution offices in Ulaanbaatar needed upgrading. Based on the survey, the EA prepared a draft Y2K Readiness Plan and a draft contingency plan.</p> <p>Under Package 3: Electric Meters, the scope of supply as set out in the original contract consisted of the procurement of 110 current transformers and 123 electronic meters.</p>	<p>During the Review Mission in November 1999, the EA indicated a need for suitably qualified consultants to review its draft Y2K readiness plan and contingency plan. These plans covered components of the Project as well as associated facilities that were essential for the Project to function properly. In a memorandum dated 4 May 1999, Vice President East advised that the loan savings could be used for possible ADB assistance to address Y2K issues. On 8 December 1999 ADB approved a minor change in project scope to employ consultants for Y2K activities and cover the relevant costs by reallocating funds from the unallocated category of the loan to the consulting services category.</p> <p>The EA requested for a minor change in the scope of the Project consisting of the procurement of additional 148 current transformers, 16 35-kV voltage transformers and 12 110-kV current transformers under Package 3 based on original contract rates for these transformers using the unallocated funds under the loan. These instrument transformers were meant to improve metering on the EA's transmission and distribution networks not under the scope of the Project. In July 2000, ADB approved this minor change in scope as it would form the technical basis for accurate and reliable measurements of electricity to the distribution systems as a prerequisite for reforming and restructuring Mongolia's energy sector of Mongolia and commercializing its existing operations.</p>

ADB = Asian Development Bank, EA = Executing Agency.

STATUS OF COMPLIANCE WITH LOAN COVENANTS

	Loan Covenants	Target Date of Compliance	Status of Compliance
A.	ENERGY SECTOR RESTRUCTURING		
1.	The Borrower and EA will, in consultation with the Bank, implement the Energy Sector Restructuring Action Plan and the Energy Conservation Action Plan. Commencing from 1 July 1997, EA will prepare and submit to the Bank a semi-annual status report on implementation of the two plans during the preceding six-month period.	Ongoing	Semi-annual report not submitted. Ongoing compliance
2.	From the recommendations of the EA Institutional and Tariff Study (TA 2035-MON), EA will prepare and submit, no later than 30 June 1997, a time-bound plan satisfactory to the Bank for commercialization of EA. The Borrower and EA will ensure the implementation and completion of all actions under the plan no later than 31 December 1997.	Proposals by 30 June 1997	Completed in June 1997
B.	FINANCIAL		
3.	Commencing with the fiscal year beginning on 1 January 1998, EA shall maintain a working ratio of total cash operating expenses to total operating revenues not higher than 60 per cent.	01 January 1998	Not complied. Working ratio: 80% in 1998, 73% in 1999, and 82% in 2000.
4.	EA will maintain its net revenues at a level that, for each year, will produce internally generally funds equal to at least 1.3 times the maximum debt-service requirement for such years on its entire debt.	01 January 1995	Complied
5.	EA will implement all actions prescribed in the Financial Action Plan. Commencing from 1 July 1997, EA will prepare and submit to the Bank a semi-annual report on implementation of the Plan during the preceding six-month period.	Ongoing	Partially complied
6.	The Borrower and EA will provide on a timely basis all counterpart funds required for the Project, including O & M funds for the Project facilities.	Ongoing	Complied. EA allocated \$0.5 million for 1999 and \$0.075 million for 2000.
C.	OPERATIONAL		
7.	Except as the Bank may otherwise agree, EA will implement and maintain the Project facilities in accordance with all safety, operation, maintenance, and preventive maintenance procedures identified by the consultants.	Ongoing	Complied with
8.	The Borrower and EA will take all necessary steps to remove in a safe and environmentally responsive manner any asbestos on district heating pipes to be replaced under the Project, and; to dispose of its designated secured disposal sites in uninhabited areas.	Ongoing	Complied

EA = Executing Agency.

FINANCIAL INTERNAL RATE OF RETURN, 1994—2018
(\$ million)

Energy Authority Mongolia

Item	npv	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2018
Incremental Inflow												
Heat Loss Reduction	3.3				0.1	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Consumer Heat Wastage Reduction	5.0				0.4	0.6	0.8	0.8	0.8	0.8	0.8	0.8
Technical Electricity Loss Reduction	7.2				1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Non-tech. Electricity Loss Reduction	4.3				0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total	19.8				2.1	2.7	2.9	2.9	2.9	2.9	2.9	2.9
Incremental Outgo												
Capital Cost	7.7		0.8	6.3	1.3	1.2						
Lost Consumer Heat Revenue	5.0				0.4	0.6	0.8	0.8	0.8	0.8	0.8	0.8
Income Tax	4.6				0.5	0.6	0.7	0.7	0.7	0.7	0.7	0.7
Total	17.3		0.8	6.3	2.2	2.4	1.4	1.4	1.4	1.4	1.4	1.4
Net Cash Flow	2.5		(0.8)	(6.3)	(0.1)	0.2	1.5	1.5	1.5	1.5	1.5	1.5
FIRR		14.6%										

FIRR = financial internal rate of return.

ELECTRICITY AND HEAT TARIFFS

Energy Authority Mongolia

Effective Date	Unit	Unit Cost (togrog /Unit)						
		1995	1996	1997	1998	1999	2000	2001
Electricity								
Base Tariff								
Industrial Consumers	MNT/kkW	16	26	34	41	41	45	45
Residential Consumers	MNT/kWh	16	16	28	35	35	45	45
Heat								
Base Tariff								
Residential consumers								
Apartments	MNT/kWh	30	48	60	65	65	160	160
Others (hot water)	MNT/kWh	42	67	100	109	109	400	400
Factories								
Industrial hot water	MNT/Gcal							5,000
Industrial steam	MNT/Gcal	1,018	1,629	5,000	8,500	8,800	9,000	9,256

Gcal = gigacalorie, kWh = kilowatt-hour.

INCOME STATEMENTS OF ENERGY AUTHORITY, 1996–2000
(MNT million)

Item	Year					
	1995	1996	1997	1998	1999	2000
Operating Data						
Total Generation (GWh)		1,912	2,015	2,079	2,228	2,293
Increase in Generation			5.4%	3.2%	7.1%	2.9%
Energy Sales (GWh)	1,402	1,427	1,526	1,512	1,699	1,802
Heat Sales (Tcal)	5,078	5,002	4,913	4,860	4,834	5,136
Average Revenue						
Electricity (Tg/kWh)	14.9	16.9	34.4	36.1	36.0	35.7
Heat (Tg/Gcal)	1,231.6	1,626.3	2,738.9	4,006.2	3,482.4	3,368.4
Revenues						
Electricity Sales	20,901	24,163	52,570	54,584	61,224	64,300
Heat Sales	6,254	8,135	13,456	19,470	16,834	17,300
Others						
Total Revenues	27,155	32,298	66,026	74,054	78,058	81,600
Operating Expenses						
Coal	14,673	15,583	27,957	34,374	36,665	39,300
Materials and equipment	2,560	3,965	6,386	7,346	6,099	2,200
Purchased power			1,062	1,251	1,475	1,493
Maintenance materials	4,496	9,229	7,946	11,911	1,053	4,100
Wages and administration	3,618	5,802	7,075	10,636	10,343	11,665
Depreciation	2,804	1,280	8,076	12,818	25,506	20,024
Others	199	654	395	1,370	986	7,765
Total Operating Expenses	28,350	36,513	58,897	79,706	82,127	86,547
Operating Income	-1,195	-4,215	7,129	-5,652	-4,069	-4,947
Non-Operating Income	338	645	2,219	1,908	0	0
Non-Operating Expenses					335	800
Interest expenses	8	8	8	0	0	8,933
Taxable Income	-865	-3,578	9,340	-3,744	-4,404	-14,680
Income Tax			-481			
Net Income	-865	-3,578	8,859	-3,474	-4,404	-14,180
Ratios						
Rate Base ^a	14,919	215,090	234,291	240,172	274,019	275,836
Operating Ratio ^b (%)	104%	113%	89%	108%	105%	106%
Working Ratio ^c (%)	94%	109%	77%	90%	73%	82%
Return on Net Fixed Assets ^c (%)	-6%	-2%	4%	-2%	-2%	-2%

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

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

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

Source: Energy Authority, Mongolia (audited accounts).

BALANCE SHEETS OF ENERGY AUTHORITY, 1996–2000
(MNT million)

Item	Year					
	1995	1996	1997	1998	1999	2000
Assets						
Fixed Assets						
Gross Fixed Assets	19,065	216,631	241,162	241,558	300,086	312,157
Accumulated Depreciation	5,096	6,376	14,452	27,270	52,776	72,800
Net fixed Assets in Service	13,969	210,255	226,710	214,288	247,310	239,357
Work in Progress	950	4,835	7,581	25,884	26,709	36,479
Total Fixed Assets	14,919	215,090	234,291	240,172	274,019	275,836
Current Assets						
Cash	1,288	1,145	1,683	1,342	1,993	3,500
Accounts Receivable	3,412	6,196	10,398	18,144	20,509	21,100
Inventories	6,026	7,300	15,932	26,897	16,795	7,800
Other Current Assets	1,812	922	967	0	7,295	14,200
Total Current Assets	12,538	15,563	28,980	46,383	46,592	46,600
Total Assets	27,457	230,653	263,271	286,555	320,611	322,436
Equity and Liabilities						
Equity						
Capital	18,337	207,420	211,138	211,138	211,138	211,138
Reserves and Retained Earnings	1025	-11579	-6099	-10223	-16134	-30514
Total Equity	19,362	195,841	205,039	200,916	195,004	180,624
Long Term Debt						
Power Rehabilitation Project	1,700	8,818	18,249	21,550	28,195	30,238
Other Capital Project		4,926	17,345	34,051	64,623	74,086
Other borrowing		8,285	12,620	8,263	3,976	
Total Long Term Debt	1,700	22,029	48,214	63,864	96,794	104,324
Current Liabilities						
Account Payable	5,670	6,266	8,343	21,709	27,816	26,690
Others	725	6,517	1,674	67	997	10,798
Short Term Loan						
Total Current Liabilities	6,395	12,783	10,017	21,776	28,813	37,488
Total Equity and Liabilities	27,457	230,653	263,271	286,555	320,611	322,436
Ratios						
Current Ratio ^a	1.96	1.22	2.89	2.13	1.62	1.24
Debt/(Debt+Equity) Ratio ^b (%)	8%	10%	19%	24%	33%	37%

^a Ratio of current assets to current liabilities.

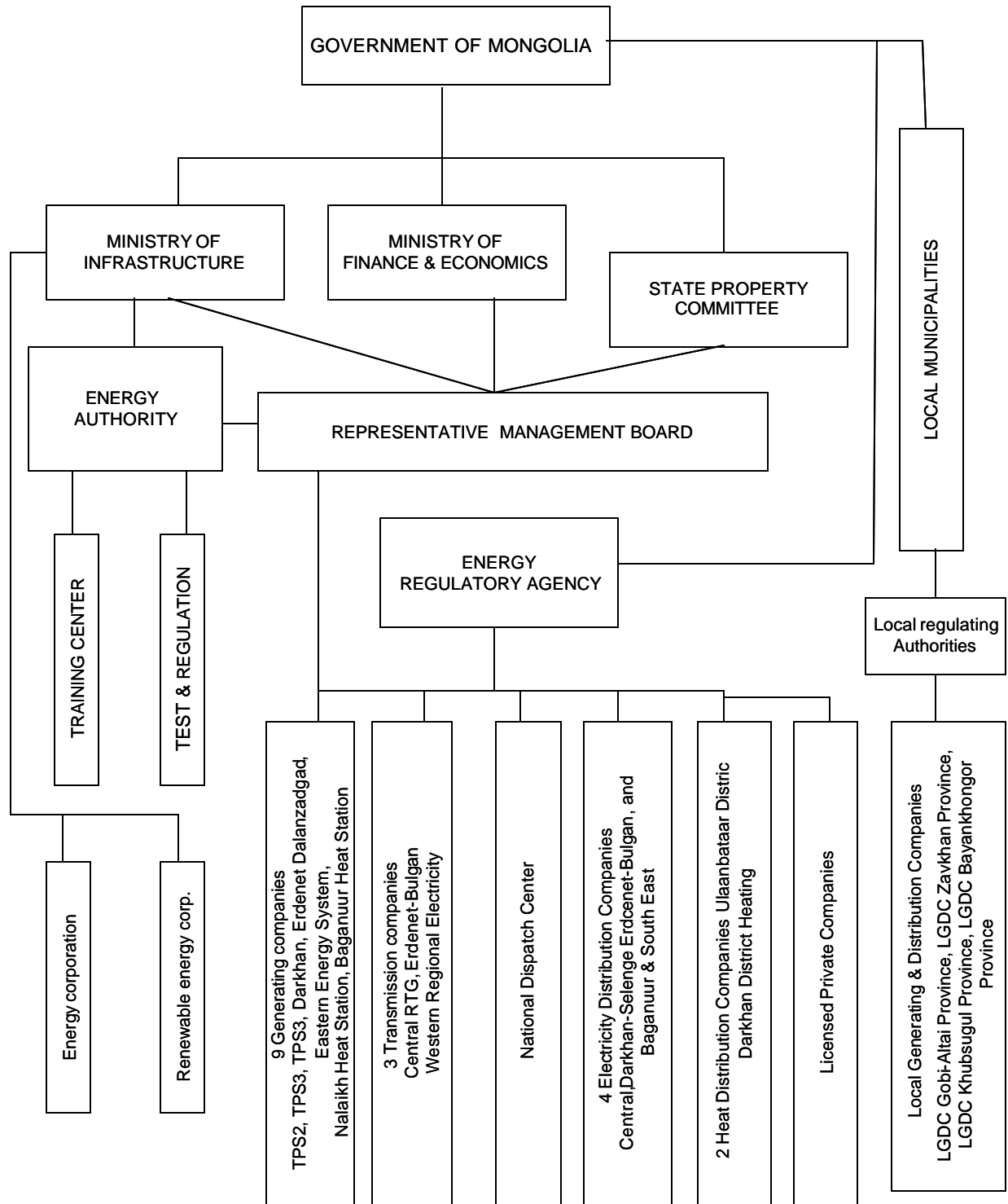
^b Ratio of long-term debt to long-term debt plus equity.

Source: Energy Authority, Mongolia (audited accounts).

CASH FLOW STATEMENTS OF ENERGY AUTHORITY, 1996–2000
(MNT million)

Item	Year					
	1995	1996	1997	1998	1999	2000
Sources						
Internal Sources						
Net Income before Interest	-857	-3,570	8,867	-3,474	-4,404	-5,247
Depreciation	2,804	1,280	8,076	12,818	25,506	20,024
Change in Working Capital		3,363	-16,183	-5,644	6,828	8,667
Net Internal Cash Generation	1,947	1,073	759	3,700	27,930	23,444
Long Term Loans	1,700	20,329	26,186	15,649	32,930	7,530
Total Sources		21,402	26,945	19,349	60,860	30,974
Application						
Capital Expenditures		19,970	27,278	18,698	59,353	21,841
Debt Service						
Principal						
Interest		8	8	0	0	8,933
Total Applications		19,978	27,286	18,698	59,353	30,774
Net Cash Inflow		1,424	-341	651	1,507	200
Cash, Beginning		259	1683.1	1342	1993	3500
Cash, Ending	259	1,683	1,342	1,993	3,500	3,700
Ratios						
Debt Service Ratio (%)						2.6

RESTRUCTURED ELECTRICITY INDUSTRY



ECONOMIC INTERNAL RATE OF RETURN, 1994–2018
(\$ million)

Energy Authority Mongolia

Item	npv	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2018
Incremental Benefits												
Heat Loss Reduction	4.9				0.1	0.6	0.8	0.8	0.8	0.8	0.8	0.8
Consumer Heat Wastage Reduction	7.5				0.6	0.9	1.2	1.2	1.2	1.2	1.2	1.2
Technical Electricity Loss Reduction	10.4				1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Non-tech. Electricity Loss Reduction												
Total	22.7				2.2	3.0	3.4	3.4	3.4	3.4	3.4	3.4
Incremental Costs												
Capital Cost	7.7		0.8	6.3	1.3	1.2						
Total	7.7		0.8	6.3	1.3	1.2						
Net Benefit	15.0		(0.8)	(6.3)	0.9	1.8	3.4	3.4	3.4	3.4	3.4	3.4
EIRR		33.3%										

EIRR = economic internal rate of return.

QUANTITATIVE ASSESSMENT OF OVERALL PROJECT PERFORMANCE

Table A17.1: Overall Rating

	Criterion	Assessment	Rating (0-3)	Weight (%)	Weighted Rating
1	Relevance	Highly Relevant	3	20	0.60
2	Efficacy	Highly Efficacious	3	25	0.75
3	Efficiency	Highly Efficient	3	20	0.60
4	Sustainability	Likely	2	20	0.24
5	Institutional Development	Little	1	15	0.15
	Overall Rating			100	2.50

Note:

Relevance: Project objectives and outputs were relevant to strategic objectives of the Government and the Asian Development Bank.

Efficacy: Project achieved its targets and objectives.

Efficiency: Project achieved objectives in an efficient manner.

Sustainability: Project benefits and development impacts are sustainable.

Institutional Development: Project had beneficial impacts on government policy and institutional capacity, and had other positive social impacts.

Table A17.2: Rating System

Rating Value	Relevance	Efficacy	Efficiency	Sustainability	Institutional Development
3	Highly Relevant	Highly Efficacious	Highly Efficient	Most Likely	Substantial
2	Relevant	Efficacious	Efficient	Likely	Moderate
1	Partly Relevant	Less Efficacious	Less Efficient	Less Likely	Little
0	Irrelevant	Inefficacious	Inefficient	Unlikely	Negligible

>2.5 = highly successful; 1.6-2.5 = successful; 0.6-<1.6 = partly successful; <0.6 = unsuccessful.