ASIAN DEVELOPMENT BANK
Operations Evaluation Department

PROJECT PERFORMANCE EVALUATION REPORT

FOR

MONGOLIA

In this electronic file, the report is followed by the Management response.

Performance Evaluation Report

PPE: MON 29012

Energy Conservation Project (Loan 1492-MON[SF]) in Mongolia

November 2005

Operations Evaluation Department
Asian Development Bank

CURRENCY EQUIVALENTS

Currency Unit – togrog (MNT)

		At Appraisal (June 1996)	At Project Completion (June 2002)	At Operations Evaluation (June 2005)
MNT1.00	=	$0.0017	$0.0009	$0.0008
$1.00	=	MNT601.70	MNT1,100.00	MNT1,180.00

ABBREVIATIONS

ADB	–	Asian Development Bank
CRETG	–	central regional electricity transmission grid
DHC	–	District Heating Company
EA	–	Energy Authority
EIRR	–	economic internal rate of return
ERA	–	Energy Regulatory Authority
ERDC	–	Energy Research and Development Center
FIRR	–	financial internal rate of return
HCSC	–	Housing and Communal Services Company
MFE	–	Ministry of Fuel and Energy
MID	–	Ministry of Infrastructure Development
MOF	–	Ministry of Finance
NPV	–	net present value
O&M	–	operation and maintenance
OEM	–	operations evaluation mission
PCR	–	project completion report
PIU	–	project implementing unit
PSC	–	project steering committee
PPER	–	project performance evaluation report
PPTA	–	project preparatory technical assistance
RRP	–	report and recommendation of the President
SDR	–	special drawing rights

WEIGHTS AND MEASURES

Gcal	–	gigacalorie (1 million kilocalories)
kWh	–	kilowatt-hour
GWh	–	gigawatt-hour (1 million kilowatt-hours)
m^3	–	cubic meter
Tcal	–	teracalorie (1,000 gigacalories)

NOTES

(i) The fiscal year of the Government and the executing agency coincides with the calendar year.

(ii) In this report, "$" refers to US dollars.

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CONTENTS

		Page
BASIC DATA		iii
EXECUTIVE SUMMARY		iv
I.	BACKGROUND	1
A.	Rationale	1
B.	Formulation	1
C.	Purpose and Outputs	2
D.	Cost, Financing, and Executing Arrangements	2
E.	Completion and Self-Evaluation	3
F.	Operations Evaluation	3
II.	PLANNING AND IMPLEMENTATION PERFORMANCE	4
A.	Formulation and Design	4
B.	Achievement of Outputs	5
C.	Cost and Scheduling	7
D.	Procurement and Construction	7
E.	Organization and Management	8
III.	ACHIEVEMENT OF PROJECT PURPOSE	9
A.	Operational Performance	9
B.	Performance of the Operating Entity	9
C.	Financial and Economic Reevaluation	10
D.	Sustainability	10
IV.	ACHIEVEMENT OF OTHER PROJECT IMPACTS	11
A.	Socioeconomic Impact	11
B.	Environmental Impact	12
C.	Impact on Institutions and Policy	12

In accordance with the guidelines formally adopted by the Operations Evaluation Department (OED) on avoiding conflict of interest in its independent evaluations, the Director General of OED did not review this report in Mongolia and delegated approval of this evaluation to the Director of Operations Evaluation Division 2. The fieldwork was undertaken by Ping Zhuang (International Consultant/Environment Specialist), and Lodon Erdenadalai (Domestic Consultant/District Heating Expert) under the guidance of the Mission Leader. To the knowledge of the management of OED, there were no conflicts of interest of the persons preparing, reviewing, or approving this report.

V. OVERALL ASSESSMENT 12

A. Relevance 12
B. Efficacy 13
C. Efficiency 13
D. Sustainability 13
E. Institutional Development and Other Impacts 13
F. Overall Project Rating 13
G. Assessment of ADB and Executing Agency Performance 13

VI. ISSUES, LESSONS, AND FOLLOW-UP ACTIONS 14

A. Key Issues for the Future 14
B. Lessons Identified 14
C. Follow-Up Actions 15

APPENDIXES

1. Financial Highlights of District Heating Company 16
2. Financial and Economic Reevaluation 19

Attachment: Management response

BASIC DATA
Energy Conservation Project (Loan 1492-MON[SF])

PROJECT PREPARATION/INSTITUTION BUILDING

TA No.	TA Project Name	Type	Person-Months	Amount ($)[a]	Approval Date
2350	Energy Conservation Project	PPTA	104	100,000	26 Jun 1995

KEY PROJECT DATA ($ million)	As per ADB Loan Documents	Actual
Total Project Cost	13.19	9.66
Foreign Currency Cost	10.00	8.57
ADB Loan Amount/Utilization	10.00	8.57
ADB Loan Amount/Cancellation		0.72

KEY DATES	Expected	Actual
Fact-Finding		22 Feb–8 Mar 1996
Appraisal		18–27 Jun 1996
Loan Negotiations		15–18 Oct 1996
Board Approval		26 Nov 1996
Loan Agreement		11 Aug 1997
Loan Effectiveness	11 Nov 1997	26 Jan 1998
First Disbursement	26 Jan 1998	22 Jun 1998
Project Completion	31 Dec 2000	30 Jun 2001
Loan Closing	30 Jun 2001	31 Aug 2001
Months (effectiveness to completion)	38	41

KEY PERFORMANCE INDICATORS (%)	Appraisal	PCR	PPER
Financial Internal Rate of Return	13.0	14.6	(2.3)
Economic Internal Rate of Return	29.0	33.3	14.9

BORROWER Government of Mongolia

EXECUTING AGENCY Energy Authority

MISSION DATA

Type of Mission	No. of Missions	Person-Days
Fact-Finding	1	75
Appraisal	1	50
Project Administration Review	7	48
Project Completion	1	16
Operations Evaluation	1	53

EXECUTIVE SUMMARY

Adequate heating is essential for survival during the harsh winter in Ulaanbaatar, the coldest capital in the world (average annual temperature of 3 degrees Celsius below zero). Ulaanbaatar's district heating system was established in 1959. By the mid-1990s, there were excessive losses of heat and hot water because of poor insulation and leaks throughout the system, which had deteriorated due to inadequate maintenance. Lack of heat and electricity meters further contributed to inefficient energy use. There was an urgent need for energy conservation through rehabilitation of critical sections of the existing heat distribution facilities and installation of heat and electricity meters. In accordance with the priorities of the Government's economic transformation and development efforts, and the operational strategy of the Asian Development Bank (ADB) in the energy sector for Mongolia at the time, the Energy Conservation Project (the Project) was approved in November 1996 with the following strategic objectives: (i) improve district heating reliability and reduce losses by rehabilitating critical sections of Ulaanbaatar's district heating systems, (ii) encourage end-use energy conservation through improved metering and demonstration projects, and (iii) improve operation and maintenance (O&M) of the district heating system through on-the-job training and technical support.

The scope of the Project at appraisal included four components: (i) district heating rehabilitation—replacement of about 6 kilometers (km) of district heating pipes, 18 km of insulation on district heating pipes, 39 section valves, and 2 district heating pumps; (ii) heat metering—installation of 10 flow meters in pump stations, 57 heat meters in block substations, and about 1,200 heat meters in buildings and industries; (iii) electricity metering—installation of about 50 electronic meters in power plants and at key points along the transmission network, about 2,000 electricity meters in distribution substations, and 4 meter calibration and testing units; and (iv) demonstration subproject—implementation of various energy conservation measures in 4 selected apartment buildings (1 unmodified serving as a baseline comparator and 3 modified with simple energy conservation measures) to demonstrate their cost effectiveness. The district heating component was expected to significantly reduce the volume of water leaks and avoid radiation losses. The heat loss reduction attributable to the heat metering and demonstration components was estimated at 100 gigawatt-hours (GWh) per year. The electricity metering component was expected to result in annual reductions of 20 GWh in technical losses and 10 GWh in non-technical losses.

The Project was implemented largely as planned except for the components under the electricity metering and demonstration subproject. The actual total project cost at completion was $9.66 million equivalent, compared with an appraisal estimate of $13.19 million equivalent. The actual cost included a foreign exchange cost of $8.57 million and local currency cost of $1.09 million equivalent. All foreign exchange costs were financed by the ADB loan from its Special Funds resources and local costs were met by the Energy Authority (EA) from its own resources. An undisbursed ADB loan of $718,310 equivalent was cancelled. The Project was completed 6 months behind schedule mainly due to late project start and postponed operation of the variable speed pumping system.

A number of issues were identified with respect to project formulation and design. First, no detailed feasibility study was carried out to analyze the existing district heating system operations, investigate possible measures for improvements, and develop a set of interrelated project components. Critical sections of water and radiation losses were identified in the district heating system based on pipeline age and visual inspection. Given a total length of about 400 km of hot water and steam pipeline, rehabilitation of about 24 km pipelines under the Project was only a patchwork of the most urgent repairs. Second, while the Project was part of a

continued rehabilitation effort, certain aspects of project design were not fully compatible with the next stage of development. Last, the demonstration subproject was designed to show consumers how much energy could be saved by making cost-effective technical changes in their installations. However, in the absence of heat meters in individual households and a tariff structure based on metered consumption, it would be difficult to show consumers the benefits of these efficiency measures and unrealistic to expect them to adopt them at home.

Most project facilities are performing satisfactorily, except the heat meters installed in residential buildings and the substation log under the demonstration subproject,. No major operational issues and breakdowns have been reported to date. The main project purpose—in terms of improving reliability and reducing water losses of the district heating system in Ulaanbaatar—has been largely achieved:

(i) Between 1997 and 2001, water losses in the entire system were reduced by a cumulative 1.6 million cubic meters (m^3), equivalent to a saving of MNT406.5 million.

(ii) Since 1998, a cumulative revenue reduction of approximately $7 million was achieved as a result of metered billing for directly connected customers whose individual heat meters were installed under the Project.

(iii) Between 1999 and 2003, water flow per unit heat in the district heating network decreased from 25.57 tons/gigacalorie (Gcal) to 22.05 tons/Gcal and make-up water flow fell from 4.47 million tons to 3.91 million tons.

(iv) Between 2000 and 2004, network heat delivery increased by 5%. Since 1999, electricity and heat supply to residential areas is no longer rationed.

The demonstration component did not achieve its intended purpose and failed to demonstrate clearly the benefits of energy conservation measures adopted. For the electricity metering component, reductions in system losses due to the Project were reported but not quantified.

ADB cooperated well with the Government and EA in formulating the Project and processing the loan. Given the design deficiencies during preparation and inaccurate findings in the project completion report, the overall performance of ADB is considered partly satisfactory. EA and its successor performed satisfactorily in terms of project preparation and implementation but did not develop baseline data during implementation and after completion as required. In view of noncompliance with key financial covenants and the weak financial position of EA and its successor, the overall performances of EA and its successor is considered partly satisfactory. Based on the assessment of relevance, efficacy, sustainability, and institutional and other development impacts, the Project is rated partly successful.

The Project yielded three main lessons:

(i) Advance action for recruitment of the implementation consultant is meant to ensure timely project implementation and quality throughout the implementation period. The impact of such advance action on project implementation seemed to be less positive in the Project. The implementation consultant was not actively involved in project implementation and supervision because the consultant started work early and had insufficient person-months input, yet was available

under the contract after 1998. To avoid such mismatch of consulting services with actual project implementation schedule, advance action for recruitment of the implementation consultant and procurement activities should not be applied mechanically during project preparation, and the consultant's mobilization date should be realistically determined and adjusted in the event of delayed loan signing and effectiveness.

(ii) The less-than-successful result of the demonstration subproject was due to poor project design. First, the existing institutional setup and tariff structure do not provide the necessary incentives for energy conservation supply and demand. Metered billing means a loss of revenue for the district heating company and will be accepted by end-users only if they have individual control over heat consumption in their apartments. However, without metered billing, none of the benefits claimed from the proposed cost-effective technical changes could be realized by the end-user. Second, individual consumers involved in the demonstration subproject were not informed about work to be carried out in their installations or its purpose. In the end, most changes took place at the substation or the buildings, rather than at the end-user level. All these design weaknesses point to inadequate feasibility analysis of proposed project instruments and lack of stakeholder consultation at the design stage.

(iii) The Project was formulated to complement work being carried out on the district heating system under the Power Rehabilitation Project and pave the way for the next stage of development to be financed under the Ulaanbaatar Heat Efficiency Project. These three projects were approved between November 1994 and September 1997 and overlapped in many aspects. However, choice of certain equipment under the Project was not fully compatible with the next stage of development. This could have been avoided through effective project design consistency checks and coordination between project officers in charge.

David Edwards
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I. BACKGROUND

A. Rationale

1. Adequate heating is essential for survival during the harsh winter in Ulaanbaatar, the coldest capital in the world (average annual temperature of 3 degrees Celsius below zero). Ulaanbaatar's district heating system was established in 1959. By the mid-1990s, there were excessive losses of heat and hot water because of poor insulation and leaks throughout the system, which had deteriorated due to inadequate maintenance. Total heat losses (including radiation losses, building losses, and water leaks) accounted for 49% of the supplied heat instead of the 21% design standard. Further, the lack of heat and electricity meters in the system resulted in inefficient energy use. Following a power system collapse in February 1996, electricity and heat supply to residential areas were severely rationed. The country's economic development and the living conditions of urban residents were severely affected. There was an urgent need for energy conservation through rehabilitation of critical sections of the existing heat distribution facilities and installation of heat and electricity meters. The Government gave high priority to adequate and reliable supply of power and heat to support Mongolia's economic transformation and development. The operational strategy of the Asian Development Bank (ADB) in the energy sector for Mongolia at the time focused on sector reforms, rehabilitation of existing facilities, tariff adjustments, energy conservation, and strengthening of sector institutions—in particular, the Energy Authority (EA).

2. In 1994, ADB provided a loan[1] to finance improvement of Ulaanbaatar's power and heat supply. As a continuation of this effort, the Energy Conservation Project (the Project)[2] was approved in November 1996 with the following strategic objectives: (i) meet the basic needs of the population in heating and electricity and support economic recovery, and (ii) promote sector efficiency. In 1997, ADB approved another follow-up loan[3] for the same purpose.

B. Formulation

3. ADB approved a project preparatory technical assistance (PPTA)[4] in June 1995 to prepare an energy conservation project for ADB financing to improve the reliability and efficiency of Ulaanbaatar's heat and electricity supply. The PPTA was completed in May 1996. An ADB loan fact-finding mission was fielded in February–March 1996, followed by an appraisal mission in June 1996. Policy dialogue with the Government and EA during loan processing focused on the need to commercialize EA's management and operations, rationalize tariffs to improve cost recovery, and phase out subsidies.

4. Based on the PPTA findings, the district heating system in Ulaanbaatar could be characterized by (i) low production efficiency at the combined heat and power plants, (ii) high

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[1] Loan 1334(SF)-MON: *Power Rehabilitation Project,* for SDR27.142 million ($40 million equivalent), approved on 19 November 1994. As the first major ADB-financed project in the energy sector, which was completed in June 2001, it rehabilitated four boilers at the Thermal Energy Station No. 3, replaced 3.1 kilometers (km) of pipeline in critical sections of the district heating network, and installed 76 heat meters at key points.

[2] Loan 1492-MON (SF): *Energy Conservation Project*, for SDR 6,944,000 ($10 million equivalent), approved on 26 November 1996.

[3] Loan 1548-MON (SF): *Ulaanbaatar Heat Efficiency Project,* for SDR29.487 million ($40 million equivalent), approved on 25 September 1997. It has three main components: (i) conversion of the district heating system from constant to variable flow operation; (ii) consumer-end heat control, metering, and billing improvement; and (iii) steam system rehabilitation.

[4] TA 2350-MON: *Energy Conservation Project*, for $100,000, approved on 26 June 1995.

energy losses in the transmission and distribution networks, (iii) significant water leakage in the system, and (iv) low end-user efficiency. The PPTA considered that investment in rehabilitation and metering to reduce energy losses was the most cost-effective approach, in view of the urgent need for more efficient and reliable heat supply and EA's financial constraints to building new facilities. PPTA recommended a number of short-term improvement activities for ADB financing. The appraisal mission concurred with PPTA findings and finalized the project components.

5. Since the Project was part of a continued rehabilitation effort, the work undertaken under the Project was complementary to work being carried out on the district heating system under the Power Rehabilitation Project (footnote 1) and should be compatible with the next stage of development to be financed under the Ulaanbaatar Heat Efficiency Project (footnote 3).

C. Purpose and Outputs

6. The purposes of the Project were to (i) improve district heating reliability and reduce losses by rehabilitating critical sections of Ulaanbaatar's district heating systems, (ii) encourage end-use energy conservation through improved metering and demonstration projects, and (iii) improve operation and maintenance (O&M) of the district heating system through on-the-job training and technical support.

7. The scope of the Project at appraisal included four components: (i) district heating rehabilitation—replacement of about 6 kilometers (km) of district heating pipes, 18 km of insulation on district heating pipes, 39 section valves, and 2 district heating pumps; (ii) heat metering—installation of 10 flow meters in the pump stations, 57 heat meters in the block substations, and about 1,200 heat meters in buildings and industries; (iii) electricity metering—installation of about 50 electronic meters in power plants and at key points along the transmission network, about 2,000 electricity meters in distribution substations, and 4 meter calibration and testing units; and (iv) demonstration subproject—implementation of various energy conservation measures in 4 selected apartment buildings (1 unmodified serving as a baseline comparator and 3 modified with simple energy conservation measures to demonstrate their cost effectiveness). The district heating component was expected to significantly reduce the volume of water leaks by about 0.9 million tons per year and avoid radiation losses of 22 gigawatt-hours (GWh) per year. The heat loss reduction attributable to the heat metering and demonstration components was estimated at 100 GWh per year. The electricity metering component was expected to result in annual reductions of 20 GWh in technical losses and 10 GWh in nontechnical losses.

D. Cost, Financing, and Executing Arrangements

8. At appraisal, the total project cost was estimated at $13.19 million equivalent, with a foreign exchange component of $10 million financed entirely by the ADB loan from Special Funds resources. The local currency cost of $3.19 million equivalent was to be funded by EA. The proceeds of the ADB loan were relent by the Government to EA under a subsidiary loan agreement. The terms and conditions of the relending included interest at a rate applicable to ADB's multicurrency loans and an amortization period of 24 years, including a grace period of 4 years. EA would bear the foreign exchange and interest rate variation risks.

9. The Government of Mongolia was the Borrower and EA[5] was the executing agency for the Project. The project steering committee (PSC) established under the Power Rehabilitation Project (footnote 1) continued to provide guidance to the project implementation unit (PIU) established under the Project. The PSC was responsible for reviewing all technical plans and designs and overseeing all project activities. The PIU was responsible for day-to-day project implementation, and was staffed by members from EA and the Housing and Communal Service Company (HCSC), a state-owned corporation responsible for supplying electricity and heat to most houses and buildings in Ulaanbaatar.

E. Completion and Self-Evaluation

10. The project completion report (PCR) was circulated in December 2002 and rated the Project successful. The PCR reported that the Project was implemented successfully as planned and its main objective of improving the efficiency and reliability of heat and electricity supply was achieved. Between 1998 and 2001, heat delivery in the district heating system increased by 14% and freshwater used reduced by 23%. The recalculated financial internal rate of return (FIRR) of 14.6% for the Project was higher than the appraisal estimate of 13.0% mainly because of higher-than-expected electricity loss reduction and lower-than-expected project cost. The economic internal rate of return (EIRR) was recalculated as 33.3%, more than the appraisal estimate of 28.6%. The PCR considers the Project's benefits and development impacts sustainable, despite failure to achieve the desired level of tariff increases and improve EA's financial health. The PCR did not identify any major issues during project preparation and implementation. The lessons learned are vague. The PCR recommended further assistance to EA in economic analysis and socioeconomic assessment in future.

11. The Operations Evaluation Mission (OEM) findings do not seem to support PCR conclusions in many aspects. The PCR did not discuss important deviations (para. 17) from the original project design, including (i) cancellation of 2,000 electricity meters originally planned under the Project, and (ii) change from fixed-speed to speed-control pumps for the two main district heating pumps. Further, the PCR did not report the disuse of 509 heat meters installed at residential buildings. In view of these deviations and less-than-satisfactory performance of some project facilities, the methodology used and results obtained in the PCR with respect to financial and economic reevaluation of the Project are highly questionable. In addition, the OEM was unable to confirm the PCR's claim of substantial energy savings from the demonstration subproject. On the contrary, the project implementation consultant concluded in its completion report that data available did not show any noticeable reduction in energy consumption among the four buildings. HCSC considers the demonstration subproject useful in proving the suitability of certain modern district heating equipment under the local conditions but less so in showing consumers how much energy could be saved by making cost-effective changes in their installations. The OEM considers some PCR findings not well substantiated or inaccurate.

F. Operations Evaluation

12. This project performance evaluation report (PPER) reviews PCR findings and assesses the Project in terms of relevance, efficacy, efficiency, sustainability, and institutional and other developmental impacts. The assessment is based on a review of ADB documents, discussion with ADB staff, and OEM findings. A questionnaire indicating information requirement was

[5] Since 2001, 18 independent companies spanned off from EA to take over its commercial and financial obligations. In 2004, EA was dissolved and most of its policy-making functions were taken over by the Energy Research and Development Center.

forwarded to EA prior to the OEM. The OEM was fielded 9–22 June 2005 and met representatives from government agencies including Ministry of Finance (MOF), Ministry of Fuel and Energy (MFE), Energy Regulatory Authority (ERA), HCSC, District Heating Company (DHC), Energy Research and Development Center (ERDC), and Central Regional Electricity Transmission Grid (CRETG). The OEM reviewed data available on costs, schedules, project management, subproject financing arrangements, and loan agreements. Reconnaissance site inspection of project facilities was carried out. The OEM also visited two gers to understand the impact on the poor of recent heat and electricity tariff increases. The views of ADB, the Government, and EA were considered when finalizing the PPER.

II. PLANNING AND IMPLEMENTATION PERFORMANCE

A. Formulation and Design

13. The Project was formulated largely on the basis of the PPTA findings. No detailed feasibility study was carried out to analyze the workings of the existing district heating system, investigate possible measures for improvements, and develop a set of interrelated project components.[6] Critical sections of water and radiation losses in the district heating system were identified by DHC based on the age of the pipeline, visual inspection, and some simple tests. No advance leak detection equipment was used for verification at the PPTA stage. The PPTA consultants accepted DHC's analysis of the main reasons for critical sections of water and radiation losses. The Project was considered the most cost-effective approach to provide more efficient and reliable heat supply on an incremental basis since the district heating rehabilitation and installation of heat meters would save heat at a lower per unit cost compared with generating heat from a new combined heat and power plant. However, given a total length of about 400 km of hot water and steam pipeline in Ulaanbaatar's district heating system, rehabilitation of about 24 km of pipelines under the Project was only a patchwork of the most urgent repairs, complementary to DHC's regular rehabilitation and maintenance.[7]

14. The district heating system in Ulaanbaatar was designed on a constant flow concept—1950s technology which made system operation simple but inflexible. Heat levels were adjusted by changing the temperature of water fed into the district heating networks at the combined heat and power plants. Thus, individual consumers had no control over their level of heat consumption and could only do so by opening windows. Furthermore, residential consumers pay a fixed charge per square meter of floor area heated. Therefore, it was not possible to use pricing to encourage energy efficiency. While the Project was considered the first step in addressing these issues in a phased approach, certain aspects of the project design were not fully compatible with the next stage of development. For example, the proposed replacement of two main district heating pumps under the Project were of the fixed speed type which did not take into account the anticipated conversion of the district heating system from constant to variable flow under the follow-up Ulaanbaatar Heat Efficiency Project—designed and approved at about the same time as the Project. Consequently, bidding document technical specifications had to be revised to new speed-controlled pumps and the contract had to be renegotiated with the successful bidder. This resulted in cost increase and implementation delays.

15. The demonstration subproject was designed to show consumers how much energy could be saved by making cost-effective technical changes in their installations. However,

[6] In the case of Loan 1548-MON(SF): *Ulaanbaatar Heat Efficiency Project*, a sophisticated hydraulic model was used for these purposes.

[7] Due to budget constraints, DHC could only rehabilitate about 3 km of pipelines per year.

people living in buildings to be modified under the Project were not consulted during project design about proposed changes in their installations. In the end, most of these changes—such as installation of new plate type heat exchanges, heat and hot water meters, and adoption of the mixing loop technology[8] for heat-hydro elevation—took place at the substation or in the buildings rather than at the end-user level. In the absence of heat meters in individual households and a tariff structure based on metered consumption,[9] it would be difficult to show consumers the benefits of these efficiency measures and unrealistic to expect them to adopt non end-user measures at home.

16. Complexities and difficulties associated with a rehabilitation project—in diagnosis of key problems and design of appropriate interventions—must be recognized. However, some of the problems discussed above could have been reasonably anticipated and addressed during project design. Therefore, diagnostic works used to justify project intervention during project preparation are considered inadequate and there is room for improvement of quality-at-entry.

B. Achievement of Outputs

17. The Project was implemented largely as planned except for components under electricity metering and the demonstration subproject.

(i) About 6 km of old pipes—mostly underground at several sections of the district heating transmission mains—was replaced. Most replaced pipelines had been in service from 25 to 40 years and required replacement. OEM was informed that replacement of these old pipes was implemented successfully.

(ii) Insulation of 18 km of district heating transmission pipes was successfully replaced. The old type of insulation with aluminum covering, which was susceptible to theft and/or damage, was replaced by cement and steel mesh covering more suitable for local conditions.

(iii) Thirty-nine section valves were installed on the heating transmission mains and provided satisfactory quality and operation. Two 6 kilovolt old fixed speed pumps at Thermal Energy Station 3 were replaced by new variable speed pumps in line with the anticipated conversion of the district heating system from constant to variable flow. Due to a change in technical specifications in the bidding processes (para. 14) that increased contract costs, the transformers for the low voltage motors and frequency converters—necessary parts of the variable speed pumping system—had to be procured under the Ulaanbaatar Heat Efficiency Project. Consequently, these pumps were not in operation until 2001 but it was reported that they performed well and saved considerable energy, as envisaged.

(iv) Ten flow meters were installed in eight locations of the pump stations and are in good operational condition. Fifty-seven large diameter heat meters were installed in the substations as planned and a heat meter calibration laboratory was provided under the Project.[10] In addition, 1,182 smaller heat meters were procured—1,143 have been installed and the rest are stored as spares. Of the

[8] The main components of this new technology included circulation pump, control valve for automatic temperature adjustment, outdoor sensor, and electronic controller.

[9] For district heating, residential consumers in Ulaanbaatar pay a fixed charge per square meter of floor area heated. There are few incentives for consumers to save energy.

[10] This laboratory was recently transferred from ERDC to DHC.

1,143 heat meters installed, 509 are for residential buildings and the remainder is for directly connected customers (i.e., organizations like schools, hospitals, and businesses). Heat meters for directly connected customers are working well and produce good energy saving results. However, the 509 residential meters have not been used for metered billing, as planned, because of lack of a regulatory mechanism and tariff structure for metered billing for residential customers.

(v) The demonstration subproject, as implemented, did not show consumers how much energy could be saved by making cost-effective technical changes in their installations. Installation of new plate type heat exchanges, heat and hot water meters, and adoption of the mixing loop technology for heat-hydro elevation took place at the substation or in buildings rather than at the end-user level. The actual cost of this component was 26.4% lower than the appraisal estimate because some efficiency improvement measures, such as weather strips on windows and doors, were not implemented. Energy conservation measures were mostly introduced at the substation rather than in individual apartments. At the time of the OEM, the substation log installed for data recording was no longer in use because the log-in password had been forgotten. However, data was collected for monitoring purposes during two heating seasons between 1999 and 2001. Comparison of energy consumption among modified and unmodified buildings was inconclusive in terms of energy conservation. Instead, automatic control devices, new plate type heat exchanges, heat and hot water meters, balancing valves, water treatment systems, and the mixing loop technology for heat-hydro elevation installed under the demonstration subproject demonstrated the appropriateness of this new equipment for local conditions and was widely adopted under the ongoing Ulaanbaatar Heat Efficiency Project.

(vi) Under the electricity metering component, 50 electronic meters were installed in power plants and at key points of the power transmission network, as planned. However, plans to install 2,000 electricity meters were cancelled.[11] Instead, 120 current transformers and 46 meters for high accuracy metering were installed at point of supply to consumers directly connected to power plants.[12] Electricity meter calibration and testing units were procured under the Project,[13] as envisaged.

(vii) The implementation consultant undertook a review of DHC's O&M procedures and made a number of recommendations. Other than a half-day presentation of Danish O&M procedures, no other specific training was provided during project implementation.

[11] The implementation consultant's project completion report stated that EA installed the 2000 meters with its own funds. The Operations Evaluation Mission (OEM) was unable to confirm this.
[12] On 12 May 1997, ADB approved a change in scope to replace the 2000 electricity meters.
[13] Calibration and testing equipment still managed by ERDC was transferred to CRETG after the OEM.

C. Cost and Scheduling

18. The actual total project cost at completion was $9.66 million equivalent, compared with an appraisal estimate of $13.19 million equivalent. The actual cost included a foreign exchange cost of $8.57 million and local currency cost of $1.09 million equivalent. All foreign exchange costs were financed by the ADB loan from its Special Funds resources and local costs were met by EA's own resources. An undisbursed ADB loan of $718,310 equivalent was cancelled. Table 1 compares appraisal estimates with actual costs.

Table 1. Summary of Appraisal and Actual Project Costs
($ million)

Component	Appraisal Estimate			Actual		
	Foreign	Local	Total	Foreign	Local	Total
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
Contingencies	1.14	0.27	1.41	0	0	0
IDC	0.16	0.97	1.13	0.12	0	0.12
Total	**10.00**	**3.19**	**13.19**	**8.57**	**1.09**	**9.66**

IDC = interest during construction.
Source: Asian Development Bank's Project Completion Report.

19. The PCR cited strong competition among bidders as the major reason for the cost underrun of the district heating network component. However, the loan savings are mainly due to lack of procurement of transformers for low voltage motors and frequency converters, which are necessary parts of the variable speed pumping system. It was not clear why these could not be procured with loan savings. The OEM was unable to obtain a satisfactory explanation from project documents or interviews with DHC. For the electricity network component, the PCR indicated the relatively small contract size as the main factor for the cost overrun. The OEM considers the change of scope (para. 17) as the main reason for the cost overrun.

20. At appraisal, the Project was scheduled to start in mid-1997 and be completed by 31 December 2000 (42 months). According to a report prepared by MFE after project completion, actual physical completion took 52 months and was completed on 18 October 2001 while ADB documents record project completion on 31 August 2001. The delay was mainly due to a late project start[14] and postponement of operation of the variable speed pumping system. The loan was closed on 31 August 2001 without extension.

D. Procurement and Construction

21. The Project was implemented on a turnkey basis and procurement was carried out in accordance with ADB's *Guidelines for Procurement* using international competitive bidding procedures. The international consultant for project implementation and construction supervision was engaged in accordance with ADB's *Guidelines on the Use of Consultants*. Since site construction could only be carried out during the summer months (June to September), ADB approved advance action for recruitment of the implementation consultant on 10 June 1996. The implementation consultant commenced work in January 1997 to finalize the bid documents prepared by the PPTA consultants. After the award of all contracts in the first half of 1998, DHC managed the contract administration and supervision of works with little assistance from the implementation consultant since the person-months of the consulting

[14] The loan was approved on 26 November 1996 and became effective after 15 months on 26 January 1998.

service under the contract were almost used up and the same consultant was engaged by ADB as the implementation consultant for the follow-up ADB-financed Ulaanbaatar Heat Efficiency Project.

22. The PCR did not report any issues regarding procurement or construction. DHC officials met by the OEM were generally satisfied with the performance of implementation consultants, contractors, and subcontractors under the Project.

E. Organization and Management

23. EA was responsible for supervising and implementing the Project through a PSC and PIU. The PIU was supported initially by the project implementation consultants financed under the loan. The PSC was chaired by the State Secretary of the Ministry of Infrastructure Development (MID) and consisted of representatives from MOF, MID, and EA. The PIU had five staff—manager, two engineers, translator, and driver—provided by EA, DHC,[15] and HCSC. They remained throughout project implementation. In general, the PSC met twice a year on a needs basis to discuss project progress and issues. The PIU was responsible for day-to-day implementation of the Project. This project implementation arrangement seemed to be appropriate and effective. When the Project was completed, PIU staff returned to their former positions.

24. In line with energy sector restructuring, the Government has gradually separated EA's financial responsibilities from its policy-making responsibilities. EA was originally a department under MID. Following the establishment of ERA[16] in 2001, all 18 subsidiary companies under EA became independent state-owned shareholding companies. To support the development of the energy sector, MFE was established in 2004 and EA was subsequently dissolved. ERDC was established after the dissolution of EA and took over some of EA's responsibilities concerning project planning and development in the energy sector.

25. From 18 April 2004, the repayment responsibility of the ADB loan for the Project was formally transferred to DHC through an onlending agreement. The main terms and conditions of this new onlending agreement between MOF and DHC include (i) repayment period of 26 years with a grace period of 6 years, (ii) annual interest rate of 2%, (iii) penalty of 1% for not paying principal and interest on time, and (iv) SDR3.3 million equivalent from the loan to be deducted as government financing and repaid by the Government. Further, DHC entered a separate agreement with CRETG with regard to payment of the portion of the ADB loan for the electricity metering component. In general, frequent organizational changes of government ministries and EA did not adversely affect the implementation and operation of the Project.

[15] DHC was a branch utility company under EA at the time.
[16] ERA is responsible for licensing of all energy-related activities, tariff setting, protection of customer's rights, dispute resolution, and promotion of fair competition among the main players in the energy sector.

III. ACHIEVEMENT OF PROJECT PURPOSE

A. Operational Performance

26. Except the 509 heat meters installed in residential buildings and the substation log under the demonstration subproject, all project facilities are performing satisfactorily. No major operational issues or breakdowns have been reported to date. The main project purpose of improving reliability and reducing water losses in Ulaanbaatar's district heating system has been largely achieved based on the following information collected by the OEM:[17]

(i) Between 1997 and 2001, water losses in the entire system were reduced by a cumulative amount of 1.6 million cubic meters (m^3), equivalent to a total saving of MNT406.5 million.

(ii) DHC reported a cumulative revenue reduction of approximately $7 million since 1998 as a result of metered billing for directly connected customers whose individual heat meters were installed under the Project.

(iii) Between 1999 and 2003, water flow per unit heat in the DHC network decreased from 25.57 tons/Gcal to 22.05 tons/Gcal and make-up water flow fell from 4.47 million tons to 3.91 million tons.

(iv) Heat delivery by the DHC network increased by 5% between 2000 and 2004. Electricity and heat supply to residential areas is no longer rationed since 1999.

27. The demonstration component did not achieve its intended purpose and failed to show clearly the benefits of various energy conservation measures adopted (para. 17). Nonetheless, the demonstration component verified the appropriateness of new equipment to be introduced under the follow-up Ulaanbaatar Heat Efficiency Project. For the electricity metering component, CRETG claimed reductions in system losses due to the Project but did not provide any specific data to substantiate the claim.

B. Performance of the Operating Entity

28. Analysis of financial performance was carried out for DHC. Financial highlights of DHC are given in Appendix 1 and summarized in terms of key financial indicators[18] in Table 2.

Table 2. Financial Highlights of District Heating Company

Items	2000	2001	2002	2003	2004
Working Ratio (%)	95.0	93.0	96.0	101.0	101.0
Debt Service Ratio (%)	109.5	112.4	123.5	108.8	Negative
Current Ratio (%)	0.7	0.5	0.6	0.5	0.5
Debt/(Debt+Equity) (%)	17.3	57.3	60.0	65.6	75.8
Net Profit/Loss (MNT million)	28	400	(55)	(790)	(2,516)

Source: District Heating Company financial statements.

[17] However, data available does not allow attribution of these achievements to the Project in quantitative terms.

[18] The loan covenants require EA to maintain (i) a working ratio of total cash operating expenses to total operating revenues not higher than 60%, and (ii) debt-service coverage ratio of at least 1.3:1. Although not entirely appropriate, this study used the same requirements as reference to assess DHC's financial performance.

29. The results show that DHC has been making losses from 2002 onwards. It is more disturbing to note the trend of increasing losses. A working ratio higher than 100% in recent years means that the revenue cannot even cover the minimum O&M cost.[19] Debt to debt+equity ratio has increased considerably from 17.3% in 2000 to 75.8% in 2004. To account for its worsening financial performance, DHC claimed a cumulative revenue reduction of $7 million due to the introduction of metered billing for directly connected customers. According to DHC, an automatic tariff adjustment was implemented in 1999, but was discontinued after the establishment of ERA in 2001. The actual reasons for DHC's poor financial performance are complex and deserve more thorough analysis than this study permits. On 14 February 2005, the average heat tariff was increased by 19.3%, which shows the Government's commitment to improve DHC's financial performance in the long run.[20]

C. Financial and Economic Reevaluation

30. Financial and economic reevaluations for the Project, undertaken using the latest available information, are discussed in detail in Appendix 2. Table 3 shows the recalculated FIRR and EIRR.

Table 3: Summary of Financial and Economic Revaluations

(%)

FIRR			EIRR		
Appraisal	**PCR**	**PPER**	**Appraisal**	**PCR**	**PPER**
13.0	14.6	(2.3)	28.6	33.3	14.9

EIRR = economic internal rate of return, FIRR = financial internal rate of return, PCR = project completion report, PPER = project performance evaluation report.
Source: Appendix 2.

31. The significantly lower FIRR and EIRR at the PPER stage are mainly due to the following reasons: (i) the report and recommendation of the President (RRP) and PCR assumed considerable benefits from the heat and electricity metering and demonstration subproject but these benefits were either realized independent of the Project or are largely unrealized to date; (ii) energy savings for large metered customers resulted in overall revenue reductions for DHC; and (iii) tariff increases were lower than expected in real terms compared with RRP and PCR projections.

D. Sustainability

32. Project sustainability depends largely on proper facility maintenance and DHC's sound financial performance. The OEM was informed by DHC operation staff that the O&M department submits an annual O&M proposal with budget required to DHC management for review and approval. The final approved budget for O&M is usually lower than the original proposal. In 2004, the approved O&M budget of MNT752 million was about 25% lower than necessary. Since operation costs cannot usually be reduced to keep the system running, the maintenance budget is cut. Thus, there has been a consistent shortage of funds to implement planned maintenance tasks. As a result, maintenance is considered as repair of equipment failures rather than a preventive measure before problems occur. Although no serious operational

[19] During the site visit, the OEM noticed that only the minimum amount of maintenance necessary to keep the equipment operational is undertaken at certain installations.

[20] A comparison between the real tariff and the long-run marginal cost of heat supply revealed that the real tariff as a percentage of the long-run marginal cost had increased from 22% in 1995 to 82% in 2004, which means that the government subsidy for heat supply is being gradually phased out.

issues were identified by the OEM, the weak financial health of DHC is of major concern for the Project's long-term sustainability. Since heat supply is a basic human need in Ulaanbaatar, there is little doubt that the Government and DHC will keep all parts of the Project operational under normal circumstances. Nonetheless, project benefits in terms of energy savings are less likely to be sustainable over time.

IV. ACHIEVEMENT OF OTHER PROJECT IMPACTS

A. Socioeconomic Impact

33. Given the rehabilitation nature of the Project, there was no land acquisition or temporary resettlement. The Project's socioeconomic impact was mainly realized in terms of better quality of life through improved reliability and efficiency of heat and electricity supply to Ulaanbaatar residents. In particular, institutional, industrial, and commercial customers directly connected to the DHC network benefited from metered billing as the Project installed individual heat meters at their premises (para. 26, point ii).

34. Heat and electricity tariffs have been increased twice since 2000 (2002 and 2005). To minimize the impact of tariff increases on the poor,[21] the Government introduced the lifeline electricity tariff in April 2005. The lifeline electricity tariff takes into account both per capita income and basic level of consumption in different areas (Table 4). Furthermore, different electricity tariff increases were applied for people living in apartment buildings and gers. In 2005, the average electricity tariff[22] increased 8.9% for apartment buildings and 3.8% for gers. Thus, the poor and vulnerable are also directly affected by tariff increases. During a visit to a typical family of a couple with three children living in gers, the OEM learned that the family has not been able to pay electricity bills for the last 7 months and electricity supply is now frequently cut off. The total monthly income of the family was about $65 and the monthly electricity bill around $10. The couple was not aware of any social assistance program other than the retirement pension. Due to practical problems associated with heat supply, no lifeline tariff has been formulated to offset the impact of heat tariff increases on the poor living in apartment buildings.[23]

Table 4. Lifeline Electricity Tariff Adopted on 1 April 2005

City/Province	**Monthly Consumption** (for Apartments)	**Tariff** (MNT/kWh)	**Monthly Consumption** (for Gers)	**Tariff** (MNT/kWh)
Ulaanbaatar	Less than 75 kWh	41.0	Less than 60 kWh	39.0
Davkan/Erdenet/Baganur	Less than 50 kWh	41.0	Less than 40 kWh	39.0
Others	Less than 40 kWh	41.0	Less than 30 kWh	39.0

kWh = kilowatt-hour, MNT = togrog.
Source: Energy Regulatory Authority.

[21] In general, per capita income below MNT40,000/month would be used as the criteria for lifeline tariff eligibility, but the exact criteria differs slightly from province to province.
[22] For the non-poor, the current electricity tariff is MNT51/kWh for apartments and MNT48.8/kWh for gers.
[23] The couple visited by the OEM used to live in an apartment building but moved to a gers after selling their apartment.

B. Environmental Impact

35. Environmental improvement was not the Project's main objective. However, reductions in water loss and associated energy savings achieved under the Project (para. 26) arguably had some positive impact on environmental improvement in Ulaanbaatar. For example, consumption of scarce freshwater was reduced by 1.6 million tons from 1997 to 2001.

36. Since most construction work was carried out during the summer seasons when heat was not supplied, there was no hot water leakage causing damage to the environment. The OEM's site visit to locations of the installed valves, pre-insulated heat pipes, and other equipment and instruments installed at the substations did not reveal any major project-related environmental problems.

C. Impact on Institutions and Policy

37. The Project made little institutional impact on EA/DHC. As discussed in para. 21, the implementation consultant was not involved in project implementation after award of procurement contracts. While the review of DHC's O&M procedures by the implementation consultant at the time of project completion produced a number of useful findings, most of the recommendations are yet to be implemented.

38. Since there was no policy component in the project scope, the policy impact directly resulting from the Project is considered minimal. However, with assistance from other agencies, the new energy law became effective on 15 April 2001 and Mongolia's Strategy for Sustainable Development of the Energy Sector (2002–2010) was approved by the Cabinet on 4 July 2002. Restructuring of the energy sector (para. 24) was gradually implemented in line with the new energy law and the Strategy for Sustainable Development of the Energy Sector (2002–2010). The OEM was informed that an energy conservation law has been drafted for consideration by the Cabinet.

V. OVERALL ASSESSMENT

A. Relevance

39. The Project's strategic objectives were consistent with the high priority accorded to the adequate and reliable supplies of power and heat in support of Mongolia's economic transformation and development efforts at the time of approval, and remain highly relevant to the Government's strategy for sustainable development of the energy sector to date.[24] The Project was consistent with ADB's operational strategy in Mongolia at the time, but less relevant to ADB's current operational strategy and strategic objective of poverty reduction. Given the design weaknesses identified in this report (paras. 13–15), project formulation and design were considered inadequate to facilitate achievement of project outcomes and objectives. Overall, the Project was assessed as relevant.

[24] Mongolia's Strategy for Sustainable Development of the Energy Sector (2002–2010) aimed to improve the effectiveness of the energy supply and economic efficiency in the energy sector.

B. Efficacy

40. The main project objective of improved district heating reliability in Ulaanbaatar and reduced hot water losses was substantially achieved after the Project (para. 26). However, this was the result of a series of interventions (para. 5) undertaken almost concurrently and not attributable solely to the Project. Further, the Project did not achieve the intended outcomes in terms of encouraging end-use energy conservation through metering and the demonstration subproject, and contributed little to improvement of the district heating system's O&M through training and technical support. Overall, the Project is assessed as less efficacious.

C. Efficiency

41. While the reestimated FIRR of the Project is negative, the EIRR of the Project is reestimated at 14.9%. Taking into account the disuse of 509 heat meters installed, the Project is assessed as efficient.

D. Sustainability

42. The overall sustainability of the Project is considered less likely (para. 32).

E. Institutional Development and Other Impacts

43. The Project made little impact on the institutional development of DHC and the energy sector as a whole since (i) no specific training was provided under the Project, (ii) policy changes took place largely independent of the Project, and (iii) EA organizational changes leading to its eventual breakup in 2004 were not envisaged at appraisal and not clearly documented in ADB project files. Therefore, the institutional development and other impacts of the Project are considered negligible.

F. Overall Project Rating

44. On the basis of the preceding assessments, the Project is rated partly successful.

G. Assessment of ADB and Executing Agency Performance

45. ADB cooperated well with the Government and EA in formulating the Project and processing the loan. ADB fielded eight missions during implementation—project start, implementation, and completion. DHC appreciated the level of support provided by ADB missions and timely response to its requests for changes during implementation. However, a number of design deficiencies during preparation (paras. 13–15) and inaccurate findings in the PCR (para.11) were identified. The overall performance of ADB is considered partly satisfactory.

46. EA/DHC performed satisfactorily in terms of project preparation and implementation, but did not develop baseline data during implementation and after completion as required. The disuse of the heat meters installed under the Project was due to factors largely outside the control of DHC and HCSC. Nonetheless, in view of noncompliance with key financial covenants and the weak financial position of EA/DHC, the overall performance of EA/DHC is considered partly satisfactory.

VI. ISSUES, LESSONS, AND FOLLOW-UP ACTIONS

A. Key Issues for the Future

47. The current district heating system in Ulaanbaatar does not allow individual customers to control and affect heat consumption and prevents the introduction of a tariff structure based on actual use. This institutional setup is not conducive to sustain reduction in water losses on the supply side and promote energy conservation by end-users. Disuse of 509 heat meters installed under the Project and the unsatisfactory result of the demonstration subproject were direct consequences of these weaknesses. In future, any rehabilitation program aimed at energy loss reduction in the district heating system should be accompanied by concrete institutional changes and tariff reforms to make the supply side more commercially orientated and the demand side more conscientious about energy conservation. However, the desired changes will be unlikely to take place until a regulatory framework including the proposed energy conservation law is in place.

48. There are about 400 km of hot water and steam pipelines in Ulaanbaatar district heating system. DHC replaces about 3% of the old pipelines annually and repairs more than 100 leakages in the network. However, physical inspection is the only means to identify leakages. Given the large number of possible leakages and associated water losses in the system, modern detection equipment should be introduced soon to ensure timely and accurate leak detection.

49. The Project was undertaken at almost the same time as other ADB interventions in the same sector, addressing similar issues (footnotes 1, 2, and 3), so it is difficult to assess project achievements and impacts in isolation. It would be more appropriate and beneficial for Operations Evaluation Department to evaluate the closely related projects in a combined manner.[25]

B. Lessons Identified

50. Advance action for recruitment of the implementation consultant is meant to ensure timely project implementation and quality throughout the implementation period. The impact of such advance action on project implementation seemed to be less positive in the Project. The implementation consultant was not actively involved in project implementation and supervision because the consultant started work early and had insufficient person-months input, yet was available under the contract after 1998. To avoid such complete mismatch of consulting services with actual project implementation schedule, advance action for recruitment of the implementation consultant and procurement activities should not be applied mechanically during project preparation, and the consultant's mobilization date should be realistically determined and adjusted in the event of delayed loan signing and effectiveness.[26]

51. The less-than-successful result of the demonstration subproject was due to poor project design. First, the existing institutional setup and tariff structure do not provide the necessary incentives for energy conservation to DHC on the supply side and end-users on the demand side. Metered billing means a loss of revenue for DHC and will be accepted by end-users only if they have individual control over heat consumption in their apartments. However, without

[25] The Power Rehabilitation Project was completed at about the same time as the Project, and the Ulaanbaatar Heat Efficiency Project was almost completed at the time of the OEM.
[26] In this case, the loan became effective one year after the consultant's work began.

metered billing, none of the benefits claimed from the proposed cost-effective technical changes could be realized at the end-user level. Second, individual consumers involved in the demonstration subproject were not informed about work to be carried out in their installations or its purpose. Furthermore, there is no record that project-affected people gave permission to implement the proposed changes in private apartments prior to implementation. In the end, most changes took place at the substation or the buildings rather than at the end-user level. All these design weaknesses point to inadequate feasibility analysis of proposed project instruments and lack of stakeholder consultation at the design stage.

52. The Project was formulated to complement work being carried out on the district heating system under the Power Rehabilitation Project and pave the way for the next stage of development to be financed under the Ulaanbaatar Heat Efficiency Project. These three projects were approved between November 1994 and September 1997 and overlapped in many aspects. However, choice of certain equipment under the Project was not fully compatible with the next stage of development. This could have been avoided through effective consistency checks of project designs and coordination among the different project officers in charge.

C. Follow-Up Actions

53. In the absence of an appropriate regulatory framework and financial incentives for demand-side energy conservation, no follow-up actions are recommended.

FINANCIAL HIGHLIGHTS OF DISTRICT HEATING COMPANY

Table A1.1: District Heating Company Income Statement

Item	2000	2001	2002	2003	2004
A. Heat Sales (Tcal)					
1. Organizations	512	516	529	536	546
2. Industries	1,335	1,346	1,382	1,400	1,424
3. Residential	1,782	1,796	1,844	1,867	1,901
Subtotal	**3,629**	**3,758**	**3,854**	**3,803**	**3,871**
Average Heat Tariff (MNT/Gcal)	3,071	4,020	4,214	4,530	4,451
Total Revenues (MNT million)	**11,144**	**15,107**	**16,240**	**17,227**	**17,228**
Operating Expenses (MNT million)					
Coal and Fuel Oil	8	11	—	12	12
Purchased Power	9,449	12,621	13,979	14,969	15,236
Own Use of Electricity	496	503	520	535	566
Water	26	21	25	26	26
Maintenance Materials	140	166	154	147	134
Salaries and Wages	402	464	502	551	598
Administration	65	72	145	227	80
Depreciation	623	686	743	863	896
Others	7	178	310	906	748
Total Operating Expenses	**11,216**	**14,722**	**16,378**	**18,236**	**18,296**
Operating Income (MNT million)	(72)	385	(138)	(1,009)	(1,068)
Non-operating Income	110	139	173	328	348
Non-operating Expenses	4	102	50	105	1,796
Interest Expenses	6	22	4	4	—
Taxable Income	28	400	(19)	(790)	(2,516)
Financial Ratios (%)					
Working Ratio	95	93	96	101	101
Operating Ratio	101	97	101	106	106
Return on Net Fixed Assets	0.2	1.2	0.0	(1.9)	(3.9)

Gcal = gigacalorie (1 million kilocalories), — = not available, and Tcal = teracalorie (1,000 gigacalories).
Source: District Heating Company.

Table A1.2: Balance Sheet

Item	2000	2001	2002	2003	2004
Fixed Assets (MNT million)					
Gross Fixed Assets	21,931	24,236	25,035	25,626	29,694
Accumulated Depreciation	1,748	2,408	3,226	4,062	4,933
Work in Progress	174	14,416	16,363	20,897	40,127
Other Fixed Assets				7	34
Net Fixed Assets	20,357	36,244	38,172	42,468	64,922
Cash	478	485	347	135	423
Account Receivables	1,410	1,119	1,472	3,258	2,277
Inventories	217	349	343	338	312
Other Current Assets	98	190	501	60	128
Total Current Assets	2,203	2,143	2,663	3,791	3,140
Total Assets	**22,560**	**38,387**	**40,835**	**46,259**	**68,062**
Equity (MNT million)					
Capital	15,742	15,552	15,557	15,557	19,065
Reserves and Retained Earnings	239	(1,097)	(1,153)	(1,844)	(4,120)
Government Grants					
Total Equity	15,981	14,455	14,404	13,713	14,945
Liabilities (MNT million)					
Long-Term Debt	3,338	19,386	21,599	26,119	46,755
Account Payables	3,240	4,544	4,831	6,191	6,341
Others	1	2	1	236	21
Total Current Liabilities	3,241	4,546	4,832	6,427	6,362
Total Equity and Liabilities	**22,560**	**38,387**	**40,835**	**46,259**	**68,062**
Financial Ratios (%)					
Current Ratio	0.7	0.5	0.6	0.6	0.5
Debt/(Debt+Equity) Ratio	17.3	57.3	60.0	65.6	75.8

Source: District Heating Company.

Table A1.3: Fund Flow Statement

Item	2000	2001	2002	2003	2004
Source (MNT million)					
Net Income before Interest	34	422	-15	-786	-2,516
Depreciation	623	686	743	863	896
Change in Working Capital		1,365	(234)	467	586
Net Internal Cash Generation	657	2,473	494	544	(1,034)
Long-Term Loans		16,048	2,213	4,520	20,636
Government Equity Infusion					3,508
Total Source	657	18,521	2,707	5,064	23,110
Application (MNT million)					
Capital Expenditures	174	14,242	1,947	4,534	22,454
Debt Service	6	22	4	5	1
Total Applications	180	14,264	1,951	4,539	22,455
Net Cash Inflow	477	4,257	756	525	655
Cash (Beginning)	1	478	485	347	135
Cash (Ending)	478	485	347	135	423
Financial Ratio (%)					
Debt Service Ratio	109.50	112.41	123.50	108.80	(1,034)

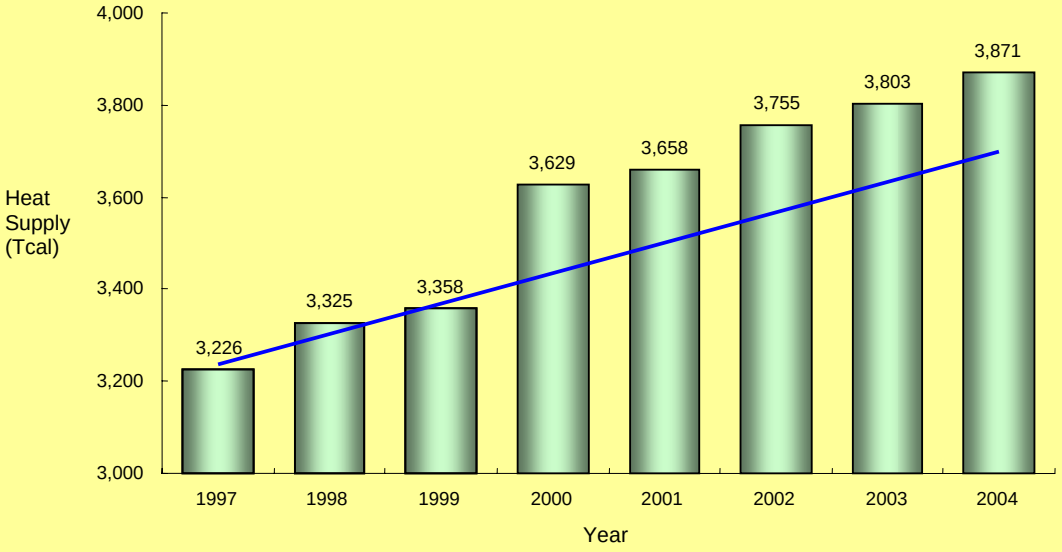
Source: District Heating Company.

FINANCIAL AND ECONOMIC REEVALUATION

1. The financial and economic reevaluation of the Project was conducted based on financial data and assumptions provided by agencies concerned and similar methodology elaborated in the report and recommendation of the President (RRP) and the project completion report (PCR). However, the financial internal rate of return (FIRR) for the project components was reestimated from the perspective of DHC instead of EA. In reestimating the economic internal rate of return (EIRR), the financial costs were adjusted to reflect the true economic opportunities lost and won because of the Project. All revenue and cost flow streams were expressed in 2005 constant prices. The reevaluation assumed an average project life of 25 years instead of 20 years.

2. Incremental capital costs were based on PCR investment figures. Incremental revenues were derived from (i) increase in heat delivery (Figure A2.1), (ii) reduction in volume of annual replenishment water (Figure A2.2), and (iii) reduction in network heat losses (Figure A2.3).

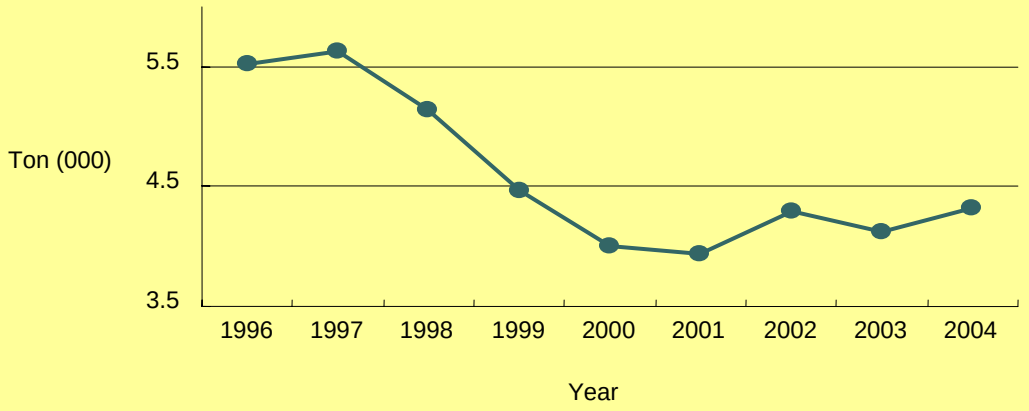
Figure A2.1: Increased Heat Delivery



Tcal= 1,000 gigacalories.

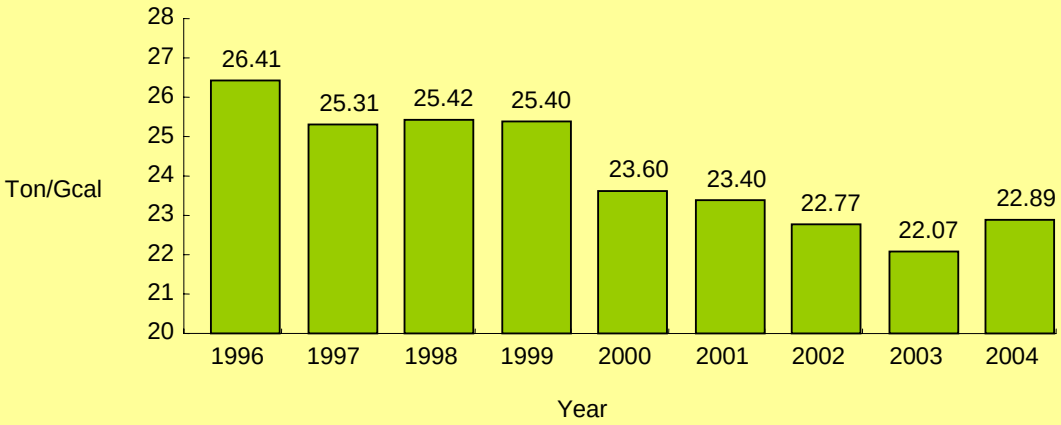
Source: District Heating Company.

Figure A2.2: Volume Reduction of Annual Network Replenishment Water



Source: District Heating Company.

Figure A2.3: Reduction in Network Heat Losses



Gcal = gigacalorie.

Source: District Heating Company.

3. Table A2.1 compares the project benefits estimated at appraisal, project completion, and postevaluation.

Table A2.1: Comparison of Project Benefits

Benefits	At Appraisal		At PCR		At PPER	
	Savings	$ Million (NPV)	Savings	$ Million (NPV)	Savings	$ Million (NPV)
Heat Loss Reduction	79 Tcal	0.6	58 Tcal	0.5	58 Tcal	0.3
Consumer Heat Wastage	80 Tcal	0.6	86 Tcal	0.8	86 Tcal	0.4
Technical Loss (Electricity)	20 GWh	1.2	25 GWh	1.0	NA	NA
Nontechnical Loss (Electricity)	10 GWh	0.6	15 GWh	0.6	NA	NA

GWh = gigawatt-hour, NA = not attributable, NPV = net present value, and Tcal = teracalorie.
Source: District Heating Company.

4. Table A2.2 shows the results of the recalculated FIRR and EIRR. Detailed recalculations of FIRR and EIRR are in Table A2.3 and A2.4.

Table A2.2: FIRR and EIRR at Appraisal, PCR, and PPER

(%)

Indicator	Appraisal	PCR	PPER
FIRR	13.0	14.6	(2.3)
EIRR	28.6	33.3	14.9

EIRR = economic internal rate of return, FIRR = financial internal rate of return, PCR = project completion report, PPER = project performance evaluation report.
Source: District Heating Company.

5. The main reasons for the significantly lower FIRR and EIRR at the PPER stage are the following: (i) RRP and PCR assumed considerable benefits from heat and electricity metering and demonstration subproject but these benefits were either realized independent of the Project or have not been realized to date; (ii) energy savings from large metered customers resulted in overall revenue reductions for DHC; and (iii) tariff increases were lower than expected in real terms compared with RRP and PCR projections.

Table A2.3: Financial Internal Rate of Return

($ million)

Item	NPV	1997	1998	1999	2000	2001	2002	2003	2004	2005	2007	2010	2018
Incremental Inflow													
Heat Loss Reduction	3.81			0.02	0.15	0.22	0.23	0.23	0.21	0.26	0.26	0.29	0.29
Consumer Heat Wastage Reduction	5.72			0.13	0.20	0.33	0.34	0.34	0.32	0.38	0.39	0.43	0.43
Government Infusion	2.98			-	-	-	-	-	3.46	-	-	-	-
Total	**12.51**		**-**	**0.15**	**0.34**	**0.55**	**0.57**	**0.57**	**3.99**	**0.63**	**0.65**	**0.72**	**0.72**
Incremental Outgo													
Capital Cost	9.07	0.80	6.30	1.30	1.20								
Lost Consumer Heat Revenue	5.72			0.13	0.20	0.33	0.34	0.34	0.32	0.38	0.39	0.43	0.43
Income Tax	0.55										0.05	0.05	0.05
Total	15.34	0.80	6.30	1.43	1.40	0.33	0.34	0.34	0.32	0.38	0.44	0.48	0.48
Net Cash Flow	**(3.05)**	**(0.80)**	**(6.30)**	**(1.28)**	**(1.05)**	**0.22**	**0.23**	**0.23**	**3.67**	**0.26**	**0.21**	**0.24**	**0.24**
FIRR	**(2.3%)**												

FIRR = financial internal rate of return, and NPV = net present value.
Source: District Heating Company.

Table A2.4: Economic Internal Rate of Return

($ million)

Item	NPV	1997	1998	1999	2000	2001	2002	2003	2004	2005	2007	2010	2018
Incremental Inflow													
Heat Loss Reduction	5.10			0.11	0.64	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
Consumer Heat Wastage Reduction	7.87			0.58	0.87	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Total	**12.97**		**-**	**0.68**	**1.51**	**1.93**	**1.93**	**1.93**	**1.93**	**1.93**	**1.93**	**1.93**	**1.93**
Incremental Outgo	-												
Capital Cost	7.42	0.80	6.30	1.30	1.20								
Government Infusion	3.09								3.46				
Total	**10.51**	**0.80**	**6.30**	**1.30**	**1.20**	**-**	**-**	**-**	**3.46**	**-**	**-**	**-**	**-**
Net Cash Flow	**2.46**	**(0.80)**	**(6.30)**	**(0.62)**	**0.31**	**1.93**	**1.93**	**1.93**	**(1.53)**	**1.93**	**1.93**	**1.93**	**1.93**
EIRR	**14.9%**												

EIRR = economic internal rate of return, and NPV = net present value.
Source: District Heating Company.

MANAGEMENT RESPONSE TO THE PROJECT PERFORMANCE EVALUATION REPORT FOR THE ENERGY CONSERVATION PROJECT (Loan 1492-MON[SF])

On 26 January 2006, the Director General, Operations Evaluation Department, received the following response from the Managing Director General on behalf of Management:

A. Overall Assessment

1. Management notes that the PPER considers the overall project partly successful, although the project completion report (PCR) rated it as successful, and suggests the following views.

2. The report is critical of the design of the project as sufficient technical diagnostic work was not carried out, and less than-satisfactory performance of some project facilities. The Operations Evaluation Mission (OEM) also recognizes that this project was conceived as the first of a series of intervention to rehabilitate a district heating system with over 400 km of old pipe network and a 1950 vintage constant-heat design. The project's design, therefore, was driven more by the urgency to restore part of the network with the available funds, rather than a comprehensive design to rectify all problems. As can be seen, changes were also incorporated during project implementation from constant to variable-speed pumps that have higher front-end cost, but lower energy cost for operations.

3. The PPER estimates a negative financial internal rate of return for the project. Comparison with the Report and Recommendation of the President (RRP) and PCR shows that the PPER has not included benefits from electricity loss reduction in the estimates for incremental revenue, which is related to the installation of energy meters. The link between installation of energy meters and reduction of losses is supported in many ADB projects, and the fact that if you cannot measure, you cannot save. The energy meters were installed at the power plant and key points in the distribution network to guide the operators. Unfortunately, the actual impact is difficult to measure because of the aggregate consumer demand and, consequently, the substation energy balance changes for various reasons. Energy specialists are generally required to make a best estimate instead of totally disregarding the benefits from improved and accurate metering.

B. Lessons Learned and Follow-Up Actions

4. Other issues and lessons identified are duly noted and will be considered in the preparation of future ADB projects.