



# Validation Report

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Reference Number: PVR-212  
Project Number: 29629  
Loan Number: 1548  
December 2012

## Mongolia: Ulaanbaatar Heat Efficiency Project

Independent Evaluation Department  
**Asian Development Bank**

## **ABBREVIATIONS**

ADB	–	Asian Development Bank
DHC	–	district heating company
DHS	–	district heating system
PCR	–	project completion report
PIU	–	project implementation unit
WTP	–	willingness-to-pay

## **NOTE**

In this report, “\$” refers to US dollars.

## **Key Words**

asian development bank, district, efficiency, energy, evaluation, heating, lessons, mongolia, ulaanbaatar

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## PROJECT BASIC DATA

<b>Project Number:</b>	29629	<b>PCR Circulation Date:</b>	Apr 2009	
<b>Loan Number:</b>	1548	<b>PCR Validation Date:</b>	Dec 2012	
<b>Project Name:</b>	Ulaanbaatar Heat Efficiency Project			
<b>Country:</b>	Mongolia		<b>Approved</b> (\$ million)	<b>Actual</b> (\$ million)
<b>Sector:</b>	Public works, urban, heating	<b>Total Project Costs:</b>	55.70	48.12
<b>ADB Financing:</b> (\$ million)	<b>ADF:</b> 40.00	<b>Loan:</b> (SDR equivalent)	40.00	40.99
	<b>OCR:</b>		29.49	29.01
		<b>Borrower:</b>	12.70	7.12
		<b>Beneficiaries:</b>		
		<b>Others:</b>		
<b>Cofinancier:</b>	None	<b>Total Cofinancing:</b>		
<b>Approval Date:</b>	25 Sep 1997	<b>Effectiveness Date:</b>	19 Mar 1998	24 Nov 1998
<b>Signing Date:</b>	8 Dec1997	<b>Closing Date:</b>	30 Jun 2003	1 Mar 2007
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ADB = Asian Development Bank, ADF = Asian Development Fund, IED2 = Independent Evaluation Department (Division 2), PCR = project completion report, SDR = special drawing right.

## I. PROJECT DESCRIPTION

### A. Rationale

1. During the appraisal period, Ulaanbaatar was considered one of the coldest capital cities in the world. It accounted for about 25% of Mongolia's population and half of the country's industrial production. The population of Ulaanbaatar depended on the district heating system. Because of its harsh winter months, heat was considered a basic human need. A serious deterioration in the efficiency and reliability of heat supply in Ulaanbaatar affected the living conditions of its 620,000 urban residents and industrial users.

2. Much was already done to improve the heating system under various projects funded by bilateral and multilateral agencies. However, additional investment to rehabilitate and modernize the district heating system was required to remove heat transmission bottlenecks. The district heating system (DHS) suffered from insufficient heat supply in many areas, hydraulic imbalance, huge water losses, as well as lack of automatic controls and energy meters. The Ulaanbaatar DHS was initially constructed in 1959. It was based on a supply of hot water produced at three combined heat and power plants, which are coal-fired and generate electricity for the central electricity grid, steam for industrial purposes supplied through a separate pipe network, and hot water for the DHS. There was also a need to promote energy conservation by

giving consumers the means to control their heat supply and to pay based on metered consumption.

## **B. Expected Impact**

3. The project's targeted impacts or goals indicated in the project framework<sup>1</sup> at appraisal were to (i) meet the basic needs of the population and support economic recovery, and (ii) improve sector efficiency. For the first targeted impact, the envisaged performance indicator was more efficient and reliable energy supply to households and industries. For the second targeted impact, the performance indicator was an economically efficient sector with financially viable and sustainable sector enterprises.<sup>2</sup>

## **C. Objectives or Expected Outcomes**

4. The intended outcome was to improve district heating and steam system operations and encourage end-user efficiency, thus ensuring the reliability and adequacy of heat and steam supply in Ulaanbaatar. Outcome indicators were: (i) increased useful supply to consumers by more than half without installing any additional capacity; and (ii) reduced by one-third the electricity consumption for pumping.

5. The project was expected to promote energy conservation and efficiency, ensure an evenly distributed heat supply, remove heat transport bottlenecks, reduce unit operation costs, improve supply reliability, and help eliminate water leakage throughout the system. These, in turn, were expected to ensure that consumers would be provided with adequate and reliable heat supply. Consumers were to pay for heat according to their actual consumption with the introduction of a tariff and billing system based on metered heat consumption. These were expected to encourage efficient heat consumption and energy conservation.

## **D. Components and Outputs**

6. The project had the following components:

(i) **Conversion of the district heating system to variable flow operation.** This involved the installation of the following: (a) about 22 variable speed pumps at the power plants; (b) about 168 substation heat exchanger units with control units; (c) about 430 differential pressure controllers for ventilation systems; (d) about 20 kilometers (km) of distribution pipe work; (e) about 1,412 heat exchanger installations in buildings; (f) about 877 bulk heat meters; (g) about 1,358 bulk hot water meters; and (h) control and monitoring system including modifications to the pressure holding system, hydraulic separation of the combined heat and power plant, plant internal heat systems, and about 300 cubic meters per hour of additional water treatment capacity.

(ii) **Consumer-end heat control, and metering and billing improvement.** This was to entail pilot installation of meters, allocators, and valves for about 5,400 apartments and the design and implementation of a new billing system.

<sup>1</sup> The project completion report (PCR) did not include a design monitoring framework or a type of project framework. It indicated project impacts as "strategic objectives" in the document. ADB. 2008. *Completion Report on Mongolia: Ulaanbaatar Heat Efficiency*. Manila.

<sup>2</sup> ADB. 1997. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Mongolia for the Ulaanbaatar Heat Efficiency Project*. Manila.

(iii) **Steam system rehabilitation.** This was to involve installation of about 2.2 km of replacement steam and condensate pipe, about 10.8 km of steam pipe insulation, 500 steam traps, and 57 steam meters.

(iv) **Project management and training.** This was to provide consulting services for implementation supervision and training.

## **E. Provision of Inputs**

7. Total project cost at appraisal was estimated at \$55.7 million equivalent, of which 77% was estimated to be the foreign exchange cost, and 23% local currency cost. The actual cost at completion was \$48.12 million, which was lower than the appraisal estimate by \$7.58 million. The project completion report (PCR) indicated that the lower cost was due to reduced interest during construction because of slow rate of disbursement, non-implementation of the steam system network component, and unused contingency of about \$5 million. At completion, 85% of the total cost was foreign exchange, the same as the Asian Development Bank (ADB) financing percentage. The remainder, or 15%, was the local currency cost. A total of \$703,509 of the loan was canceled.

## **F. Implementation Arrangements**

8. During project implementation, several organizational changes occurred within the government, which required a change in the executing agency for the project. Initially, the Energy Regulation Authority was the executing agency. But because of these changes, the Ulaanbaatar District Heating Company (DHC) was designated as the executing agency under the Ministry of Fuel and Energy. The DHC took over both implementation and repayment responsibilities for the ADB loan. The project management structure included a project steering committee that had been established under previous ADB-funded energy projects and a project implementation unit (PIU) for day-to-day management. During implementation, several staff changes within the PIU were made. As a result, the executing agency relied heavily on the consultants for the front-end work such as design, tender documents, bid evaluation, and negotiations. The PIU was most active during implementation in the field with the assistance of the consultants.

9. In operating the DHS, the Ulaanbaatar DHC acts as a heat wholesaler, buying heat from the power plants and selling it in bulk to large industrial, commercial, public, and institutional building operators; to the various housing and communal services companies that belong to the local government of Ulaanbaatar and administer the majority of residential buildings; and to other, smaller housing companies in Ulaanbaatar. The steam system is administered by the power plants and covers parts of the city, generally near the power plants, where industries are located.

10. The PCR indicated that covenants were generally complied with. However, covenants on tariff were not complied with, most important of which were the establishment of a quarterly automatic heat and electricity tariff adjustment mechanism and individual metering of heat and hot water consumption. Project preparatory technical assistance was provided to help prepare the project. There was no advisory technical assistance approved in conjunction with the project.

## II. EVALUATION OF PERFORMANCE AND RATINGS

### A. Relevance of Design and Formulation

11. The PCR rated the project *highly relevant*. According to the PCR, the government placed a high priority on adequate and reliable supply of power and heat to support Mongolia's economic transformation and development. The project was in line with ADB's operational strategy at the time for Mongolia's energy sector, which focused on sector reforms, rehabilitation of existing facilities, tariff adjustments, energy conservation, and strengthening of sector institutions. Moreover, the project was designed to complement the electricity and heat system rehabilitation measures being implemented with assistance from ADB.<sup>3</sup>

12. However, the project implementation was undertaken with constant reviews and modifications of design. For example, problems were encountered during the installation of heating units and heat exchanges. According to the PCR, the actual numbers and sizes of installed equipment differed from the estimates at appraisal due to design and scope changes. For the steam system rehabilitation component, items were redefined to include reinforcement of the secondary district heating pipe network and replacement of booster pumps at the pumping stations with speed-controlled pumps. In the case of substations' installations, there were numerous design changes during the implementation of the package 2 components to accommodate unexpected hydraulic conditions, and the locations and capacities of heating substations and heat exchangers.

13. In addition, late provision of counterpart funds had the effect of causing some difficulties for the executing agency, contractors, and consultants. These should have been anticipated during project preparation stage. Given these shortcomings in the project design, this validation downgrades the project to *relevant*.

### B. Effectiveness in Achieving Project Outcomes

14. The PCR reported that the installation of heat exchangers with automatic controls at selected locations enabled heat supply to secondary side installations to be adjusted automatically. At the heat producers' end, speed-controlled pumps with frequency converters were installed, enabling the power plants to supply the required pressure and flow under variable flow conditions. Other improvements at the power plants were replacement of hand-operated valves with automatic control valves and new condensate control units for the heat exchanges, upgrading the pressure holding and water replenishment system, separation of internal heating systems, installation of water treatment equipment and de-aerator system, and installation of a control monitoring system to control the heat transferred to the distribution network. At the distribution and consumers' end, 17 heating units were installed at 14 substations and 2 new substations, 417 units of heat exchangers were also installed at various selected distribution centers around the city, and about 9,000 meters (m) of underground and external pipes were connected to the heating units.

15. Hot water treatment systems were installed, together with about 979 mixing loops and about 100 balancing valves for the ventilation system to improve water quality in the network. Residential buildings were fitted with balancing valves, balancing risers, and energy meters. A

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<sup>3</sup> Loan 1334-MON (SF): *Power Rehabilitation Project*, for SDR27.142 million (\$40 million equivalent), approved on 24 November 1994; Loan 1492-MON (SF) *Energy Conservation Project*, for SDR6.944 million (\$10 million equivalent) approved on 26 November 1996.

pilot program was included to install water meters, thermostatic valves and heat allocators on radiators in individual apartments so that consumers could individually control the heat supply and measure heat and hot water consumption. The actual installation included 5,822 thermostatic radiator valves; 510 strainers for risers; 3,850 allocators; and 2 monitoring systems. These were installed in 26 buildings.

16. The steam system rehabilitation component was planned to be funded by the Government of Spain. However, the agreement was not ratified by the Mongolian Parliament. In view of this, the rehabilitation was to be carried out by the executing agency using its own resources. In addition, the PCR reported that the consultants and contractors sufficiently trained the executing agency staff members. Training and study tours were likewise completed successfully.

17. Overall, the project largely achieved its envisaged outputs and outcomes at appraisal. The project was able to improve district heating and steam operations by providing additional heat and hot water for new consumers. Energy conservation was achieved through rehabilitation and modernization of the main and secondary heating systems. As of 2007, the PCR reported that about 2,000 new customers were supplied with adequate and reliable heat from the DHS, adding a load to the system of about 400 gigacalories per hour. Moreover, around 6,000 customers connected to the DHS were assured of adequate and reliable heat and hot water. Detracting from this generally favorable attainment of project outcome was the failure to introduce a new billing system based on heat consumption, including the collection of data to monitor the individual consumer's use. The PCR rated the project *effective* and this validation concurs.

### **C. Efficiency of Resource Use in Achieving Outputs and Outcomes**

18. The project was expected to be completed within about 5 years of loan effectiveness, or in December 2002. Frequent changes in government following loan approval affected loan effectiveness, the date for which had to be extended twice for a total of about 8 months. A contentious point seemed to involve government's agreement with the automatic tariff adjustment mechanism (Loan Agreement, Schedule 6, para. 8).

19. The loan closing date was extended three times for a total of 44 months, which implied that the project was completed after a total of about 9 years. The PCR indicated that there was some delays in adjusting and approving contract package 1 (improvements at power plants) to meet the available budget. Implementation of this package was hampered by delays in equipment delivery, insufficient labor force, and inadequate communication between the DHC, the consultant, and the contractor. The revised contract was signed in June 2000 with a completion date of 1 September 2002. Due to contractor inexperience and the poor quality of both the materials and works, the contract package completion was not found acceptable until June 2006.

20. The benefits used in the estimation of the economic internal rate of return were based on the incremental heat supply produced because of the project. This was valued based on the end-users' willingness-to-pay (WTP). The WTP was estimated based on the average heating costs of traditional felt-covered nomadic homes that use wood and coal, the most expensive form of heat. This may not be the best measure of WTP since heat is necessary at almost any cost. An option could have been to determine the price paid by nontraditional houses (buildings) that are not connected to the DHS. The recalculated economic internal rate of return was 32%, compared to 23.4% estimated at appraisal. However, the assumptions and

parameters used in estimating the WTP were not indicated in the PCR's abbreviated economic evaluation appendix. The assumptions and parameters used in the economic reevaluation could not be ascertained, which could have helped in validating the results.

21. The PCR rated the project *efficient*. Given the implementation delays and the unascertained economic evaluation, this validation rates the project *less than efficient*.

#### **D. Preliminary Assessment of Sustainability**

22. A major assumption used in reestimating the financial internal rate of return (FIRR) concerned the tariff to end users. This was expected to increase by 20% in 2008 and 10% in subsequent years. From experience, such high rates of increase appear unlikely. Nevertheless, the PCR estimated the FIRR at 5% compared to the appraisal estimate of 10%. The lower FIRR was attributed to past losses, project implementation delays, and lower incremental tariff adjustments. The PCR indicated that the weighted average cost of capital was estimated to be negative in view of prevailing inflationary conditions and the low interest rate for the ADB loan. However, the estimate for the weighted average cost of capital was not shown, including the assumptions used. Hence, the results could not be validated.

23. The PCR argued that the project is *likely* to be sustainable as the government will continue to subsidize DHS to ensure a reliable heat supply. This validation disagrees as the government is more likely to respond to funding emergency maintenance rather than those involving routine or periodic maintenance. Furthermore, tariffs set by the Energy Regulation Authority tended to be based on customer affordability rather than on cost recovery. As a result, the DHC barely covered operating costs and rate of return requirements. Since the DHS is having difficulties meeting operating expenses, this validation rates the project *less than likely sustainable*.

#### **E. Impact**

23. The envisaged impact indicator of providing more efficient and reliable energy supply to households and industries was largely achieved. The improvement in reliability and efficiency of the heat supply benefited most of Ulaanbaatar's population, regardless of income level. However, the other impact indicator of an economically efficient sector with financially viable and sustainable sector enterprise appear to have not been met mostly due to the weak financial position of the DHC and the failure to introduce a tariff system and adjustment mechanism for tariff increases. Therefore, this validation rates the project impact *moderate*.

### **III. OTHER PERFORMANCE ASSESSMENTS**

#### **A. Performance of the Borrower and Executing Agency**

24. The PCR rated the performance of both borrower and executing agency *satisfactory*. However, it indicated that delays in implementation were attributed partly to the contractors, and partly to the borrower and the executing agency for not facilitating the administrative procedures, such as importation of equipment and making funds available on time. These were exacerbated by a very short construction and/or work season that generally lasted from May to September after which no work could be done. Also, preparatory work in identifying sites for heating units could have been better designed and planned as changes were often required during implementation.

25. Given the long delays in completing project implementation, difficulties in implementing requirements of the financial covenants, lack of flexibility in adjusting administrative arrangements, and difficulties providing funding in a timely manner, this validation rates both the borrower's and the executing agency's performance *less than satisfactory*.

## **B. Performance of the Asian Development Bank**

26. ADB appears to have been actively involved in the supervision of this project as evidenced by 13 review missions from 1997 until 2006 or about 1.4 missions per year. This was necessary as the executing agency was still not familiar with ADB procedures and other internationally accepted procedures. Considerable assistance was needed during the procurement process to help resolve implementation issues throughout implementation. The PCR noted that "ADB headquarters and the Mongolia Resident Mission provided guidance and support by formal and informal communication with the EA". The PCR rates ADB's performance *satisfactory* and this validation agrees.

## **C. Others**

27. Governance was an issue due to the adjustments being made from a command economy to one that is more market-based. Some of the covenants were not fully understood or politically acceptable and led to their noncompliance. There was no evidence of corruption although there were issues concerning the potential use of substandard parts and materials. The government was slow in some cases with regard to providing local counterpart funds.

28. Mongolia has in place necessary environmental regulations, which are regularly monitored. The PCR reported that the project did not increase coal use and related emissions. The socioeconomic impact was not subjected to formal study but the PCR noted that low income apartment residents benefited from more efficient heating. Also, no resettlement or temporary displacement of people was involved, employment was generated during construction, and the impact of technical support was positive. No negative socioeconomic impacts associated with the project were reported.

# **IV. OVERALL ASSESSMENT, LESSONS, AND RECOMMENDATIONS**

## **A. Overall Assessment and Ratings**

29. This validation downgrade the PCR's overall rating of *successful*. Overall, the project is rated *less than successful* based on the ratings of *relevant*, *effective*, *less than efficient*, and *less than likely sustainable* (see table).

### **Overall Ratings**

<b>Criteria</b>	<b>PCR</b>	<b>IED Review</b>	<b>Reason for Disagreement and/or Comments</b>
Relevance	Highly relevant	Relevant	Numerous design changes detracted from the project's overall relevance (para. 13).
Effectiveness in achieving outcome	Effective	Effective	
Efficiency in achieving outcome and outputs	Efficient	Less than efficient	Implementation delays and unascertained economic evaluation (para. 21).
Preliminary assessment of sustainability	Likely	Less than likely	DHC barely meets operating expenses. Expected tariff increases are unlikely

Criteria	PCR	IED Review	Reason for Disagreement and/or Comments
			(para. 23).
<b>Overall assessment</b>	<b>Successful</b>	<b>Less than successful</b>	
Borrower and executing agency	Satisfactory	Less than satisfactory	Delays in project implementation, difficulties in implementing financial covenants, and difficulties in providing counterpart funding (para. 25).
Performance of ADB	Satisfactory	Satisfactory	
Impact	Not rated	Moderate	Refer to para. 23.
Quality of PCR		Less than satisfactory	Refer to para. 32.

ADB = Asian Development Bank, DHC = district heating company, IED = Independent Evaluation Department, PCR = project completion report.

Note: From May 2012, IED views the PCR's rating terminology of "partly" or "less" as equivalent to "less than" and uses this terminology for its own rating categories to improve clarity.

Source: ADB Independent Evaluation Department.

## B. Lessons

29. The PCR identified several important lessons, some of which are briefly summarized below. During the period when the project was under preparation, Mongolia was undergoing significant structural changes and adjustments. This required close monitoring by ADB and interaction with the government and consultants to ensure appropriate adjustments. Similarly, loan covenants could have been flexibly crafted to encourage reforms. The very short construction season required careful, complete, and early planning. International competitive bidding was considered new in both concept and practice. Special care could have been exercised by all concerned to ensure that the international competitive bidding approach would succeed. Procedures regarding logistics, particularly for landlocked countries, need to be carefully reviewed and adjusted to help ensure efficiency. Since accounting methods and economic concepts were often different, care should be taken in preparing financial and economic evaluations. This validation agrees with these lessons.

## C. Recommendations for Follow-Up

30. The PCR made a number of appropriate project-related and general recommendations, and this validation agrees. Considerable reforms, particularly for cost recovery and efficiency pricing need to be continuously pursued with full consideration of the social and political context. A commercialization plan including greater autonomy and financial options for the DHS needs to be developed.

## V. OTHER CONSIDERATIONS AND FOLLOW-UP

### A. Monitoring and Evaluation Design, Implementation, and Utilization

31. Neither environmental nor social monitoring was considered necessary for this project, although social impact monitoring might have been useful in evaluating the impacts of projects with potentially high social impact.

**B. Comments on Project Completion Report Quality**

32. The information on the project is clear and well-presented. However, the PCR did not present a design and monitoring framework, which could have provided information on the extent to which performance targets for impacts and outcome were achieved and the logical connections between activities, outputs, and outcome. Financial and economic evaluations, as presented, were limited. Accompanying parameters and assumptions could have facilitated validation of the results of these analyses. This validation assesses overall quality of the PCR as *less than satisfactory*.

**C. Data Sources for Validation**

33. Sources included the report and recommendation of the President, PCR, minutes of staff and management meetings, and back-to-office reports of review missions.

**D. Recommendation for Independent Evaluation Department Follow-Up**

34. In view of major deviations from the PCR's findings, a project performance evaluation report for this project is warranted.