

Performance
Evaluation Report

People's Republic of China: Gansu Clean Energy Development Project



Performance Evaluation Report
December 2013

**People's Republic of China:
Gansu Clean Energy Development Project**

Reference Number: PPE:PRC 2013-15
Project Number: 34476
Loan No.: 2032
Independent Evaluation: PE-765

Independent
Evaluation  ADB

NOTES

- (i) In this report, "\$" refers to US dollars.
- (ii) For an explanation of rating descriptions used in Asian Development Bank evaluation reports, see Asian Development Bank. 2006. *Guidelines for Preparing Performance Evaluation Reports for Public Sector Operations*. Manila.

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Abbreviations

ADB	–	Asian Development Bank
CER	–	certified emission reduction
ICB	–	international competitive bidding
IED	–	Independent Evaluation Department
km	–	kilometer
kV	–	kilovolt
kWh	–	kilowatt-hour
MW	–	megawatt
PCR	–	project completion report
PPER	–	project performance evaluation report
PRC	–	People's Republic of China
XHC	–	Xiaogushan Hydropower Company
XHP	–	Xiaogushan hydropower plant

Currency Equivalents

Currency Unit – yuan (CNY)

		At Appraisal (10 November 2003)	At Project Completion (15 May 2009)	At Independent Evaluation (31 October 2013)
CNY1.00	=	\$0.12	\$0.15	\$0.16
\$1.00	=	CNY8.3	CNY6.8	CNY6.2

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Acknowledgments

This project performance evaluation report for the Gansu Clean Energy Development Project in the People's Republic of China was prepared by a team of staff and consultant from the Independent Evaluation Department. The team consists of Kelly Hewitt (team leader), Ma. Olivia Nuestro, and Elizabeth Li-Mancenido. Eugene McCarthy was the consultant, with overall guidance from Hemamala Hettige, Senior Advisor and Officer-in-Charge, Division 2; and Vinod Thomas, Director General, Independent Evaluation Department. Valuable inputs and comments at various stages were received from Kapil Thukral (peer reviewer).

Basic Data

Loan 2032-PRC: Gansu Clean Energy Development Project

Project Preparatory and Institution Building

TA No.	Technical Assistance Name	Type	Person-Months	Amount (\$)	Approval Date
3730	Gansu Hydropower	PP	45	950,000	27 Sep 2001

Key Project Data (\$ million)	Appraisal Estimate	Actual
Total project cost	87.0	93.4
Foreign exchange cost	35.0	34.0
Local currency cost	52.0	59.3
ADB loan amount/utilization	35.0	35.0
Key Dates		
Fact-finding		15–24 January 2003
Loan negotiations		27–30 October 2003
Board approval		5 December 2003
Loan signing		27 April 2004
Loan effectiveness		4 August 2004
First disbursement		4 August 2004
Loan closing		2 September 2008

Borrower	People's Republic of China
Executing Agency	Gansu Provincial Government
Implementing Agency	Xiaogushan Hydropower Company

Mission Data

Type of Mission	No. of Missions	No. of Person-Days
Fact-finding	1	48
Appraisal	Waived	
Inception mission	1	12
Loan review	5	157
Project completion	1	31
Independent evaluation	1	9

ADB = Asian Development Bank, PP = project preparatory, PRC = People's Republic of China, TA = technical assistance.

Source: Asian Development Bank database.

Executive Summary

During the 2001 country programming mission, the People's Republic of China (PRC) requested Asian Development Bank (ADB) assistance for a clean energy development project in Gansu province. This request reflected the evolving priorities of the government's own strategy in the energy sector, which emphasized improved efficiency, development of renewable energy sources such as hydropower to reduce a heavy dependence on coal-fired power plants, and the need to address severe air pollution in the country's urban centers.

The investment chosen for ADB support was a 98-megawatt (MW), later upgraded to 102 MW, run-of-the-river hydropower development that formed part of a larger, cascade, hydropower development scheme (700 MW) along the Heihe River in the northwest PRC. The main project objective was to contribute to environmental improvement in Zhangye City in Gansu province by improving access to clean energy. The environmental classification of the hydropower development was category A. The expected benefits were the supply of a clean, low-cost, source of electricity that would reduce load shedding; improve air quality; and provide a secure electricity supply to small, local townships in the project area. A special feature of the project was its potential to receive significant financial benefits from the Clean Development Mechanism administered under the United Nations Framework Convention on Climate Change.

Project preparatory technical assistance of \$0.95 million helped prepare the inputs needed to appraise the project for ADB financing. ADB provided a loan of \$35.00 million toward an estimated project cost of \$87.00 million. The government asked ADB to approve advance action to expedite the recruitment of consultants and procurement for civil works and critical equipment. ADB Management approved this request in May 2003, and on 11 September 2003 approved the government's request for up to \$3.50 million in retroactive financing for equipment and civil works for the period from 1 October 2003 until the time the loan would take effect. The ADB loan was approved in December 2003. By then, implementation was under way; it was later completed more than 6 months ahead of schedule, which enabled the plant to start generating electricity in June 2006. Overall, implementation arrangements were very successful.

The project is rated *highly successful*. It was completed ahead of schedule, within budget, and the main goals were met. A low-cost, clean source of energy has been developed, which has helped improve the dependability of electricity supply in Gansu province. It has also made an important contribution to improving air quality in nearby urban centers by developing a new, clean energy source, which enabled the closure of two heavily polluting, coal-fired generating units. Finally, it provided significant socioeconomic benefits to the small townships affected by the hydro development.

Based on the operational performance and related benefits during the first 6 years of operation, the sustainability of the project is rated *most likely*. In terms of the specific evaluation criteria, the ratings are as follows:

- (i) **Relevance:** *highly relevant*, based on a close alignment of the project objectives and design with the government's own development objectives in Gansu province as well as with ADB's country strategy in the PRC, which gave priority to regional development in poorer provinces, development of clean energy sources, and improved sector efficiency. The project design was sound and took into account lessons learned in past projects. A comprehensive feasibility study was also prepared during the study process, and project implementation issues were given special emphasis. Technical aspects were carefully reviewed and project alternatives were examined prudently. Project design has carefully considered environmental and social aspects, including resettlement, and has ensured that the project is consistent with ADB's energy, safeguards, and environment policies.
- (ii) **Effectiveness:** *highly effective*, based on (a) much improved electricity supply to nearby consumption centers, reflected in the absence of blackouts or load shedding; (b) a sharp reduction in air pollution in urban areas, reflected in the 2011 indices of key pollutants, which are now within grade II air quality standards; and (c) the provision of a reliable electricity supply to small, poor communities in the vicinity of the plant, enabling improvements in their health and education facilities.
- (iii) **Efficiency:** *highly efficient*, based on a higher economic internal rate of return after 6 years of operation (27.1%) than estimated at appraisal (23.4%); efficient borrower implementation, which brought the project on stream 6 months ahead of schedule; and sound ADB supervision support.
- (iv) **Sustainability:** *highly likely*, based on the economic, financial, environmental, and institutional benefits already realized, which have been sustained for more than 6 years since the hydro plant first came into operation in late May 2006.

The **impact** of the project has been *substantial* based on its socioeconomic, environmental, and institutional impacts. The substantial socioeconomic impact is seen in the much improved electricity supply to urban consuming centers as well as in its impact on the livelihoods of small rural communities close to the plant. The environmental impact has been substantial, contributing to a major and sustained improvement in air quality in nearby urban centers. The project also has had an important institutional impact not only in strengthening the management and administrative capacity of the implementation agency but also in supporting an independent, environmental monitoring agency at the local municipal level. Finally, in regard to safeguard aspects, the project did not have any adverse environmental impact and safeguard aspects were addressed satisfactorily. Resettlement began in early 2002 and was completed by the end of 2005. The affected people have now been resettled and fully compensated, with compensation generally exceeding rates stated in the resettlement plan.

ADB performance was rated *satisfactory* while the borrower's performance was rated *highly satisfactory*. Borrower feedback on ADB's supervision performance was positive, despite several changes in project officers. Borrower performance was characterized by strong ownership, effective coordination between local authorities, and high technical and managerial competence. With some 13 ADB-financed projects under implementation in Gansu province, the Clean Energy Development Project stood out as a successful project, implemented ahead of schedule, and within budget.

A number of lessons have emerged from this project performance evaluation review.

First, strong project ownership is key to a highly successful project. Strong project ownership is also essential for successful implementation. In evaluating project ownership, attention must be given during appraisal not only to investment planning priorities but also to whether counterpart funding has been committed; whether key staff are in place; whether coordination mechanisms across, and within, different government levels are working effectively; and whether institutional capacity exists to address social and environmental issues affecting the project's long-term sustainability. A particularly positive feature of this operation was the close coordination between municipal and provincial authorities and the implementing agency, Xiaogushan Hydropower Company—reflecting a shared ownership in the benefits of the project.

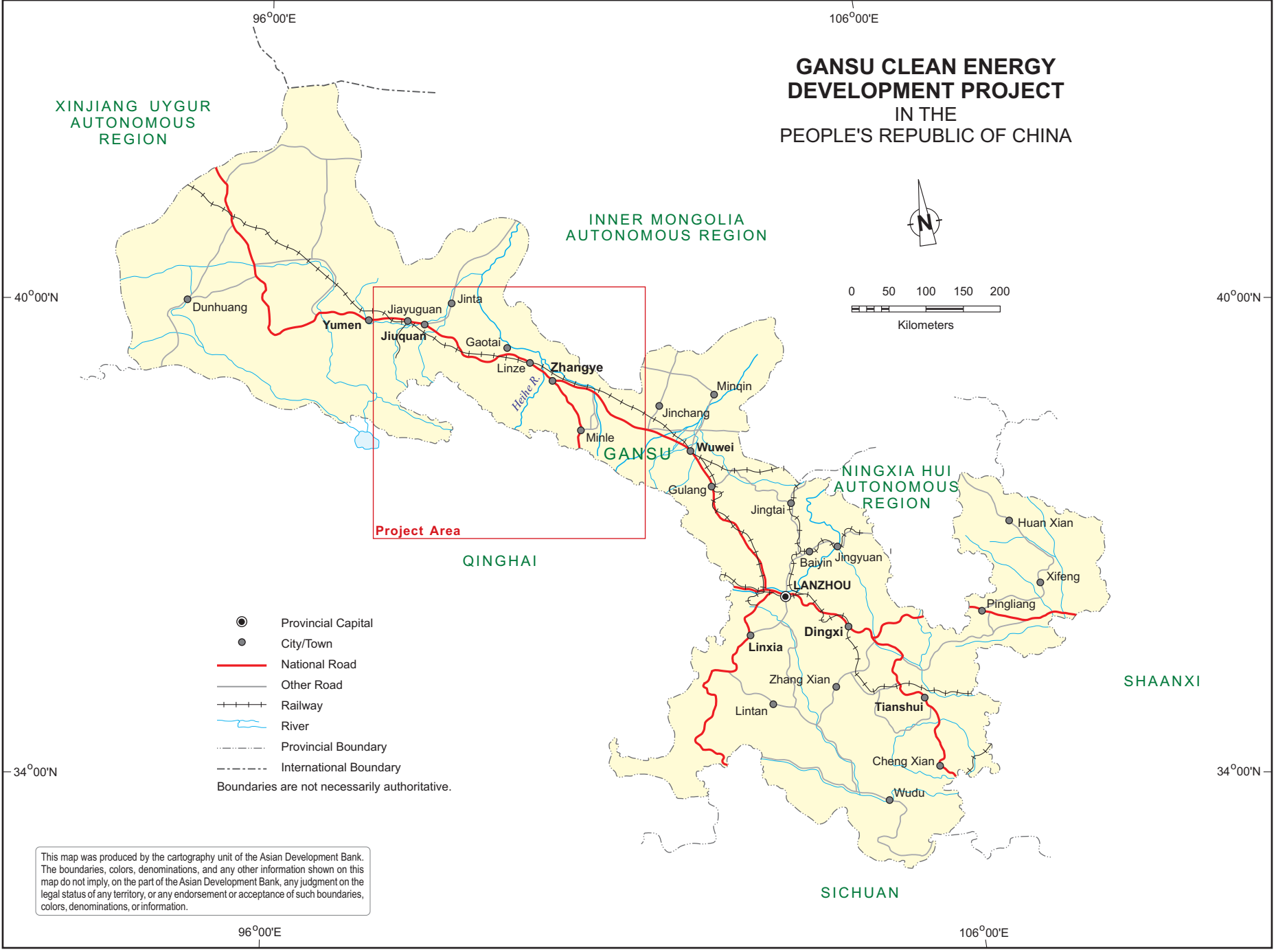
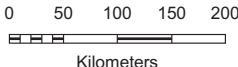
Second, lessons that help ensure the project sustainability of hydropower investments deserve highlighting: (i) strong commitment from the power company to address social and environmental issues is essential; (ii) local communities in the vicinity of the hydropower plant must also receive electricity supplies; (iii) funding needs to be set aside for clinics, schools, local roads, and related investments that directly benefit the communities; and (iv) independent mechanisms need to be put in place at project startup to monitor progress in realizing the planned social and environmental benefits.

Third, in countries such as the PRC, with well-developed local capacity in implementing large infrastructure projects, partnerships with an international consulting firm in the implementation arrangements can be an effective way to enable the transfer of state-of-the-art management and operational practices to national companies and agencies. In this project, the involvement of an international consulting firm, experienced in modern management techniques of hydropower plants, helped transfer such practices to Xiaogushan Hydropower Company.

Finally, there are useful lessons for the future supervision of ADB-financed projects. ADB supervision performance was rated satisfactory overall, with a number of positive aspects that deserve highlighting. These included advance contracting and retroactive financing provisions, project officer continuity between the preparation and implementation stages, and subsequent delegation of implementation responsibility to the resident mission in Beijing. At the same time, changes in the project officer during supervision put at risk early implementation momentum, though they did not affect adversely project completion because of strong and sustained borrower performance throughout implementation.

GANSU CLEAN ENERGY DEVELOPMENT PROJECT

IN THE PEOPLE'S REPUBLIC OF CHINA



- Provincial Capital
 - City/Town
 - National Road
 - Other Road
 - ++++ Railway
 - River
 - Provincial Boundary
 - - - International Boundary
- Boundaries are not necessarily authoritative.

This map was produced by the cartography unit of the Asian Development Bank. The boundaries, colors, denominations, and any other information shown on this map do not imply, on the part of the Asian Development Bank, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries, colors, denominations, or information.

Introduction

A. Evaluation Purpose and Process

1. The People's Republic of China (PRC) has made enormous progress since a decision to open up the economy in 1978. Over this period, economic growth has averaged 9% annually—faster than any other country in the world—which has enabled the country to lift millions out of poverty. While all regions of the PRC have experienced economic growth, coastal regions have grown faster than the interior. Furthermore, urban areas have experienced higher levels of growth than rural areas. Throughout this period, investment in infrastructure has been emphasized, especially investment in roads, electricity, and water supply. A particular challenge has been to ensure that rapid economic growth has been inclusive, in terms of benefitting the country's poorer regions, as well as environmentally sustainable.

2. In the energy sector, much of the growth in production has been coal-based, causing severe air pollution in many urban areas. This has highlighted the need to diversify away from coal toward cleaner energy sources to help reduce environmental pollution. These economic, social, and environmental challenges provided the country and sector context for the Gansu Clean Energy Development project in 2003.¹

3. The project was completed in July 2006, 6 months ahead of the estimated start of operations, January 2007. The project completion report was prepared in August 2009 and rated the project *highly successful*.² It was rated highly relevant, highly effective, efficient, and most likely to be sustainable. It rated implementation progress *satisfactory* from December 2003 to July 2005, improving to *highly satisfactory* from August 2005 to August 2007.

4. The project performance evaluation report (PPER) has been scheduled more than 6 years after the project's operational start, an interval that provides adequate time to assess progress in project effectiveness and sustainability. It also provides adequate time to assess the impact of the rural electricity distribution component, which supplied electricity to three poor townships near the hydropower station. In addition, given the efficient implementation of this project within the forecast period, the PPER should also enable key lessons to be identified for successful implementation of other large infrastructure projects. The project had a significant civil works component in this poor region of the PRC, which may have broader applications for the Asian Development Bank (ADB) and its clients. ADB is financing 13 projects at different stages of implementation in Gansu province, which could benefit from the lessons of the Clean Energy Development Project. Finally, the PPER may feed into the thematic evaluation study on ADB's support for inclusive growth in 2014.

¹ ADB. 2003. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Gansu Clean Energy Development Project*. Manila (Loan 2032).

² ADB. 2009. *Completion Report: Gansu Clean Energy Development Project in the People's Republic of China*. Manila (Loan 2032).

B. Expected Results

5. The main objectives of the project were to (i) increase clean energy generation; (ii) improve the reliability and efficiency of electric power in the project area; (iii) prevent the deterioration of air quality; and (iv) support the poverty reduction program of Zhangye City, an urban township in the project area in Gansu province. The environmental classification of the hydropower development was category A.³

6. The expected benefits were threefold: economic, environmental, and social. The main economic benefit was to provide a low-cost and reliable source of electricity to the project area, which would result in reduced load shedding and increased per capita annual electricity consumption. In terms of environmental benefits, the project would contribute to improved air quality standards in the project area, especially in regard to particulate matter, sulfur dioxide, and nitrogen oxides. Finally, with regard to social benefits, the project would result in a more reliable electricity supply to small, local townships in the project area. As a result, it was expected to lead to improvements in small agricultural production as well as health and education facilities in these townships.

³ A proposed project is classified category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment, including an environmental management plan, is required.

Design and Implementation

A. Formulation

7. Energy sector lending to the PRC had been a priority for ADB since its first lending operations to the country in 1987. ADB's initial lending operations in energy supported traditional power generation and transmission investments, aimed at ensuring electricity supplies for a rapidly growing economy. During the 2001 country programming mission, the PRC requested ADB assistance for a run-of-the-river hydropower and clean energy development project in Gansu province. This request reflected the government's evolving strategy in the energy sector, which emphasized energy efficiency, developing renewable energy sources to reduce heavy dependence on coal-fired power plants, and the need to address severe air pollution in urban centers. It also reflected a government commitment to ensure that energy shortages and worsening air pollution were tackled in poorer regions such as Gansu province.

8. As a first step, project preparatory technical assistance costing \$950,000 was approved in September 2001.⁴ This helped prepare the policy and institutional aspects needed to appraise the full project for ADB financing. It addressed the policy and institutional requirements of the project as well as the feasibility of the proposed hydropower investment. The final report on the project, which the technical assistance helped prepare, was submitted to ADB in December 2002. The project was appraised in September 2003 and was approved by ADB's Board of Directors in December 2003.

B. Rationale

9. The decision to support the development of hydropower in Gansu, one of the PRC's poorest provinces, had a clear justification. First, the development of clean energy sources such as hydropower was consistent with the government's strategy of developing such sources wherever available. In the southeast region of Gansu province, the development of hydropower represented the best, low-cost option to meet growing electricity demand in a province already heavily dependent on coal-fired thermal plants. Second, development of the province's hydro potential helped reduce severe air pollution in urban centers close to the proposed project area by developing a new, clean energy source that enabled the closure of two heavily polluting, coal-fired generating units. Finally, the distribution component of the project provided a reliable and affordable source of electricity to poor townships in the project area (para. 42).

10. The project was also consistent with ADB's country and sector objectives in the PRC, which emphasized achieving balanced and sustainable growth, expanding the use of clean and renewable energy sources, and more stringent protection of the environment. The proposed investment supported the development of a clean source of renewable energy in one of the PRC's poorest provinces, addressed worsening

⁴ ADB. 2001. *Technical Assistance to the People's Republic of China for Gansu Hydropower Development*. Manila.

environmental pollution in urban centers of the province, and provided a reliable electricity supply to three poor townships in the project area.⁵

11. A special feature of the project—of particular interest to the government—was its potential to receive financial benefits from the Clean Development Mechanism being administered under the United Nations Framework Convention on Climate Change.⁶ These benefits started to be received in 2006, amounting to about CNY12.3 million annually, and will terminate at the end of 2015.

C. Cost and Financing

12. The estimated project cost at appraisal was \$87 million, including price and physical contingencies as well as financial charges incurred during development; the base cost estimate at appraisal was \$74 million. The project cost, calculated at the time of the project completion review in May 2009, was \$93.4 million, 7% higher than the cost estimated at appraisal (Appendix 1). Overall, this increase in cost was modest and mainly attributable to cost increases in certain components (para. 13) as well as the appreciation of the yuan against the US dollar during this 6-year period.

13. The main cost variations in project components were (i) a 10% increase in the large civil works components (from \$53.6 million to \$59.2 million) partly caused by work quantity increases incurred (a) in the diversion tunnel works for geological reasons, and (b) in the construction of the dam and power house; (ii) the institutional strengthening component, which increased from \$0.7 million to \$4.0 million primarily caused by high project design costs; (iii) land acquisition, resettlement, and other costs, which were \$2.5 million overall, mainly resulting from large construction management expenses; (iv) designing and supervising, which decreased from \$4.1 million to \$3.1 million; and (v) financial charges during development which decreased from \$9.0 million to \$7.7 million.⁷ A total of \$3.1 million for physical and price contingencies in the appraisal cost estimate helped absorb part of the cost increase in the base cost subcomponents.

14. These cost increases were modest and had no evident impact on the project financing plan. The amounts provided from the main financing sources remained substantially unchanged. ADB contributed \$35 million to the project cost, with domestic banks (\$40.2 million) and equity capital (\$19.1 million) from Heihe Hydropower Development Company and Zhangye Water and Power Bureau covering the remaining financing needs.

⁵ ADB. 2002. *Country Strategy and Program Update: People's Republic of China, 2003–2005*. Manila.

⁶ The Clean Development Mechanism, defined in Article 12 of the Protocol, allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to 1 ton of carbon dioxide, which can be counted toward meeting Kyoto targets.

⁷ Including front-end fee, interest during construction, and commitment charges.

D. Implementing Arrangements, Procurement, Construction, and Scheduling

15. Gansu Provincial Government was responsible for overall execution of the project. The implementing agency was Xiaogushan Hydropower Company (XHC)—a joint stock company of Heihe Hydropower Development Company and the local municipal company, Zhangye Water and Power Bureau—established in 2001 to undertake project development. A project director was appointed with responsibility for overall project management, approval of contracts, and payments. The key operational groups were the planning, engineering, and finance departments. These arrangements were strengthened through the provision of international consulting services, which provided project management expertise, on-the-job training, and overseas study tours for XHC staff. The provision of international consulting services was a noteworthy feature and enabled modern management practices to be transferred to XHC.

16. Overall, the project was very well implemented. Prior to Board approval in May 2003, the government requested advance contracting approval from ADB on key civil works, equipment, and consulting service contracts as well as up to \$3.5 million of retroactive financing, or 10% of the loan amount. This enabled implementation to move ahead quickly without interruption. Coordination between the implementing agency, municipal authorities in Zhangye City, and provincial authorities in Lanzhou on the project financing needs was extremely efficient. The environmental and resettlement aspects associated with the project were effectively addressed. To address these aspects of the project, a special office was created within XHC to facilitate land acquisition, undertake social protection measures, and interact with local communities affected by the project.

17. Some 63 contract packages were awarded under the project: 26 for civil works, 32 for equipment, and five for consulting services. Of these packages, nine were procured under international competitive bidding (ICB) procedures and the remaining 54 contract packages under national competitive bidding procedures.⁸ ICB contracts varied in amount from \$17.3 million for hydraulic turbines to \$3.6 million for the supply of cranes. With the sole exception of the contract (\$367,800) for project management and training awarded to GHD consultants, all other contracts were awarded to national equipment suppliers and construction companies, reflecting the technical capacity and price competitiveness of national companies.

18. The project had two construction supervision companies, both national companies with experience in large civil works. These companies had primary responsibility for project quality and monitoring construction progress. An international consulting firm, in its capacity as project management consultant for the implementing agency, also provided inputs on construction quality. Overall, the local contractors that undertook the main construction works performed satisfactorily, as did the main equipment suppliers.

19. The completion of the project was achieved ahead of the appraisal schedule, which enabled the hydropower station to start generating electricity in June 2006 compared with the appraisal estimate of January 2007. This was a significant achievement. During the 3-year implementation period, critical works were completed

⁸ Footnote 2, Appendix 8.

on time; the main turbine units were also delivered and installed on schedule (Appendix 2).

E. Design Changes

20. Some minor changes were made to the initial design capacity of the power plants as well as the design of the transmission line component for the project. The design capacity of the power plants increased from 98 megawatts (MW) to 102 MW as the length of the diversion tunnel was reduced by 300 meters and the tunnel lining was optimized—resulting in greater annual generation capacity than forecast at appraisal. Annual power generation data since mid-2006, when the plant came on stream, have confirmed this capacity increase (Appendix 3).

21. The project also made provision for two 35-kilovolt (kV) lines needed to transmit electricity from the hydropower station to the three nearby townships. However, this design was later modified to take advantage of a 35 kV transmission link already built to provide standby power during project construction. A further transmission link between the townships was also built as part of the rural power upgrading program. These lines ended up being financed with domestic funds as part of the upgrading program of the municipal government of Zhangye City. The lines were completed at an early stage of project implementation and helped provide reliable electricity supply to these townships.

F. Outputs

22. The main project output was the construction of a new hydropower station on the Heihe River, comprising a diversion weir, a tunnel, and 2x40 MW plus 1x18 MW units by 2007. As noted above, the plant's initial design capacity of 98 MW was increased to 102 MW. Two 19-kilometer (km) 110-kV transmission lines were built to connect the hydropower plant to a nearby substation.

23. Rural transmission links were also components of the project and were completed to three townships in the project area, providing a reliable supply of electricity to these rural communities for the first time. Finally, the institutional strengthening component was intended to ensure (i) adequate project management capacity in XHC to implement the project, and (ii) a sound management system for XHC in place by 2007. Both these institutional objectives were achieved.

G. Consultants

24. Two main groups of consultancy services were provided under the project: (i) 637 person-months of national consultant services for supervision of the main construction contracts, provided by two engineering companies based in Gansu province; and (ii) 14 person-months of international consultant services provided by GHD consultants, which supported XHC in project management, organized training in financial and computer management, and arranged overseas study tours for XHC staff.

25. Overall, the performance of both international as well as national consultants was satisfactory. The two national construction companies supervised the quality and scheduling of construction works, the supply of critical equipment such as turbines, and coordinated project funding. The international consultants enabled the transfer of modern management practices to the newly formed hydropower company, XHC.

H. Loan Covenants

26. All major loan covenants concerning implementation arrangements, reporting environmental protection and resettlement, and the economic and financial performance of the hydropower company have been complied with. At the time of the completion review in August 2009, three covenants were being complied with. One covenant required the collection of data and subsequent reporting to ADB annually on the project impact, in particular on the poor (project agreement, schedule, para. 21) for 3 years after project completion. Monitoring and evaluation reports were prepared for 2009, 2010, and 2011. Two additional covenants (project agreement, schedule, paras. 10 and 11) required XHC to maintain (i) net revenues of 1.3 times the estimated debt service starting in fiscal year 2010, and (ii) a debt to equity ratio not greater than 65:35 starting in 2010. In regard to the debt to equity ratio, the proportion of debt in XHC was 67.58% in 2009, 65.34% in 2010, and 61.36% in 2011, indicating compliance with this covenant. In regard to the net revenue covenant, net revenues have been 1.3 times the debt service ratio since 2010 (Appendix 9).

I. Policy and Sector Context

27. Development of the Xiaogushan hydropower plant (XHP) has been an important step forward in developing the full hydropower potential of the Heihe River in Gansu province. As of September 2012, eight medium-sized hydropower plants had been developed at different locations along this river over a period of 25 years, resulting in an aggregate hydropower capacity of over 700 MW. ADB financing helped support the development of three of these hydropower plants: Erlongshan (50.5 MW), Dagushan (65.0 MW), and Xiaogushan (102.0 MW).

28. The aggregate development of this hydropower capacity has resulted in a low-cost, clean energy source of electricity to meet rapidly growing electricity demand in the central region of Gansu province. Benefits already achieved have been increased electricity supply; a significant reduction in air pollution in urban townships; and the availability of a reliable electricity supply for smaller, rural communities. Potential adverse impacts—such as water rights disputes resulting from drought conditions, earthquake damage to the construction works, or low wholesale electricity prices, which might weaken XHC's financial position—have not been concerns during the first 6 years of operation. Overall, the development of this potential has been efficiently implemented and has resulted in the provision of low-cost electricity from a clean energy source that is likely to be economically, socially, and environmentally sustainable.

CHAPTER 3

Performance Assessment

A. Overall Assessment

29. Overall, the project is rated *highly successful*. The main goals summarized in the project framework have been met and no negative impacts have been recorded. The project was completed ahead of schedule, with a modest cost increase. A low-cost, clean source of energy has been developed efficiently and has helped improve significantly the dependability of electricity supply in Gansu province. It has also made an important contribution to improving air quality in nearby urban centers. The performance of the implementing agency was strong while coordination between the provincial and municipal authorities on issues affecting implementation was efficient.

30. Table 1 summarizes the ratings for the different criteria and the corresponding weighting given to each criterion. Based on the benefits provided during the first 6 years of operation (i.e., mid-2006–2012), the sustainability of the project is considered *most likely*.

Table 1: Overall Performance Assessment

Criterion	Assessment	Rating (0–3)	Weight (%)	Weighted Rating
Relevance	Highly relevant	3	25	0.75
Effectiveness	Highly effective	3	25	0.75
Efficiency	Highly efficient	2	25	0.50
Sustainability	Most likely	3	25	0.75
Total rating				2.75

Source: Independent Evaluation Department.

B. Relevance

31. The project is rated *highly relevant*. It is in line with the government's development strategy in Gansu province as well as ADB's country and sector objectives in the PRC, as described in the country program and strategy update, 2003–2005 (footnote 5). In 2003, at the time of appraisal, Gansu province suffered from severe electricity shortages with frequent load shedding and blackouts. Most of the electricity supply was based on aging coal-fired generation plants, which contributed significantly to air pollution in the province's urban centers. Consequently, the development of 102 MW by XHP provided an urgently needed, clean source of electric power to support the province's growing demand for electricity.

32. The design was an appropriate response to the identified economic, social, and environmental objectives of the project. The design had three components: the main hydropower plant component, which provided a new, reliable, and environmentally clean source of electricity; the rural electricity distribution component, which supplied electricity to three poor townships in the vicinity of the hydropower station; and the institution building component, which helped strengthen project management capacity

as well as the monitoring of resettlement aspects. As such, the design was appropriate to meet the project objectives. The project also supported the provincial government's Overall Program of Poverty Reduction and Development in Gansu Province, 2001–2010. Safeguard preparation gave careful attention to the impact of the project on the environment and to its resettlement impact, including its impact on ethnic minorities. Finally, the project was fully in line with ADB's strategy in the energy sector in the PRC, which emphasized (i) the development of clean energy sources such as hydropower; (ii) promoting system-wide efficiency, strengthening sector institutions, and emphasizing cost recovery; and (iii) enhancing the reliability of rural electricity supply and access to the poor.

C. Effectiveness

33. The project is rated *highly effective*. The main goals of the project, summarized in the project framework of the report and recommendations of the President, were achieved: (i) improved reliability of electricity supply in the project area; (ii) an increase in clean energy from 2005 onward; (iii) a reduction in rural poverty incidence in Zhangye City (para. 43); and (iv) no deterioration of air quality (footnote 1). Since the project became operational in mid-2006, the dependability of electricity supply has improved significantly in the main urban center, Zhangye City, about 60 km from the XHP. The hydropower plant has been in operation for more than 6 years, supplying on average 450,000 megawatt-hours per year (Appendix 3). The availability of a clean, low-cost electricity source, supplemented by the development of the 65 MW Dagushan power plant and other plants along the Heihe River, has been an incentive for industrial development in the Zhangye City region of Gansu province. In 2012, electricity is not in short supply in Zhangye City and more than half of generated electricity is being transmitted to the regional power grid; the reliability of electricity supply has also improved, with no reoccurrence of load shedding or blackouts, which were frequent before 2005—reflecting effective plant maintenance. Air quality in Zhangye City has also improved dramatically, despite growing demand for electricity supply in the past decade. This can be attributed to the aggregate impact of the development of hydropower potential in the region, the closing down of old and heavily polluting coal-fired plants, and the effective monitoring of air quality standards. Overall, air quality in Zhangye City has improved significantly since 2006, reflected in the 2011 indices for sulfur dioxide (SO₂), nitrous oxides, and particulates shown in Appendix 4.

34. Finally, the provision of a reliable and stable source of electricity to townships in the vicinity of the hydropower plant has improved health, education, and community development facilities. The September 2011 monitoring and evaluation report describes the main impact of the project on local townships: (i) roads, communication facilities, and electricity reliability are much improved; (ii) the health center is in much better condition and well staffed; it can now offer medical, pediatric, and gynecological treatment, and vaccines can be stored; and (iii) financial support has been given for primary schools and community worship centers. In the 7 years since monitoring began, the project, through financial support provided by XHC, has made a significant contribution “compensating land acquisition, improving fundamental facilities, and supporting local social activities.”⁹ While the project was one investment among several that contributed to these economic, environmental, and social improvements, its main goals were successfully achieved and have resulted in the development of a clean and

⁹ Lanzhou University, School of Journalism and Communication. 2011. *Monitoring and Evaluation Report on Resettlement Work*. Lanzhou. pp. 7–8.

reliable source of energy in support of income growth and poverty reduction in Gansu province.

D. Efficiency

35. The project overall is rated *highly efficient*. The economic internal rate of return, calculated on the basis of the project's actual performance, was higher than the appraisal estimate: 27.1% during the project completion stage versus 23.4% at appraisal. The recalculated economic rate of return based on operating data through 2011 was maintained at 27.1% and is higher than the 18.0% hurdle rate qualifying the project as highly efficient.¹⁰ The comparative economic internal rates of return at the different stages are summarized in Table 2 and discussed in detail in Appendix 5. The increase in the economic internal rates of return can be attributed to higher power generating capacity and generation in the first 5 years of operation than estimated at appraisal (102 MW versus 98 MW)—leading to increased annual generation plus a greater willingness to pay for electricity than estimated at appraisal.

Table 2: Economic and Financial Internal Rates of Return Recalculation
(%)

Rate of Return	Appraisal	Project Completion Report	Project Performance Evaluation Report
Economic internal rate of return	23.4	27.1	27.1
Financial internal rate of return	7.5	8.7	8.4

EIRR = economic internal rate of return, FIRR = financial internal rate of return.

Sources: Asian Development Bank database and Independent Evaluation Department.

E. Sustainability

36. Overall, project sustainability was rated *most likely*. The assessment of sustainability was based on technical, financial, environmental, and social considerations. During the first 6 years of operation, 2006–2012, the hydropower plant has delivered a reliable supply of electricity above its planned capacity of 98 MW. Inspection of the plant turbines has also been undertaken regularly during this period and there is no evidence of severe erosion of the turbine blades. The turbines are expected to have a normal 30-year life.¹¹ In addition, while the hydropower station is located in a seismic region, the incidence of earthquakes is low (the last severe earthquake was in 1926) and the construction standards for the dam and power station took account of this possibility. The longer term technical sustainability of the project is therefore rated *most likely*.

37. The financial position of XHC as of the end of 2011 is sound, as shown in the company's annual financial statements, 2006–2011 (Appendix 6, Table A6.3). The main factors affecting the finances of XHC are annual power generation and the sales tariff; operating expenses are modest and stable while the number of staff employed in XHC is established at 88 employees—an acceptable number for operating and maintaining a 100 MW hydropower plant (Appendix 6). Annual power generation since start-up in mid-2006 has exceeded forecast levels. The tariff level has been stable in constant terms at CNY0.2478 per kilowatt-hour (kWh), and is reviewed every 3–5 years, taking into account cost recovery and loan payment obligations. XHC has generated healthy operating profits during its first 6 years of operation as well as net profits (Appendix 6,

¹⁰ ADB. 2006. *Guidelines for Preparing Performance Evaluation Reports for Public Sector Operations*. Manila.

¹¹ Lanzhou Power Engineering Company. 2011. Technical Inspection Report.

Table A6.3). Even with the certified emission reduction revenue terminating at the end of 2015, XHC's financial position is likely to remain strong. Finally, the financial internal rates of return for the project investment were calculated at different stages and the results are summarized in Table 2. The higher financial rates of return compared with the appraisal estimate are due to a 14% increase in generation during the first 5 years of operation over appraisal assumptions. While the sales tariff is marginally lower than that assumed at appraisal, the adequacy of the tariff to ensure XHC's financial soundness will continue to be reviewed every 3–5 years. Overall, based on the above findings, prospects for financial sustainability are rated *most likely*.

38. The project has resulted in significant environmental benefits. Any adverse environmental impacts from the civil construction and power station works have been minor and temporary, and have been adequately handled during preparation of the project (Appendix 7). The hydro development is run-of-the-river, with negligible displacement of populations. At the time of the independent evaluation mission, evidence showed that ethnic minorities had benefited from the project, with no adverse effects. The project's main environmental benefit has been its contribution to reduced air pollution in this region of Gansu (Appendix 4, Table A4). Monitoring of the environmental impact of the project has been carried out annually at the municipal level, with the preparation of annual reports, and has shown steady improvement. Given the above considerations, the environmental sustainability is also rated *most likely*.

39. The project has supported the construction of a stable electricity supply to poor townships affected by the hydro development. The benefits of this supply are already evident in these communities and have enabled (i) refrigeration of food stuffs and medicines, (ii) construction and staffing of small community clinics and schools, (iii) improvement in rural roads for better access to hospitals and schools, and (iv) construction of community facilities such as temples. Community capacity to pay for the electricity service has also been maintained. Monitoring of the social impact of the project on these small communities has continued annually, starting in 2009 through 2011 (footnote 9). These annual reports have confirmed the beneficial social effects of the project on these townships, as discussed in para. 34. Consequently, social sustainability is rated *likely*.

CHAPTER 4

Other Assessments

A. Impact

40. The project impact is assessed from the following standpoints: economic benefits; social benefits, including gender; environmental benefits; and institutional benefits. These are the key considerations to ensure the longer term sustainability of the original investment.

41. The *economic* impact has been substantial. The development of XHP has provided a reliable supply of electricity to the growing urban center, Zhangye City, as well as to small rural townships in the project vicinity. The increase in power generation from this clean energy source has resulted in a secure and stable supply of electricity, and an overall decrease in air pollution in Zhangye City. The project catalyzed economic and industrial development in the Zhangye City region of Gansu province.

42. The *social* impact of the project has also been substantial. In the nearby urban center, Zhangye City, the development of XHP has provided a reliable and affordable supply of electricity to low-income households, especially during peak demand. It has also helped spur regional economic growth in this region of Gansu province. In the small, rural townships close to the project site, the availability of a reliable electricity supply has improved local health facilities, local schools, and small agricultural production. Women and young girls in these communities have shared equally in these benefits. During construction (2002–2006), women were employed at the construction site; following construction, improved transportation and communication facilities have enabled women to search for employment opportunities in Zhangye City.

43. Overall, poverty in the project area was significantly reduced over 2002–2011 (Appendix 8, Table A8). During this period, the incidence of poverty declined sharply from 30% to 11%, reflecting the remarkable progress the PRC has made over the past decade in reducing poverty in its poorest regional areas. While a number of investments and community initiatives have contributed to this reduction in poverty, the availability of a secure, low-cost, and affordable electricity supply has been an important factor.

44. The *environmental* benefits resulting from the project have also been substantial. At the time of appraisal in 2003, this region of Gansu province depended on aging, coal-fired power plants, which caused severe air pollution. The combined impact of the development of clean energy from hydropower in conjunction with the retirement of two small, heavily polluting coal-fired generation units has been instrumental in improving air quality in Zhangye City. In addition, during project construction, measures were taken to mitigate the impact of the large civil works on the local environment. The lengthy 3–4 year construction period had minimal adverse impact on the local environment. The operation of the hydropower plant has continued to be monitored annually by the municipal environmental authority, which contracts

out this work to a specialized department in Lanzhou University—a cost-effective, good practice in building up a provincial, environmental monitoring capability. The annual reports from 2009 to 2011 indicate very little negative impact on the environment—including river flow, which has been held around the proposed minimum dry season flow of 1.6 cubic meters per second—the minimum dry season flow specified in the summary environmental impact assessment.¹²

45. The modest resettlement impact of the project investment was handled satisfactorily. The small number of people affected by the project was resettled and adequately compensated while the external resettlement monitoring report prepared in 2007 indicated that the project impact on the affected households was limited (Appendix 8).

46. Finally, the *institutional* impact of the project has been substantial. Since the project was appraised in 2003, XHC has developed into an experienced hydropower company, responsible for the operation and maintenance of the power plant at Xiaogushan. Staffing is efficient, with less than 100 employees; maintenance inspections of the turbines have been undertaken at regular intervals; and the plant has been running without major stoppage for more than 6 years. The financial position of the company is also sound. The provision of training in modern management practices during construction by international consultants, in particular in financial and computer management, made an important contribution to strengthening the institutional capacity of XHC.

47. At the municipal level in Zhangye City, an independent environmental monitoring unit is in place that monitors key air pollution indicators annually. Its municipal mandate extends beyond air pollution and includes the monitoring of water pollutants and investment in wetlands conservation, which has also benefited from ADB support. The project has thus made an important contribution to the adoption of internationally accepted air quality standards as well to strengthening local regulatory capacity to enable monitoring of these standards.

B. ADB Performance

48. ADB's performance was rated *satisfactory* overall. Provincial and municipal government counterpart staff as well as XHC staff were uniformly positive about ADB supervision performance throughout the 4-year implementation period. Missions were frequent, and gave attention to all aspects affecting the project's impact, in particular to environmental, resettlement, and social aspects. While no major technical issues arose during implementation, the presence of an experienced hydropower engineer from ADB headquarters in one or two supervision missions could have helped facilitate the transfer of good operational practices in the management of hydropower plants from other countries (para. 57).

49. During implementation of the project, the project officer changed several times. The project completion report noted that six ADB project officers, one after another, were responsible for the project. Responsibility for implementation was only transferred to the resident mission in Beijing in late 2004—by which time most of the main procurement contracts had already been awarded. Continuity of the ADB project officer between appraisal and the initial 12–18 months of implementation, in

¹² ADB. 2003. *Summary Environmental Impact Assessment: Gansu Clean Energy Development Project in the People's Republic of China*. Manila.

conjunction with advanced contracting approval and retroactive financing, enabled an efficient start to project implementation. Overall, implementation was not adversely affected by the subsequent changes in ADB project officers mainly because of the competence, commitment, and continuity of key staff in the provincial and municipal governments as well as in XHC.

C. Borrower Performance

50. The overall performance of the borrower, implementing agency, and executing agency was rated *highly satisfactory*. Borrower commitment and ownership of this strategically important investment was a critical factor. This was complemented by commendable coordination between the implementing agency and the municipal and provincial authorities on the different financing, environmental, resettlement, and community development issues associated with the project investment. The project management was also carried out efficiently. The end result was a well implemented investment that has been providing significant economic, environmental, and social benefits to Gansu province for more than 6 years since it first came on stream in May 2006. Prospects that it will continue to do so for a further 2 decades are very good.

CHAPTER 5

Lessons

51. **Project ownership.** Strong project ownership was a vital factor in ensuring the project was implemented 6 months ahead of the estimated 4-year schedule and within the original budget. Coordination between the provincial authorities (in the provincial capital, Lanzhou); municipal authorities (in Zhangye, 60 km from the project site); and the hydropower company, XHC, was effective throughout implementation. Early counterpart funding difficulties were resolved without causing delays to implementation, key procurement contracts were awarded within 12 months of project approval, and construction supervision was efficient throughout.

52. Lesson 1: Strong project ownership is essential for successful implementation. In evaluating project ownership, attention must be given during appraisal not only to investment planning priorities but also to whether counterpart funding has been committed, key staff are in place, coordination mechanisms across and within different government levels are working effectively, and an institutional capacity exists to address social and environmental issues affecting the project's long-term sustainability.

53. **Project sustainability.** Effective social and environmental management requires (i) strong commitment from the power company to address such issues; (ii) provision of funds from the company for community clinics and schools, local road investment, and community places of worship; and (iii) independent monitoring mechanisms to assess the social and environmental impact. Each of these issues has been addressed satisfactorily under the project. A comprehensive environmental impact analysis was carried out during preparation together with a detailed resettlement plan of the project's impact on small, local communities. Despite underestimation of the land acquisition costs, the needed resources were made available without difficulty. The subsequent monitoring framework, put in place to measure the project's benefits, has also worked well. Today, the local communities are fully sharing in the benefits of this hydro development. In particular, they have had a stable and reliable electricity supply since 2009, which has led to improved local health and education facilities as well as transportation and communication facilities, which enable younger members of the local communities to seek employment in nearby urban areas.

54. Lesson 2: Addressing adequately the social and environmental impact of hydropower development projects during preparation and making sure the local communities affected by the development participate in the benefits of the investment is an important lesson to ensure longer term project sustainability. To achieve this goal, funding needs to be committed before loan approval to ensure that such issues will be addressed during implementation, and independent monitoring mechanisms put in place to measure the impact on local communities.

55. **Project management of large hydropower developments.** The project management contract, undertaken by an international consulting firm with expertise in the development and management of hydropower schemes, made an important contribution to strengthening the management capacity of the newly formed provincial

power company, XHC. The same firm also provided training services, which enabled key management and operational staff of XHC to become familiar with modern operational practices of large hydro developments outside of the PRC. All of the remaining 64 contracts awarded under the project, including five contracts procured through ICB procedures, were awarded to national companies, many of them based in Gansu province. Despite the modest size of the project management contract (\$367,000), the management and training services provided had a beneficial impact on the organization and staff of the newly formed hydropower company, XHC.

56. Lesson 3: For Asian developing countries with a well developed local capacity in electric power or other infrastructure sectors, partnership with an international consulting firm in the implementation arrangements can be an effective mechanism to enable the transfer of state-of-the-art management and operational practices to national companies and agencies.

57. **ADB performance.** Provincial and municipal government counterpart staff as well as XHC staff spoke positively of ADB supervision performance throughout the 4-year implementation period. Missions were frequent, and gave full attention to all aspects affecting the project's impact, including environmental, resettlement, and social aspects. In some of the supervision missions, the presence of an experienced hydropower engineer from ADB headquarters could have helped facilitate the transfer of good operational practices in the management of hydropower plants from other countries.

58. One concern noted during the implementation period was frequent changes in project officers from 2004 to 2007. The early phases of project implementation have a decisive influence in shaping the direction of future implementation, with the first 24 months often critical in determining a project's outcome. Significant delays at project start-up—whether because of staffing, bidding document preparation, or appointment and mobilization of project management consultants—are rarely recuperated at later stages. For the implementing agency, it is essential to have a fully staffed implementation unit in place at project start-up, familiar with the financing agency's procurement rules. For the financing agency, staff continuity and stability are essential during the initial 24 months.

59. During early implementation of the project, the project officer changed several times. The project completion report noted that six ADB project officers, one after another, were responsible for the project. In addition, responsibility for implementation was only transferred to the resident mission in Beijing in late 2004 when most of the main procurement contracts had already been awarded. That project implementation was not affected adversely was due, in large part, to the commitment, continuity, and stability of key staff in the provincial and municipal governments as well as in XHC.

60. Lesson 4: Continuity and stability in project officers are essential elements for successful implementation, especially during the early implementation phases. Delegation of implementation responsibility to the resident mission at an early stage of the project cycle is also good practice, provided locally recruited staff have sufficient familiarity with ADB operational and procurement procedures.

Appendixes

APPENDIX 1: APPRAISAL AND ACTUAL PROJECT COSTS

(\$ million)

Component	Appraisal			Actual		
	Foreign	Local	Total	Foreign	Local	Total
A. Base Cost						
1. Civil works	14.5	39.2	53.6	16.9	42.3	59.2
2. Power station equipment	12.5	0.3	12.7	9.7	3.0	12.6
3. Environment protection and conservation	0.6	0.0	0.6	0.0	0.7	0.7
4. 110 kV transmission line	2.3	0.0	2.3	1.1	1.2	2.3
5. Designing and supervising	0.3	3.8	4.1	0.9	2.2	3.1
6. Institution strengthening	0.7	0.0	0.7	2.2	1.8	4.0
7. Rural electrification	0.1	0.8	0.9	0.0	1.3	1.3
8. Land, resettlement, and others	0.0	0.0	0.0	0.0	2.5	2.5
Subtotal (A)	30.9	44.0	74.9	30.8	54.9	85.7
B. Contingencies						
1. Physical contingencies	0.2	1.8	2.0	0.0	0.0	0.0
2. Price contingencies	0.0	1.1	1.1	0.0	0.0	0.0
Subtotal (B)	0.2	2.9	3.1	0.0	0.0	0.0
C. Financial Charges During Development	3.9	5.2	9.0	3.2	4.4	7.7
Total	35.0	52.0	87.0	34.0	59.3	93.4

kV = kilovolt.

Note: Numbers may not sum precisely because of rounding.

Source: Asian Development Bank. 2009. *Completion Report: Gansu Clean Energy Development Project in the People's Republic of China*. Manila (Loan 2032).

APPENDIX 2: PLANNED AND ACTUAL IMPLEMENTATION SCHEDULE



Source: Asian Development Bank. 2009. *Completion Report: Gansu Clean Energy Development Project in the People's Republic of China*. Manila (Loan 2032).

APPENDIX 3: XIAOGUSHAN HYDROPOWER PLANT ANNUAL GENERATION DATA, 2006–2012

Year	Electricity Generation (megawatt-hour)
2006 (from May) ^a	251,525.031
2007	474,849.713
2008	433,920.151
2009	472,444.264
2010	423,088.624
2011	458,933.920
2012	464,236.608
2013 (through August)	303,830.032
Total	3,282,828.343

^a Plant initiated operations in late May 2006.

Source: Xiaogushan Hydropower Company data, September 2012.

APPENDIX 4: SUMMARY OF AIR QUALITY IN ZHANGYE CITY, 2011

1. In 2011, Zhangye City committed to protect the environment in order to build an ecological city suitable to live in. It has strengthened pollution reduction and highlighted ecological construction. The overall environmental situation has improved greatly.

2. Air quality in Zhangye City has met grade II air quality standards. The average annual concentration value of the main pollutants in 2011 was 0.033 milligrams per cubic meter (mg/m^3) for sulfur dioxide (SO_2), 0.014 mg/m^3 for nitrogen dioxide (NO_2), and 0.079 mg/m^3 for particulate matter (PM10).¹ Compared with the previous year, 2010, these pollution levels all declined to some degree. The comprehensive pollution index was 1.52; the good air quality was 343 days, accounting for 94.5% of the year. In 2011, the pH of the precipitation was 7.26–7.51; no acid rainfall occurred. Sand and dust weather was monitored throughout the year. Severe sand and dust weather occurred only five times, in February. The concentration range of PM10 was 0.230 mg/m^3 to 3.281 mg/m^3 .

Table A4: Air Quality Standards in Zhangye City, 2006–2011

Year	Sulfur Dioxide			Nitrogen Dioxide		
	Average	Standard	Air Quality Level	Average	Standard	Air Quality Level
2006	0.042	0.06	α	0.014	0.08	—
2007	0.032		α			—
2008	0.028		α			—
2009	0.028		α			—
2010			α			—
2011	0.033		α			—

NO_2 = nitrogen dioxide, SO_2 = sulfur dioxide.

Source: Government of the People's Republic of China, Environmental Bureau of Zhangye City. 2012.

¹ PM10 are particles that pass through a size-selective inlet with a 50% efficiency cut-off at 10 μm aerodynamic diameter. PM10 corresponds to the "thoracic convention" as defined in ISO 7708:1995, Clause 6.

APPENDIX 5: ECONOMIC REEVALUATION

A. General Approach and Methodology

1. The economic reevaluation recalculates the economic internal rate of return (EIRR) of the Gansu Clean Energy Development Project and compares the result with the estimate calculated in mid-2003 during project appraisal (23.4%) and with the estimate calculated at the time of project completion in August 2009 (27.1%).
2. The main assumptions used in the economic evaluation were the following:
 - (i) Project costs were based on the information provided by Xiaogushan Hydropower Company at the time of the project completion report (PCR). These costs were valued using actual domestic prices at the time, expressed in constant 2008 prices, as indicated in the PCR.
 - (ii) Power generation data are based on (a) actual power generation from 2006 to 2011 (Appendix 3); and (b) from 2012 to 2025, forecasts for average annual power generation of 396 gigawatt-hours used in the PCR, resulting in 358.38 gigawatt-hours after taking into account 9.5% for transmission and distribution losses.
 - (iii) Local inflation is based on the consumer price index taken from the International Monetary Fund World Economic Outlook database from 2006 to 2017, extrapolated at 3% annually until 2025.
 - (iv) The nominal weighted average electricity tariff in Zhangye City is forecast to increase to 2025 at the consumer price index level, i.e., remain at the 2008 level in constant price terms.

B. Methodology for Calculating Economic Benefit

3. The methodology used to reevaluate the expected economic benefit of the project is consistent with the estimate of the economic benefit for this project reported in the PCR.¹ The methodology is calibrated with 2008 data taken from Appendix 10 of the PCR, summarized in Box A5.

Box A5: Calculating Economic Benefit

The methodology for the reevaluation of the project's economic benefit described here was developed because details of the methodology used for the appraisal^a and for the project completion report (PCR)^b were not available. The new methodology is based on the same approach used for the project appraisal and PCR.

The **demand function** takes the following semilog form: $\ln q^e = \alpha + \beta \cdot p^e$
where \ln is the natural logarithm, q^e and p^e represent the quantity of electricity consumed and the price (weighted average tariff) of electricity, respectively; and α and β are coefficients

The project is bounded on the demand curve by the points (p_0, q_0) and (p_1, q_1) (see figure).

The price elasticity is given by the expression: $\eta_p = (dq^e/dp^e)(p^e/q^e)$
Differentiating q^e with respect to p^e in the demand function yields the equation $(1/q^e) \cdot (dq^e/dp^e) = \beta$
Hence: $\eta_p = \beta p^e$
whence: $\beta = \eta_p / p^e$

¹ ADB. 2009. *Completion Report: Gansu Clean Energy Development Project in the People's Republic of China*. Manila (Loan 2032).

The weighted average electricity tariff in 2008 for Zhangye City was **CNY0.638 per kilowatt-hour (kWh) = p_1** .^c

Assume that the price elasticity of demand at the marginal point of consumption (p_1, q_1) for all electricity consumers:

$$\eta_p = -0.20$$

Hence, from the formula above: the value of the coefficient at this point $\beta = -0.3135$

Expected benefit: $EB = q_1(p_1 - 1/\beta) - q_0(p_0 - 1/\beta)$

where (q_1, p_1) and (q_0, p_0) represent the boundary points on the demand curve for the project (see figure). The EB is for project output ($q_1 - q_0$), which means that the EB is computed annually.

Incremental annual consumption from the project = **358.38 gigawatt-hours [GWh] = ($q_1 - q_0$)** (based on annual generation of 396 GWh less 9.5% for transmission and distribution losses).

Electricity consumption in Zhangye City in 2008 = **37,223 GWh = q_1** (footnote c).

Electricity consumption excluding consumption from the project in 2008 = $(37,223 - 358)$ GWh per year = **36,865 GWh = q_0**

On the assumption that the project output is very small relative to total consumption:

that is: $(q_1 - q_0) \ll q_0$

Then as an **approximation: $\eta_p = [(q_1 - q_0)/(p_1 - p_0)](p_1/q_1)$**

whence: $p_0 = p_1 - [(q_1 - q_0)/\eta_p](p_1/q_1)$

In fact: $(q_1 - q_0)/q_0 = 358/37223 = 1.0\%$, which is very small

Hence: $p_0 = 0.638 - (358.38/(-0.20)) * (0.638/37223) = \text{CNY}0.669/\text{kWh} = p_{00}$

Therefore from the formula given above for EB:

$$\text{Expected Benefit in 2008} = 37223 * (0.638 - 1/(-0.3135)) - 36865 * (0.669 - 1/(-0.3135)) \\ = \text{239.65 CNY million}$$

Incremental transmission and distribution costs are CNY0.16/kWh of project output for 358.38 GWh/year.

Hence the **incremental transmission and distribution costs** amount to = **CNY57.34 million**

Therefore: **Net Expected Benefit = (239.65 - 57.34) = CNY182.31 million**

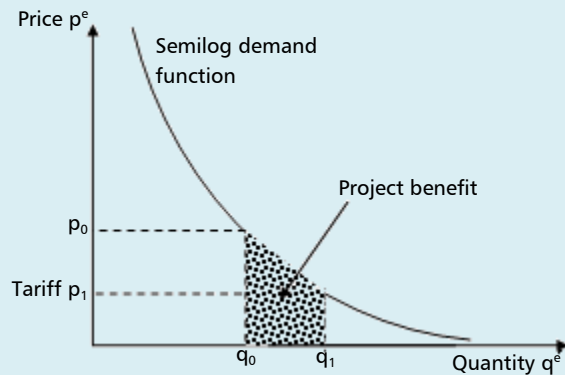
This value is **close to the value of CNY181.48 million** given in the PCR, Table A10.2 (footnote b).

Conclusion: This calibration confirms that a computation based on a price elasticity of demand of about -0.20 replicates the estimate of expected benefit derived in the PCR evaluation.

Therefore: The reevaluation uses this semilog demand function with a value for β of -0.3135. The expected benefit is therefore computed from the expression $[q_1(p_1 + 3.19) - q_0(p_0 + 3.19)]$

The project output will be treated as the final increment of total consumption for all years of project output. This approach gives a conservative estimate of project benefits.

Economic Benefit of Increased Electricity Consumption
(Project output evaluated as the final increment of total consumption)



^a Asian Development Bank (ADB). 2003. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Gansu Clean Energy Development Project*. Manila (Loan 2032).

^b ADB. 2009. *Completion Report: Gansu Clean Energy Development Project in the People's Republic of China*. Manila (Loan 2032).

^c Footnote b, Appendix 10, Table A10.1.

Sources: ADB. 2009. *Completion Report: Gansu Clean Energy Development Project in the People's Republic of China*. Manila (Loan 2032); Demand function proposed in P. Choynowski. 2002. *Measuring Willingness to Pay for Electricity*. ERD Technical Note. No. 3. Manila: ADB.

1. Economic Internal Rate of Return

4. The reevaluated EIRR is 27.1 % compared with 27.1% calculated at the time of the PCR (and 23.4% at appraisal). This equality is mainly due to the assumption of the same values for the

construction and operating costs and the derivation of similar average project benefit under the evaluation methodologies. The economic reevaluation is in Table A5.1.

Table A5.1: Economic Reevaluation

Year	Capital Cost ^a (CNY million)	O&M Cost ^a (CNY million)	Incram. T&D Costs ^b (CNY million)	Project Economic Cost (CNY million)	Project Economic Benefit ^c	Net Project Economic Benefit
2002	13.88			13.88		(13.88)
2003	57.04			57.04		(57.04)
2004	155.99			155.99		(155.99)
2005	203.57			203.57		(203.57)
2006	97.48	5.43	36.42	139.33	147.46	8.12
2007	28.26	10.92	68.76	107.94	282.12	174.18
2008	6.75	10.23	62.83	79.81	257.16	177.35
2009		8.97	68.37	77.34	280.50	203.15
2010		9.06	61.26	70.32	250.59	180.27
2011		9.27	66.45	75.72	272.40	196.68
2012		9.45	57.34	66.79	234.17	167.38
2013		9.57	57.34	66.91	234.17	167.26
2014		9.57	57.34	6.91	234.17	167.26
2015		9.57	57.34	66.91	234.17	167.26
2016		9.57	57.34	66.91	234.17	167.26
2017		9.57	57.34	66.91	234.17	167.26
2018		9.57	57.34	66.91	234.17	167.26
2019		9.57	57.34	66.91	234.17	167.26
2020		9.57	57.34	66.91	234.17	167.26
2021		9.57	57.34	66.91	234.17	167.26
2022		9.57	57.34	66.91	234.17	167.26
2023		9.57	57.34	66.91	234.17	167.26
2024		9.57	57.34	66.91	234.17	167.26
2025	(173.85)	9.57	57.34	(106.94)	234.17	341.11
					EIRR	27.1%
					NPV at 12%	454

() = negative, EIRR = economic internal rate of return, NPV = net present value, O&M = operation and maintenance, T&D = transmission and distribution.

^a No change in economic costs from the project completion report values.

^b Incremental T&D costs for the project computed as CNY0.16 per kilowatt-hour consumed (project completion report assumption).

^c Expected economic benefits recomputed according to the methodology developed for this reevaluation.

Source: Independent Evaluation Department evaluation mission.

2. Sensitivity Analysis

5. The sensitivity analysis was carried out using the following four variables:

- (i) power generation reduced by 20%;
- (ii) consumer surplus decreased by 20%;
- (iii) operation and maintenance costs increased by 20%; and
- (iv) a combination of (i), (ii), and (iii).

6. The results of the sensitivity analyses are summarized in Table A5.2.

Table A5.2: Sensitivity Analyses Results
(%)

Case	Economic Internal Rate of Return	Project Completion Report Economic Internal Rate of Return
Base Case	27.1	27.1
Generation reduced by 20%	25.8	24.3
Consumer surplus decreased by 20%	26.9	21.8
Operation and maintenance costs increased by 20%	26.8	26.9
Combination of (i), (ii) and (iii)	25.4	18.9

Source: Independent Evaluation Department evaluation mission.

APPENDIX 6: FINANCIAL REEVALUATION

A. General Approach and Assumptions

1. The financial internal rate of return (FIRR) for the Gansu Clean Energy Development Project was calculated using the actual power generation and sales for 2006–2011 provided by Xiaogushan Hydropower Company (XHC). It was compared both with the estimated FIRR calculated in mid-2003 during project appraisal (7.5%) as well as the estimate calculated at the time of project completion in August 2009 (8.7%).

2. The main financial assumptions in the reevaluation were the following:

- (i) **Power generation data.** These are based on (a) actual power generation from 2006 to 2011, and (b) from 2012 to 2025, forecasts for average annual power generation of 396 gigawatt-hours used in the project completion report, resulting in 358.38 gigawatt-hours after taking into account 9.5% for transmission and distribution losses.
- (ii) **Carbon emission reduction revenues.** In addition to revenues from sales of power, XHC receives revenue for certified emission reductions (CERs) at \$4.5 per ton of carbon dioxide, or CNY12.3 million annually. These revenues terminate at the end of 2015.
- (iii) **Tariffs.** Gansu Provincial Price Bureau approved a power tariff of CNY0.2478 per kilowatt-hour (KWh) for XHC. While the tariff will be reviewed every 3–5 years, it is assumed to remain constant in real terms.
- (iv) **Taxes.** Sales-related taxes include a 17% valued-added tax plus a city construction tax (1%) and an education tax (3%). Income tax rates for XHC are 7.5% from 2008 to 2011 and 25% thereafter. Taxable income of XHC excludes depreciation and other costs.¹

B. Financial Internal Rate of Return

3. The reevaluated FIRR is 8.4% compared with 8.7% calculated at the time of the project completion report (and 7.5% at appraisal); these calculations do not include financial benefits received from CERs. The main reason for the somewhat higher FIRR, when compared with the appraisal estimate, is higher actual power generation—and sales—during the first 5 years of hydropower plant operation, i.e., 2006–2011. The financial reevaluation is in Table A6.1.

¹ Asian Development Bank (ADB). 2009. *Completion Report: Gansu Clean Energy Development Project in the People's Republic of China*. Manila. Appendix 6, Table A6.3.

Table A6.1: Financial Reevaluation – Derivation of the Financial Return in the Evaluation Base Case

Year	Capital Expenses	O&M Expenses	Total Expenses	Energy Sales	CERs	Total Revenues	Income Tax	NCF with CERs	NCF without CERs
(2008 CNY million)									
2002	14.61		14.61					(14.61)	(14.61)
2003	64.25		64.25					(64.25)	(64.25)
2004	168.41		168.41					(168.41)	(168.41)
2005	218.49		218.49					(218.49)	(218.49)
2006	106.82	5.43	112.25	49.68	7.81	57.49		(54.76)	(62.57)
2007	30.80	10.92	41.72	93.79	14.75	108.54		66.82	52.07
2008	8.16	10.23	18.39	85.70	13.48	99.18	5.08	75.71	62.23
2009		8.97	8.97	93.26	14.67	107.93	4.43	94.53	79.86
2010		9.06	9.06	83.56	13.14	96.71	4.43	83.22	70.07
2011		9.19	9.19	90.64	14.25	104.90	14.72	80.99	66.73
2012		9.38	9.38	78.21	12.30	90.51	14.68	66.45	54.15
2013		9.57	9.57	78.21	12.30	90.51	14.63	66.31	54.01
2014		9.57	9.57	78.21	12.30	90.51	14.63	66.31	54.01
2015		9.57	9.57	78.21	12.30	90.51	14.63	66.31	54.01
2016		9.57	9.57	78.21		78.21	11.56	57.08	57.08
2017		9.57	9.57	78.21		78.21	11.56	57.08	57.08
2018		9.57	9.57	78.21		78.21	11.56	57.08	57.08
2019		9.57	9.57	78.21		78.21	11.56	57.08	57.08
2020		9.57	9.57	78.21		78.21	11.56	57.08	57.08
2021		9.57	9.57	78.21		78.21	11.56	57.08	57.08
2022		9.57	9.57	78.21		78.21	11.56	57.08	57.08
2023		9.57	9.57	78.21		78.21	11.56	57.08	57.08
2024		9.57	9.57	78.21		78.21	11.56	57.08	57.08
2025	(183.00)	9.57	(173.43)	78.21		78.21	11.56	240.08	240.08
							FIRR		
							=	10.1%	8.4%

() = negative, CER = certified emission reduction, FIRR = financial internal rate of return, NCF = net cash flow, O&M = operation and maintenance.

Source: Independent Evaluation Department.

C. Sensitivity Analysis

4. The sensitivity analysis was carried out using the three variables as well as with or without CERs:

- (i) electricity sales reduced by 20%,
- (ii) operation and maintenance costs increased by 20%, and
- (iii) a combination of (i) and (ii).

5. The results of the sensitivity analyses are summarized in Table A6.2.

Table A6.2: Sensitivity Analyses Results

Case	FIRR (with CERs) (%)	Project Completion Report FIRR (without CERs) (%)
Base Case	10.1	8.7
Electricity sales reduced by 20%	7.5	6.2
Operation and maintenance costs increased by 20%	9.0	7.7
Combination of (i) and (ii)	6.3	5.0

CER = certified emission reduction, FIRR = financial internal rate of return.

Source: Independent Evaluation Department.

D. Financial Performance of Xiaogushan Hydropower Company

6. XHC was established in 2001 to construct and operate Xiaogushan hydropower plant. It was set up as a joint stock company in accordance with the laws and regulations governing commercial operations in the People's Republic of China (PRC). XHC has two shareholders—Heihe Hydropower Development Company (60%) and Zhangye Water and Power Bureau (40%). The hydropower plant started operations in May 2006. The financial statements of XHC for 2006–2011 are shown in Table A6.3.

Table A6.3: Income Statement of Xiaogushan Hydropower Company, 2006–2011
(CNY million in current prices)

Item	2006 ^a	2007 ^a	2008 ^a	2009	2010	2011
Sales	55.89	117.17	107.53	111.95	107.11	113.78
Net sales	47.44	99.47	91.29	95.51	93.59	98.09
Operating profit	30.3	64.57	56.76	37.43	41.46	61.64
CER revenues	4.01	13.72	12.3	11.89	10.63	...
Before tax	20.42	47.42	55.48	49.85	51.36	71
Net profit	20.42	47.42	51.3	46.09	47.49	60.27

... = data not available, CER = certified emission reduction.

^a Provisional.

Source: Xiaogushan Hydropower Company, November 2012.

7. The project agreement contains three main financial covenants for XHC to maintain (i) an annual return of not less than 6.0% of the average current net value of the fixed assets in operation for each of its fiscal years beginning in fiscal year 2007; (ii) a debt service coverage ratio of at least 1.2 times from 2008 to 2009, and 1.3 times thereafter; and (iii) a debt–equity ratio of not more than 75:25 from 2007 to 2009, and not more than 65:35 thereafter. XHC's actual financial performance during 2006–2011 was in compliance with these three financial covenants. The average rate of return on net fixed assets was about 10% during 2006–2011; XHC's debt ratio decreased from 73% to about 60% by 2011; and its debt coverage ratio was above 1.8 during 2009–2011.

8. XHC's sound financial performance is attributed to (i) annual power generation, and resulting sales in electricity, in the first 6 years of operation that exceeded forecast levels; (ii) an adequate tariff that has been maintained in constant terms; (iii) a sound capital structure; (iv) low operating costs and high operational efficiency, reflected in the relatively low staffing (85 employees for a 102-megawatt plant); and (v) additional revenues from certified carbon emission reductions since 2006 (which will continue through 2015). While accounts receivable are high—at about 300 days of sales—the financial performance of XHC in the first 6 years of operations indicates a high likelihood that this performance will be sustained.

Table A6.4: Cash Flow Statement of Xiaogushan Hydropower Company, 2006–2011

(CNY million in current prices)

Item	2006	2007	2008	2009	2010	2011
Net incomes	20.42	47.42	51.3	77.97	88.28	100.98
Plus: Financial costs	13.89	30.87	13.58	23.73	22.46	21.16
Depreciations	12.02	24.3	24.3	24.00	24.94	25.23
Total sources of funds	46.34	102.59	89.18	109.13	118.65	136.56
Capital expenditures	0	1.64	0.66	4.89	1.93	2.87
Interest paid	25.77	1.08	60.76	21.16	14.11	15.45
Dividend paid	0	43.94	39.38	29.67	37.47	50.74
Loan principal repayment	0	0	0	22.56	23.13	26.57
Net cash flow	20.57	39.13	(32.81)	77.97	88.28	100.98
Cash balance: Beginning	0	20.57	59.7	24.48	37.63	47.88
Cash balance: Ending	20.57	59.7	26.89	37.63	47.88	40.61

() = negative.

Sources: Gansu Provincial Audit Office of the People's Republic of China for 2006–2008 data and Xiaogushan Hydropower Company for 2009–2011 data, November 2012.

Table A6.5: Balance Sheet of Xiaogushan Hydropower Company, 2006–2011

(CNY million in current prices)

Item	2006	2007	2008	2009	2010	2011
Cash	20.56	59.69	24.48	37.63	47.88	40.61
Accounts receivable	26.83	29.16	87.51	83.35	87.81	93.28
Inventories	0.22	0.47	1.64	1.53	1.62	1.79
Total current assets	47.62	89.32	113.63	122.51	137.31	135.68
Gross fixed assets	575.34	581.3	652.88	627.70	659.63	662.50
Net fixed assets	561.75	543.98	591.9	572.88	549.87	527.50
Total assets	666.31	699.34	705.54	695.39	687.17	663.18
ADB loan	0	211.85	228.67	224.31	215.09	197.49
Domestic long-term loan	0	263.2	246.2	228.00	209.60	188.00
Total long-term liabilities	487.88	475.05	474.87	453.39	426.08	387.04
Paid-in capital	130	130	130	130.00	130.00	130.00
Retained earnings	2.14	28.64	80.95	73.65	86.32	104.43
Total equity	132.14	158.64	210.95	225.46	238.13	256.24
Total equity and liabilities	666.31	699.34	705.54	695.39	687.17	663.18

ADB = Asian Development Bank.

Sources: Gansu Provincial Audit Office of the People's Republic of China and Xiaogushan Hydropower Company, November 2012.

APPENDIX 7: ENVIRONMENTAL IMPACT EVALUATION

A. Introduction

1. The Gansu Clean Energy Development Project comprises a 102 megawatt hydropower facility and two 19-kilometer 110-kilovolt (kV) transmission lines, built to connect the hydropower plant to a nearby substation. During preparation, the project was classified environmental category A. The environmental impact assessment concluded that the project would result in significant environmental benefits in terms of avoided air pollution from coal-fired power generation, which would have been the likely alternative power generation source. Any adverse environmental impact resulting from project construction was considered small, and specific mitigation measures were put in place to limit impacts during the 4-year construction period.

B. Institutional Arrangements for Environmental Management

2. During construction, an environmental management department was established within Xiaogushan Hydropower Company (XHC), the implementing agency, comprising staff from XHC and representatives from the three small townships affected by the hydro development. At the municipal level, Zhangye Environmental Protection Bureau was responsible for monitoring air, water, noise, solid waste, and ecological impacts and for supervising the implementation of the environmental mitigation measures. The Environmental Protection Bureau, with a staff of about 30, has continued to monitor the different environmental impacts resulting from the project, in particular air and water pollution.

C. Environmental Mitigation Measures

3. The following environmental impact measures were taken during construction:

- (i) erosion control and revegetation measures,
- (ii) water flow control measures through the construction of a special gate,
- (iii) solid waste and waste water disposal measures, and
- (iv) noise reduction measures.

4. The completion report indicated that the above measures were implemented satisfactorily during the construction period.¹ A site visit on 28 September 2012, more than 6 years after the plant came into operation, did not show a need for erosion control or revegetation measures.

D. Environmental Impact

5. The main environmental benefit of the investment has been avoided air pollution from alternative power generating plants, which would most likely have been based on coal. In parallel, two smaller but heavily polluting coal-fired power stations have been retired. The aggregate impact of the full development of the Heihe River hydro potential—comprising eight hydro plants, including the 102 megawatt Xiaogushan hydro plant—has been to increase the proportion of hydro-based power significantly in this regional area of Gansu province (Table A7.1). With power consumption in Zhangye City at 3.2 billion kilowatt-hours (kWh), the residual is transmitted by the regional grid to other areas of Gansu—improving the environmental air quality in other regions of Gansu.

¹ Asian Development Bank. 2009. *Completion Report: Gansu Clean Energy Development Project in the People's Republic of China*. Manila (Loan 2032).

Table A7.1: Total Power Generation in 2011
(kilowatt-hour)

Type	Power Generation
Hydro	4.6 billion
Coal	3.3 billion
Total	7.9 billion

Source: Zhangye City Municipal Bureau.

6. The project has produced additional environmental benefits in the form of certified emission reductions (CERs) of carbon dioxide, which have been successfully traded through the Clean Development Mechanism. Since the start of plant operations in mid-2006 through August 2007, more than 2.30 million tons of carbon dioxide greenhouse gas emissions had been reduced through certified emission reduction trading as shown in Table A7.2.

Table A7.2: Certified Emission Reductions, 2006–2012
(ton)

Year	Certified Emission Reductions
2006 ^a	166,867
2007	407,596
2008	374,039
2009	407,246
2010	372,460
2011	395,653
2012 ^b	267,292
Total	2,391,153

^a From May 2006.

^b Through August 2012.

Source: Xiaogushan Hydropower Company data.

E. Environmental Sustainability

7. The environmental sustainability of the benefits from the Gansu Clean Energy Project rests on two main considerations:

- (i) Long-term operation and maintenance of the Xiaogushan power plant in order to continue to supply this clean energy source for a minimum of 20 more years.
- (ii) Effective institutional arrangements to monitor the continuity of the environmental benefits and take corrective actions in the event of an operational breakdown of the plant.

8. The Xiaogushan plant has been in operation for more than 6 years. Essential maintenance has been undertaken regularly while a more detailed inspection of the key turbines has not indicated accelerated erosion to date from possible silting. Regular maintenance and inspection will continue, so the plant is likely to operate for a further 20 years or more. The hydro plant is located in a seismic region of the PRC where occasional earthquakes have occurred and could occur again. This risk was mitigated in the construction works of the hydro plant. Finally, environmental institutional arrangements are in place, within the hydro company (XHC) and in the Environmental Protection Bureau in Zhangye City. These institutions are well staffed and well funded.

9. On the basis of the above considerations, the sustainability of the project's environmental benefits is considered highly likely.

APPENDIX 8: RESETTLEMENT AND SOCIAL IMPACT EVALUATION

A. Introduction

1. This run-of-the-river hydro development had only a small impact on both land acquisition and resettlement. Less than 10 hectares of land needed to be permanently acquired, while a further 7–8 hectares were temporarily acquired during implementation. The acquisition of land affected only 29 persons (six households), and only 17 persons (two households) were affected on a permanent basis. Despite its small impact, a special community development plan was prepared and implemented under the project, aimed at improving the livelihoods of these communities. Land acquisition and the resettlement plan were prepared in accordance with the resettlement policies and compensation rates of the People's Republic of China (PRC) that were in effect at that time.¹

B. Institutional Arrangements and Resettlement Costs

2. Institutional responsibility for land acquisition and resettlement was shared between Zhangye municipal government together with the hydropower company, Xiaogushan Hydropower Company (XHC), and the local county government. A project resettlement group was set up, with XHC assuming most of the responsibility for resettlement. The costs of land acquisition and resettlement were significantly underestimated during preparation. The report and recommendation of the President allocated only a nominal budget (\$25,000) for resettlement expenditures, which did not include costs of land acquisition or monitoring and evaluation of resettlement; however, additional funding for these activities was later provided without difficulty.² The affected people were resettled and fully compensated by the end of 2006.

3. Despite inadequate provision of funds for resettlement activities during preparation and delays in recruiting an external monitoring team, the land acquisition and resettlement activities were implemented efficiently and were responsive to community needs. In general, compensation exceeded rates in the resettlement plan.

C. Monitoring and Evaluation

4. XHC contracted Lanzhou University in 2006 to carry out external monitoring of the resettlement of the affected households. Its first two monitoring reports were prepared in 2006 and 2007. In accordance with the project agreement (schedule 21), monitoring and evaluation reports on the resettlement work and project impact were also submitted in successive years from 2009 to 2011.

D. Impact on Regional Economic Growth and Poverty Reduction

5. The project has had a significant impact on the project area. Prior to the construction of Xiaogushan hydropower plant (XHP), Zhangye City had a serious shortage of power which constrained economic development. The construction of 102 megawatts of new hydro capacity has helped meet the deficits in supply and has improved the reliability of supply—helping spur regional economic growth. In addition, taxes levied on the project operation have made an important contribution to local government revenues and enabled investment in social services. Since 2002, significant increases have

¹ Asian Development Bank (ADB). 2009. *Completion Report: Gansu Clean Energy Development Project in the People's Republic of China*. Manila. p. 46.

² ADB. 2003. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Gansu Clean Energy Development Project*. Manila (Loan 2032).

occurred in per capita gross domestic product, per capita fiscal revenues, and per capita rural net income. An important contributing factor to improved economic growth has been the increased availability of a secure and dependable electricity supply.

6. The incidence of poverty in the project area has also been significantly reduced over 2002–2011, as shown in Table A8. During this period, the incidence of poverty declined sharply from 30% to 8%, reflecting the remarkable progress the PRC has made over the past decade in reducing poverty in its poorest regional areas. Many factors have contributed to this reduction in poverty but the availability of a clean, low-cost supply of electricity, as provided under the Gansu Clean Energy Development Project, has been essential.

Table A8: Poverty Incidence in the Project Areas 2001–2011

District/ County	2001			2007			2011		
	Rural Population	Poverty Headcount (<CNY825/ person)	Poverty Incidence (%)	Rural Population	Poverty Headcount (<CNY825/ person)	Poverty Incidence (%)	Rural Population	Poverty Headcount (<CNY825/ person)	Poverty Incidence (%)
Shandan	146,221	74,041	51	145,618	15,602	11	102,600	17,455	17
Minle	215,839	121,609	56	206,221	17,908	9	159,900	22,635	14
Ganzhou	345,649	47,531	14	324,089	17,313	5	300,500	20,832	7
Linze	121,279	21,443	18	124,084	7,040	6	88,300	8,111	9
Gaotai	130,832	22,840	17	132,711	10,950	8	102,500	9,591	9
Sunan	23,803	5,634	24	25,215	3,380	13	22,700	4,880	22
Total	983,623	293,098	30	957,938	72,193	8	776,500	83,504	11

Source: Zhangye City Poverty Reduction Office, November 2012.

E. Impact on Community Development

7. The project gave special attention to the project's impact on the local communities most affected by the hydro development—for which a community development plan was put in place. The plan included the following investments: (i) 80 kilometers (km) of class 4 highway, which gave the townships access to Zhangye City; (ii) improved facilities and computers for the existing primary school; (iii) improved medical services for the community clinic; (iv) much improved electricity supply to these communities through the construction of a 35 kilovolt distribution line; (v) the repair and improvement of community temples; and (vi) services of experts, who provided training in livestock breeding and other small agricultural activities.

8. The implementation of the community development plan has had a significant impact on the development of these small communities and enabled the inhabitants to share in the project benefits. The most important of these benefits has been the provision of a reliable electricity supply to the communities. The benefits of this supply are already evident in these communities and have enabled (i) refrigeration of foodstuffs and medicines; (ii) construction and staffing of small community clinics and schools; (iii) improvements in rural roads, which have enabled better access to hospitals and schools; and (iv) construction of community facilities such as temples. Women and young girls have shared in these benefits, in particular access to better health and education facilities.

F. Social Sustainability

9. As noted in para. 4, the project provided for continued monitoring and evaluation of the impact of the investment on local townships. Over 2009–2011, monitoring and evaluation reports on

the resettlement work were prepared by the School of Journalism and Communications of Lanzhou University. Their report of September 2011 made the following observations:

- (i) The working and living conditions of the six resettled families are stable.
- (ii) XHC continues to give support to local social activities in these communities—in particular, to the local health center and Dharma temple.
- (iii) XHC is still responsible for road maintenance and making sure the road is unobstructed from Dayekou to the project site, which is of great benefit to local herdsmen.

10. It has been nearly 7 years since monitoring of the project's benefits started. In this period, significant progress has been made in compensating local inhabitants for the land acquired; improving local infrastructure (electricity, roads, and health facilities); supporting local social activities; and protecting the environment. In terms of the impact, the 2011 monitoring and evaluation reported that "traffic and communication improvements have made local social and economic life more convenient."³ The new 80-kilometer road reduces the time spent in travelling to Zhangye City where modern hospital facilities are located. At the local level, the "facilities of the health center has been improved. The villagers all said that the medical condition of the health center is now much better compared to previous years...though there are still not enough medicines."⁴ Overall, XHC has been meeting its commitment to continue supporting the development of these small communities that were affected by the project.

11. Based on progress made since the hydro plant started operation, the prospects for sustainability of the community development benefits are rated *likely*. As long as the hydro plant continues to operate, there is every prospect that the hydropower company, XHC, will continue to maintain local roads and community facilities as well as ensure continued supply of electricity to these communities. The benefits, in terms of improved communications health and education facilities, are evident. The modest livelihoods of the agricultural herdsmen now have more stability. While their livelihood will always be vulnerable to drought conditions, the continuing presence of XHC provides a safety net to help ensure these community development benefits are maintained.

³ Lanzhou University, School of Journalism and Communication. 2011. *Monitoring and Evaluation Report on Resettlement Work*. Lanzhou.

⁴ Footnote 3, pp. 8–9.

APPENDIX 9: STATUS OF COMPLIANCE WITH LOAN COVENANTS

Covenant	Reference in Loan and Project Agreement	Status of Compliance as of the Independent Evaluation Mission
General		
1. The Borrower shall, through GPG and ZCG, cause XHC to carry out the Project with due diligence and efficiency and in conformity with sound administrative, financial, engineering, environmental, hydropower, and rural electrification.	LA, Section 4.01(a); PA, Section 2.01(a)	Complied with
2. The Borrower shall make available to GPG, and cause GPG and ZCG to make available to XHC, promptly as needed an on terms and conditions acceptable to ADB, the funds, facilities, services, land, and other resources which are required, in addition to the proceeds of the Loan, for the carrying out of the Project.	LA, Section 4.02; PA, Section 2.02	Complied with
3. The Borrower shall ensure that the activities of its departments and agencies with respect to the carrying out of the Project and operation of the Project facilities are conducted and coordinated in accordance with sound administrative policies and procedures	LA, Section 4.03	Complied with
4. The Borrower shall take all action which shall be necessary on its part to enable GPG, ZCG, and XHC to perform their respective obligations under the Project Agreement, including the establishment and maintenance of tariffs as stipulated in para. 7 of the Schedule to the Project Agreement, and shall not take or permit any action which would interfere with the performance of such obligations.	LA, Section 4.04; PA, Section 2.01(b)	Complied with
5. The Borrower shall cause ZCG to exercise its rights under the On-lending Agreement in such a manner as to protect the interest of the Borrower and ADB and to accomplish the purposes of the Loan.	LA, Section 4.05(a); PA, Section 2.07(a)	Complied with
6. No rights or obligations under the On-lending Agreement shall be assigned, amended, abrogated, or waived without the prior concurrence of ADB.	LA, Section 4.05(b); PA, Section 2.14	Complied with
7. In the carrying out of the Project, XHC shall employ competent and qualified consultants and contractors, acceptable to ADB, to an extent and upon terms and conditions satisfactory to ADB.	PA, Section 2.03(a)	Complied with
8. Except as ADB may otherwise agree, all goods and services to be financed out of the proceeds of the Loan shall be procured in accordance with the provisions of Schedule 4 and Schedule 5 to the Loan Agreement.	PA, Section 2.03(b)	Complied with
9. XHC shall carry out the Project in accordance with plans, design standards, specifications, work schedules, and construction methods acceptable to ADB.	PA, Section 2.04	Complied with
10. XHC shall furnish to ADB quarterly reports on the execution of the Project and on the operation and management of the Project facilities.	PA, Section 2.08(b)	Complied with
11. Promptly after physical completion of the Project, but in any event not later than three (3) months thereafter or such later date as ADB may agree for this purpose, XHC shall prepare and furnish to ADB a report, in such form and in such detail as ADB shall reasonably request, on the execution and initial operation of the Project, including its cost, the	PA, Section 2.08(c)	Complied with

Covenant	Reference in Loan and Project Agreement	Status of Compliance as of the Independent Evaluation Mission
performance by XHC of their respective obligations under this Project Agreement, and the accomplishment of the purposes of the Loan.		
12. XHC shall (i) maintain separate accounts for the Project and for its overall operations; (ii) have such accounts and related financial statements (balance sheet, statement of income and expenses, and related statements) audited annually, in accordance with appropriate auditing standards consistently applied, by external auditors whose qualifications, experience, and terms of reference are acceptable to ADB; and (iii) furnish to the Bank promptly but not later than nine months after the close of the fiscal year to which they relate, certified copies of audited accounts and financial statements and report of the auditors relating thereto (including the auditor's opinion on the use of the Loan proceeds and compliance with the covenants of the Loan Agreement as well as on the use of the procedures for statement of expenditure), all in the English language. XHC shall furnish to ADB such further information concerning such accounts, and financial statements and the audit thereof as ADB shall from time to time reasonably request.	PA, Section 2.09(a)	(i) Complied with (ii) Complied with (iii) Complied with
13. XHC shall enable ADB, upon ADB's request, to discuss XHC's financial statements and financial affairs from time to time with XHC's auditors, and shall authorize and require any representative of such auditors to participate in any such discussions requested by ADB, provided that any such discussion shall be conducted only in the presence of an authorized officer of XHC unless XHC shall otherwise agree.	PA, Section 2.09(b)	Complied with
14. XHC shall, promptly as required, take all action within its powers to maintain its corporate existence, to carry on its operations, and to acquire, maintain, and renew all rights, properties, powers, privileges, and franchises which are necessary in the carrying out of the Project or in the conduct of its business.	PA, Section 2.11(a)	Complied with
15. XHC shall at all times conduct its business in accordance with sound administrative, financial, environmental, hydropower, and rural electrification practices, and under the supervision of competent and experienced management and personnel.	PA, Section 2.11(b)	Complied with
16. XHC shall at all times operate and maintain its plants, equipment, and other property, and from time to time, promptly as needed, make all necessary repairs and renewals thereof, all in accordance with sound administrative, financial, engineering, environmental hydropower, rural electrification, and maintenance and operational practices.	PA, Section 2.11(c)	Complied with
17. Except as ADB may otherwise agree, XHC shall not sell, lease, or otherwise dispose of any of its assets which shall be required for the efficient carrying on of its operations or the disposal of which may prejudice its ability to perform satisfactorily any of its obligations under this Project Agreement.	PA, Section 2.12	Complied with
Environment		
18. XHC shall ensure that the design, construction, and operation of all Project facilities comply with the	PA, Schedule, para. 14	Complied with

Covenant	Reference in Loan and Project Agreement	Status of Compliance as of the Independent Evaluation Mission
environmental laws and regulations and procedures of the Borrower and the local government and ADB's guidelines and procedures on environment.		
19. XHC shall ensure that any adverse environmental impacts arising from the construction and operation of the Project facilities will be minimized by implementing the mitigation measures, monitoring program, and other recommendations in the environmental impact assessment.	PA, Schedule, para. 15	Complied with
20. XHC shall submit to ADB a comprehensive environmental status on a bi-annual basis starting from June 2004 to the completion of the Project implementation, including (i) progress made on the mitigation measures, (ii) monitoring data, (iii) problems encountered, (iv) enforcement plan, and (v) if being cited as violating any safety or environmental standards, or any laws and regulations of the Borrower or the local government, confirmation from the relevant agency of the Borrower or the local government showing that the violation has been corrected or a plan to correct the violation has been accepted.	PA, Schedule, para. 16	Complied with
21. GPG shall cause ZEPC to complete the closure of one coal-fired power plant with a total capacity of 8.5 MW in the North West Power Grid by 31 December 2007 in accordance with the Borrower's environmental and safety standards. GPG shall cause ZEPC to ensure that the workers at the power plant will be redeployed in a manner consistent with the policy and relevant law on labor and social security protection of the Borrower and ADB's Social Protection Strategy.	PA, Schedule, para. 19	Complied with
Economics		
22. GPG and ZCG will cause ZEPC and XHC to implement the power sector and tariff reform program of the Government and tariff reduction programs including a lifeline tariff for poor consumers as agreed upon with ADB.	PA, Schedule, para. 6	Complied with
23. GPG and ZCG shall be responsible for formulating tariff of the electricity generated by XHP will be adequate for XHC to cover operating costs, maintenance and depreciation, financing cost, and from fiscal year 2009, allow an acceptable return on the net fixed assets.	PA, Schedule, para. 7	Complied with
Financial		
24. ZCG and XHC shall ensure that on a timely basis all funds and resources necessary for construction of the Project Power Plant and other facilities under the Project be provided in accordance with the financing plan for the Project as agreed by ADB.	PA, Schedule, para. 3	Complied with
25. XHC shall not incur any debt unless a reasonable forecast of the revenues and expenditures of XHC shows that the estimated net revenues of XHC for each fiscal year shall be, (i) commencing from the fiscal year 2008, at least 1.2 times, and (ii) commencing from the fiscal year 2010, at least 1.3 times, the estimated debt service requirements of XHC in such year on all debt of XHC including the debt to be incurred.	PA, Schedule, para. 10	Complied with
26. XHC shall maintain for each year, (i) commencing from the fiscal year 2008, a ratio of debt to equity not greater than 75:25; and (ii) commencing from 2010, a ratio of debt	PA, Schedule, para. 11	Complied with

Covenant	Reference in Loan and Project Agreement	Status of Compliance as of the Independent Evaluation Mission
to equity not greater than 65:35.		
Sector		
27. XHC shall construct a 35 kV transmission line from Longqu hydropower plant to the Project Power Plant. ZCG shall construct another 35 kV transmission line to transmit electricity from the Project Power Plant to Baojiwan through Xishui, Huazhai, and Anyang townships. During the operation of the Project Power Plant, XHC shall supply power to these three townships at the average or a lower than average of the prevailing market price of power.	PA, Schedule, para. 26	Complied with
Social		
28. GPG, ZCG, and XHC shall ensure that all land and rights-of-way required for the Project be made available in a timely manner and that the Resettlement Plan agreed upon with ADB be carried out promptly and efficiently in line with ADB's Policy on Involuntary Resettlement.	PA, Schedule, para. 17	Complied with
29. ZCG shall implement the community development strategy and plan dated April 2003 for Xishui Township which has been endorsed by ADB during the Project implementation period and keep ADB updated of any changes and progress of implementation.	PA, Schedule, para. 18	Complied with
30. With the assistance of the relevant local authorities, GPG, through ZCG, and XHC shall cause contractors to distribute information on the risks of sexually transmitted diseases to those employed during Project construction and to the local communities in Xishui Township.	PA, Schedule, para. 22	Complied with
31. XHC shall ensure that (i) there is no differential payment between men and women for work of equal value, and (ii) civil works contractors do not employ child labor in the construction and maintenance activities in accordance with the relevant laws and regulations of the Borrower.	PA, Schedule, para. 23	Complied with
32. XHC, in consultation with Heihe Hydropower Development Company (HHDC), shall prepare a human resource development plan. Before undertaking international training, XHC shall prepare, for ADB's concurrence, (i) a training plan and number of trainees, (ii) a program of workshops to be delivered by those trained internationally, and (iii) a list of training equipment and aids required to strengthen XHC's and HHDC's training programs. Upon completion, XHC shall submit to ADB an evaluation of international and domestic training.	PA, Schedule, para. 25	Complied with
Others		
33. GPG and ZCG shall ensure that additional transmission lines to the existing Zhangye city 330/110 kV substation and expansion of that substation shall be completed in a timely manner to accommodate additional power delivery from the Project Power Plant.	PA, Schedule, para. 5	Complied with
34. A mid-term review shall be carried out in 2006. During the mid-term review, XHC shall, among others, submit to ADB for its review, financial projections for the next five years. Thereafter, XHC shall update the financial projections annually.	PA, Schedule, para. 12	Complied with

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35. GPG, through ZCG, and XHC shall monitor, evaluate, and report to ADB the Project impacts through PPMS to ensure that the Project facilities are managed effectively and benefits particularly to the poor, are maximized. GPG, through ZCG, and XHC shall collect data agreed with ADB prior to Project implementation, project completion, and annually for three years after the Project completion.	PA, Schedule, para. 21	Complied with
36. In accordance with the Company Law of the Borrower, XHC shall convene a general meeting of shareholders once a year within 6 months after the completion of the previous accounting year and convene a temporary general meeting of the shareholders to discuss and decide on the matters in accordance with its Articles of Association.	PA, Schedule, para. 27	Complied with
37. XHC shall ensure that its Supervisory Board be formed in accordance with the Borrower’s Company Law, comprising representatives of shareholders and including an appropriate proportion of representatives of the staff and workers of XHC, and ensure that the members of the Board of Directors, managers, and chief financial officer of XHC shall not serve on the Supervisory Board.	PA, Schedule, para. 28	Complied with
38. XHC shall ensure that (i) a minimum of 30% of its Board of Directors represent finance and energy industries in order to benefit from the knowledge and experiences of cross regional and cross industrial board members; (ii) the independent board members be free from any business or other relationship with XHC that can adversely affect their independent judgment, such as from any provincial or national finance bureaus.	PA, Schedule, para. 28	Complied with
39. XHC shall constitute an Audit Committee within its Board of Directors. XHC shall ensure that (i) the Audit Committee comprise a chairperson and two other non-executive members, each of whom will be appointed by XHC’s Board of Directors; (ii) the Chairperson of its Board of Directors will not be Chairperson of the Audit Committee; (iii) the majority of the Audit Committee will consist of the independent directors; and (iv) the head of internal audit department will be required to attend and report to the Audit Committee.	PA, Schedule, para. 31	Complied with

ADB = Asian Development Bank, GPG = Gansu provincial government, HHDC = Heihe Hydropower Development Company, kV = kilovolt, MW = megawatt, PPMS = project performance management system, XHC = Xiaogushan Hydropower Company, ZCG = Zhangye city government, ZEPC = Zhangye Electric Power Company.

Source: Independent Evaluation Department.