



# Evaluation Study

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Sector Assistance Program Evaluation  
August 2010

## Bhutan: Energy Sector

Independent Evaluation Department

Asian Development Bank

## CURRENCY EQUIVALENTS

(as of July 2010)

Currency Unit	–	ngultrum (Nu)
Nu1.00	=	\$0.02126
\$1.00	=	Nu47.0300

## ABBREVIATIONS

ADB	–	Asian Development Bank
ADF	–	Asian Development Fund
BEA	–	Bhutan Electricity Authority
BPC	–	Bhutan Power Corporation
CAPE	–	country assistance program evaluation
CDM	–	Clean Development Mechanism
CDTA	–	capacity development technical assistance
CHPC	–	Chhukha Hydro Power Corporation
COS	–	country operational strategy
CSP	–	country strategy and program
DGPC	–	Druk Green Power Corporation
DoP	–	Department of Power
EIRR	–	economic internal rate of return
FIRR	–	financial internal rate of return
GDP	–	gross domestic product
HPP	–	hydropower plant
IED	–	Independent Evaluation Department
IEM	–	independent evaluation mission
JFPR	–	Japan Fund for Poverty Reduction
JICA	–	Japan International Cooperation Agency
NEC	–	National Environment Commission
OCR	–	ordinary capital resources
PCR	–	project completion report
PPAR	–	project performance audit report
PPMS	–	project performance and monitoring system
PPP	–	public–private partnership
RIE	–	rigorous impact evaluation
RRP	–	report and recommendation of the President
SAPE	–	sector assistance program evaluation
SCADA	–	supervisory control and data acquisition
TPAR	–	technical assistance performance audit report

## WEIGHTS AND MEASURES

GWh	–	gigawatt-hour
km	–	kilometer
kV	–	kilovolt
kVA	–	kilovolt-ampere
kW	–	kilowatt
kWh	–	kilowatt-hour
MW	–	megawatt

## NOTES

- (i) The fiscal year (FY) of the government and its agencies ends on 30 June. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2000 ends on 30 June 2000.
- (ii) In this report, "\$" refers to US dollars.
- (iii) For an explanation of rating descriptions used in ADB evaluation reports, see: ADB. 2006. *Guidelines for Preparing Performance Evaluation Reports for Public Sector Operations*. Manila.

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The guidelines adopted by the Independent Evaluation Department (IED) on avoiding conflict of interest in its independent evaluations were observed in the preparation of this report. To the knowledge of the management of IED, there were no conflicts of interest of the persons preparing, reviewing, or approving this report.

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## EXECUTIVE SUMMARY

### Sector Development Context

The main development challenges faced by Bhutan's power sector in the mid-1990s were identified as (i) the institutional weakness of the sector, and (ii) its inability to assume the role of key growth driver in promoting the country's economic development through power exports and providing access to electricity for rural consumers. The sector also suffered from poor cost recovery and dependence on donor financing for new investments. Institutional reforms undertaken during 1999–2002, with the assistance of the Asian Development Bank (ADB) and other development partners, addressed some of these challenges. However, the newly established power sector entities in 2002 faced the challenge of transforming Bhutan's power sector from a state department dependent on fiscal allocations to financially sustainable utilities. The sector also faced the challenge of mobilizing investments for expanding access to rural communities, mobilizing financing for export-oriented hydropower projects, and improving cost recovery through tariff adjustments.

By 2009, power sector entities in Bhutan had achieved an adequate level of institutional maturity and sophistication, with the exception of the power sector regulatory agency Bhutan Electricity Authority (BEA). Bhutan Power Corporation (BPC), responsible for domestic power supply, and Druk Green Power Company (DGPC), responsible for operating the export-oriented hydropower projects, have been profitable. The power sector has achieved adequate self-finance and debt service capacity, and contributed to over 40% of the fiscal revenues in 2009. However, the domestic power supply continues to receive an implicit subsidy from power exports in terms of discounted transfer pricing of electricity earmarked for domestic supply. Bhutan has committed to an ambitious agenda of developing over 10,000 megawatts (MW) of hydropower capacity by 2020 with assistance from the Government of India, and achieving 100% electrification by 2013.

### Government Policy Response

The government's development strategy during 1994–2009 recognized the central role of the power sector in promoting (i) economic development and poverty alleviation by exploiting the abundant hydropower potential for increasing the government's fiscal revenues from power exports, (ii) balanced regional growth through access to electricity for rural communities, and (iii) industrial investments based on cheap and reliable supply of electricity. To achieve these objectives, the government has recognized the importance of improving the institutional capacity of power sector entities to expand the power generation capacity through investments in large export-oriented hydropower projects, and to expand the reach of the power transmission and distribution network to rural areas.

The government followed a consistent policy framework during 1994–2009 to achieve these strategic objectives. The five year plans during this period prioritized the following aspects of this strategy:

- (i) establishing a transparent governance framework for the sector by separating the policy making, sector regulation, and utility operation functions;
- (ii) increasing the commercial orientation and operational efficiency of the utility function of the power sector for expanding the power transmission and distribution network to facilitate the evacuation of power from export-oriented

- hydropower plants (HPPs) and to increase access to electricity for people in rural areas;
- (iii) improving the financial performance and cost recovery of the sector through tariff adjustments while maintaining the government's objective of providing affordable electricity to low-income households; and
  - (iv) establishing a competent agency to consolidate government ownership in export-oriented hydropower projects and to act as a strategic partner in developing new export-oriented HPPs.

### **ADB's Energy Sector Support Program**

ADB's assistance program for Bhutan's energy sector during 1992–2009 can be divided into three parallel but complementary thematic subsectors: (i) encouraging policy, institutional, and legal reforms to improve the commercial orientation and financial performance of power sector entities through a series of technical assistance (TA) grants and policy dialogue, supported through targeted loan covenants; (ii) providing financial assistance to expand the distribution network to provide access to electricity for rural communities; and (iii) mobilizing investments to hydropower development through public–private partnerships.

During 1993–2009, ADB approved four lending operations amounting to \$135.2 million comprising an ordinary capital resources (OCR) loan for \$51.0 million, a hard term Asian Development Fund (ADF) loan of \$29.0 million, three ADF loans of \$26.9 million, and an ADF grant of \$28.3 million. ADB also provided nine advisory TA grants amounting to \$5.5 million, five project preparatory TA grants amounting to \$3.9 million, and a Japan Fund for Poverty Reduction (JFPR) grant of \$1 million during this period.

### **Evaluation of ADB Assistance to the Energy Sector**

**Strategic positioning.** ADB's strategy during 1994–2001 identified the importance of institutional reforms and the introduction of commercial utility management practices as means to achieving the government's broader development objectives. ADB engaged decision makers in policy dialogue to explore institutional models for sector reforms; once a consensus was reached, ADB took the lead in providing assistance to implement institutional, legal, and regulatory reforms. After completion of the initial phase of institutional reforms in 2002, ADB supported the newly established power sector entities through capacity building TA grants to assume new responsibilities and consolidation of the management of HPPs. ADB support for institutional reforms, including capacity building of recently established power sector entities, has been sequenced and has demonstrated a high degree of continuity.

Given the government's prioritization of rural electrification as an instrument for bringing development to rural areas, ADB assumed a leadership role in channeling development partner assistance to rural electrification during 1994–2009. ADB has demonstrated a high degree of continuity and focus in supporting the government's rural electrification program. ADB's strategy during last five years has placed increased emphasis on diversifying financing sources for the hydropower sector from official bilateral assistance to more commercially oriented public–private partnerships (PPPs) in accordance with the strategic priorities set out in Strategy 2020 and country-specific priorities. ADB's energy sector strategy for Bhutan has been closely aligned with country priorities and has demonstrated a high degree of continuity, selectivity, and sequencing while being consistent with ADB's corporate strategies. Hence, the strategic positioning of ADB assistance to Bhutan's energy sector is rated *highly satisfactory*.

**Program relevance.** ADB assistance to institutional and policy reforms was *highly relevant*, as the reforms supported by ADB were critical to enable the power sector to meet Bhutan's development challenges. ADB assistance to rural electrification has been relevant to the country in spite of issues with the design of some smaller components of rural electrification projects. ADB assistance to mobilizing investments to the hydropower sector is rated *relevant*, as Bhutan faced funding constraints after completion of Tala HPP and the project was designed after undertaking thorough analysis of Bhutan's debt sustainability. The overall assessment of ADB's energy sector program in Bhutan is *relevant*.

**Efficiency in resource use.** The efficiency of the rural electrification projects supported by ADB is assessed based on the economic internal rate of return (EIRR). Based on the recalculated EIRR, it can be concluded that Rural Electrification Project is *efficient* (EIRR of 12.9%), and Sustainable Rural Electrification (EIRR of 23.0%) and Rural Electrification and Network Expansion (EIRR of 21.7%) are *highly efficient*. The economic benefits of Dagachhu hydropower project are conservatively valued at the electricity export price and the EIRR is estimated to be 13.8%. The project is under construction and no adverse developments have warranted an adjustment of the appraisal EIRR estimates. The ongoing rural electrification project financed under Rural Electricians Training Program is also likely to be efficient despite its high connection cost caused by more remote and sparsely populated areas to be electrified under the project. The overall assessment of ADB's energy sector program in Bhutan is *efficient*.

**Effectiveness in achieving intended outputs and outcomes.** ADB assistance to institutional reforms and commercialization has been effective in transforming Bhutan's power sector from being dependent on fiscal allocations to becoming a highly profitable sector. The power sector has effectively assumed the role of the country's main growth driver as a result of institutional reforms facilitated through ADB assistance. The rural electrification program that was extensively supported by ADB has been effective in increasing the electrification rate from 17% in 1995 to over 60% by 2009. ADB financed over 29,000 household connections, amounting to over 50% of the household connections provided during 1995–2009. ADB has played a highly significant role, initially as a transaction advisor and subsequently as a project financier, in facilitating Dagachhu HPP—the first PPP transaction in Bhutan and the only hydropower project to be commissioned during 2007–2010. ADB has also played a key role in achieving the successful registration of Dagachhu hydropower project as the first ever cross-border Clean Development Mechanism (CDM) project. The overall assessment is that ADB's assistance program has been *highly effective* in achieving the development outcomes.

**Sustainability of outputs and outcomes.** The institutional reforms supported by ADB are rated *sustainable*, as the newly created power sector institutions—such as BPC, DGPC, and DoP (Department of Power), with the possible exception of BEA—have achieved both institutional and financial sustainability. The financial sustainability of the rural electrification program critically depends on the continued availability of “royalty energy” (i.e. 15 % of energy output provided to BPC at a discount to the export price) to the domestic power supply at a discounted price to the export price. Under the prevailing policy of providing royalty energy at a deep discount to export prices, a substantial increase in power exports after 2016, and the resultant cash surplus in the sector, it can be concluded that the rural electrification will continue to be financially sustainable. While the financial sustainability of the ADB-supported Dagachhu hydropower project is assured through the off-take agreement, environmental sustainability will have to be assessed once the project has been commissioned. The ADB assistance program is rated *likely* to be sustainable.



**Development impacts.** ADB has made a substantial contribution to establishing a sound institutional and sector governance framework. ADB has also contributed to preparing an enabling policy framework for mobilizing private sector resources for sustainable development of the hydropower sector, and is assisting in preparing the policy framework for promoting non-hydro renewable energy development. Since 1995, ADB has anchored the rural electrification program, which enabled BPC/DOE to undertake rural electrification in a programmatic manner, resulting in a rapid increase in the electrification rate. The findings of the rigorous impact assessment indicate that the electrified households enjoy a better quality of life and most of the economic, social, and health outcomes are better in electrified households than in un-electrified households. The development impacts of the ADB assistance program are rated *substantial*.

The overall assessment of ADB assistance to Bhutan's energy sector is *successful*.

**ADB performance.** ADB's lending program for rural electrification has demonstrated a high degree of country ownership, as demonstrated by the priority assigned to rural electrification in the government's five year plans since 1994. ADB has consistently responded to the client's needs, given the close alignment of ADB's energy sector strategy with the government's strategic agenda for the energy sector. ADB's performance—in terms of the quality of policy advice, long-term engagement with a consistent sector policy, continuity of staff engagement, energy sector expertise of ADB staff involved in managing the energy sector program, and recognition and acceptance of ADB as a trustworthy and knowledgeable development partner by the relevant stakeholders—is rated *satisfactory*.

## Key Findings

**Institutional and corporate reform (para. 125).** Institutional reforms and corporatization of the sector facilitated the successful implementation of the rural electrification program. Prior to the establishment of BPC in 2002, Bhutan's power sector was managed as part of the government under civil service rules and regulations. It would have been difficult to scale up the rural electrification program in the absence of flexibility introduced under a more enterprising corporate culture.

**Cost recovery (paras. 29, 97, and 127).** Emphasis on cost recovery has increased since commercialization of the sector. When the power sector was managed as part of the government, awareness was lacking regarding the cost of supply and the need to achieve an adequate return on investments. Since the establishment of BPC in 2002, there has been a better understanding of the financial and economic cost of electricity supply to different categories of consumers, and the government has introduced steady tariff adjustments to improve cost recovery and target subsidies to residential consumers consuming less than the lifeline block.

**Rural electrification (paras. 103, 104, and 127).** Rural electrification is likely to be financially sustainable in the long run in the context of an increasing cash surplus in the power sector. The electricity for domestic power supply is provided at a deep discount to the export price (the implicit subsidy amounted to Nu2,130 million) and the power sector had contributed over Nu5,000 million to government revenues in 2009 after the cost of domestic power supply. The cash surplus in the power sector is expected to increase to over Nu23,000 million and the subsidy requirement for domestic power supply will be less than Nu3,000 million by 2016. Hence, Bhutan's power sector can continue to absorb the high cost of rural electrification if the government continues to provide electricity for domestic supply at a discount to export price.

**Grid extension and off-grid renewable energy (para. 128).** There is scope for a judicious use of mix of grid extension and off-grid renewable energy applications in rural electrification. Bhutan has achieved an electrification rate of around 60%, mostly with grid extensions, at an average connection cost of \$1,500 per household; and the rural electrification projects completed to date have an adequate economic rate of return. The government recently launched an ambitious plan to achieve 100% electrification by 2013. As more remote and sparsely populated areas are being electrified, there is increasing scope for using economically efficient off-grid renewable energy applications as the grid extensions may become economically less efficient beyond a certain threshold value of connection cost per household. A detailed study of costs and benefits of alternatives would help guide ensuring economic efficiency and social objective of rural electrification in remote villages.

## Lessons Learned

**ADB Financing (para. 129).** The long-term continuity and predictability of ADB financing for rural electrification has proven to be highly effective. ADB has maintained continuity in its support for institutional building and financial assistance for rural electrification. This has enabled the government to plan ahead, as there was certainty over the availability of financing. ADB's presence as the anchor financier for the rural electrification program also provided comfort to bilateral development partners to complement ADB financing and share the project preparation and implementation arrangements with larger ADB-financed rural electrification projects.

**Ownership of technical assistance (para. 131).** Increased ownership of TA by the executing agencies results in more effective TA implementation and sustainable TA outcomes. The executing agencies have shown a high degree of ownership in identifying the need for TA, defining the scope of the TA projects, and in TA implementation. Increasing the role of executing agencies in TA management on a selective basis, founded on their record in TA implementation, can increase the effectiveness of TA as it provides an increased sense of ownership and responsibility.

## Key Issues

**Environmental and social issues (para. 132).** Addressing the environmental and social issues associated with large-scale hydropower development will be a major challenge for Bhutan, in the context of possible changes to hydrology in the Himalayas as a result of climate change. The National Environment Commission (NEC), which has the primary responsibility for monitoring and enforcing mitigating measures for the adverse environment impacts of large hydropower projects, lacks the institutional capacity to discharge its responsibilities effectively given the scale of proposed hydropower development in Bhutan. In addition, there are no basin-wide studies to assess the cumulative impacts of the development of hydropower projects in cascade along the same river basin, and to determine the need for environmental flows to ensure the ecological integrity of river basins.

**Ensuring the development of the high voltage (400 kilovolt [kV]/220 kV) transmission network in parallel with implementation of the 10,000 MW hydropower program remains a challenge (para. 133).** In the context of the development of over 10,000 MW of hydropower capacity, comprising over 10 projects during the next 10–15 years, a holistic approach to development of the transmission network could enable Bhutan to minimize the investment requirement in the transmission network while providing adequate redundancy in the network to ensure network reliability and provide connectivity to domestic load centers and

collecting substations in India. Adverse impacts on biodiversity corridors could be reduced by minimizing transmission corridors through protected areas.

**Seasonal availability (para. 134).** Hydropower availability is seasonal and Bhutan is experiencing difficulties in meeting its domestic power demand during winter. An adequate level of firm power capacity must be developed through several hydropower projects, with storage to minimize power shortages during winter. Another option is to develop non-hydro forms of renewable energy such as wind power to complement hydropower and diversify the country's energy mix to reduce over-dependency on hydropower and mitigate the hydrology risk (i.e. uncertainty over availability of water for power generation). However, the development of renewable energy projects in Bhutan is limited by lack of data and feasibility studies on potential renewable energy projects, including small hydropower projects (below 25 MW), transmission network connectivity constraints, and financial constraints.

**Predominance of hydropower (paras. 135 and 136).** The predominance of the hydropower sector in the national economy is expected to increase during the next 10 years. The commissioning of Tala HPP (1,020 MW) in 2007 had a major impact on both gross domestic product (GDP) and exports, with hydropower exports rising to over Nu10 billion. The power export in 2008 was 45% of total exports and the power sector contributed over 40% of fiscal revenues (over Nu5 billion). Debt related to the power sector amounted to 55% of external debt as of 2009. The addition of debt from Tala HPP and the expected addition of further debt from new hydropower projects to be commissioned during 2014–2019 will substantially increase external debt. Hydropower-related debt will amount to about 80% of GDP by 2017 and debt service will rise to about 50% of total exports by 2020.

The increased debt burden will be accompanied by an increase in fiscal and export revenues from hydropower exports. After meeting debt service obligations, the net cash surplus of the power export sector is projected to be Nu24 billion in 2017 (22.5% of projected GDP in 2017), increasing to Nu45 billion in 2020 (31% of projected GDP in 2020). Instituting prudent and transparent financial management practices to utilize the substantial financial surplus from power exports—to promote overall economic growth and socioeconomic well-being in a sustainable manner—will be a challenge for the government.

This sector assistance program evaluation report proposes the following recommendations for consideration by ADB Management in formulating the country strategy and operations for Bhutan in the energy sector.

Recommendations	Responsible Department	Time Frame
<b>1. Consider supporting the grid-connected renewable energy projects, including small hydro-power projects (below 25 MW) (para. 137)</b>	SARD	
(i) Assist the government in preparing a renewable energy policy addressing institutional and policy barriers		2010
(ii) Assist in preparing an inventory of potential renewable energy projects, including pre-feasibility studies		2012

Recommendations	Responsible Department	Time Frame
(iii) Assist in providing financing mechanism for renewable energy projects developed by the private sector, including PPP where relevant.		2012
(iv) Assist in developing a medium voltage network to facilitate the evacuation of power generated by renewable energy projects		2013
<b>2. Increase efforts to develop follow-up PPP transactions to the Dagachhu hydropower project (para. 138)</b>	SARD	
(i) Assist in undertaking feasibility studies, identifying private sector participants, structuring PPP transactions		2011– 2012
(ii) Extend political and commercial risk mitigation measures to facilitate commercial financing for PPP transactions		2013– 2014
<b>3. Increase focus on the environmental sustainability of large hydropower development (paras. 132 and 139)</b>	SARD	
(i) Undertake cumulative and strategic environment impact assessments of river basins identified for large-scale hydropower development, taking into account the possible impacts of climate change		2011
(ii) Assist the government in implementing mitigation measures to enhance the environmental sustainability of hydropower development		2011
(iii) Provide capacity building to the NEC and DGPC on environmental impact assessments, implementing EMPs , and enforcing compliance with EMPs during project implementation and operation		2011

DGPC = Druk Green Power Corporation, EMP = Environment Management Plan, MW = megawatt, NEC = National Environment Commission, PPP = public-private partnership, SARD = South Asia Department.

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## I. INTRODUCTION

### A. Objective and Goals

1. Bhutan is the only country in South Asia with surplus power generation capacity and a power sector that contributes a significant share to its national economy—40% of government revenues, 45% of export earnings, and 25% of gross domestic product (GDP) in 2009. Given the potential of hydropower as a major export and the potential of rural electrification to improve the living conditions of the rural population in remote parts of the country, the government has undertaken far-reaching institutional reforms in the power sector to improve the investment climate for export-oriented hydropower projects and to expand the power distribution to largely rural domestic consumers in a financially sustainable manner.

2. The Asian Development Bank (ADB) has been a major development partner in Bhutan's power sector. It has provided financial assistance through concessionary loans for the expansion of the rural power distribution network. ADB also played a catalytic role in structuring and financing Bhutan's first public-private partnership (PPP) transaction in the export-oriented hydropower sector. ADB has been instrumental in promoting institutional and regulatory reforms in the power sector to improve the legal and institutional framework, regulatory regime, commercial orientation, and financial sustainability of power sector entities as well as the investment climate and institutional arrangements for promoting further investments in export-oriented hydropower projects.

3. ADB's Independent Evaluation Department (IED) undertook a country assistance program evaluation (CAPE) to assess ADB's overall assistance to Bhutan during 1999–2009. Given the critical importance of the power sector to Bhutan's overall economy and the significant role of ADB in promoting rural electrification, sector and institutional reforms through advisory technical assistance (TA) grants, and policy dialogue, this sector assistance program evaluation (SAPE) was prepared to provide a useful input to the CAPE for assessing ADB assistance to the energy sector as well as for formulating future ADB assistance. A rigorous impact evaluation (RIE) to assess the welfare and socioeconomic impacts of ADB-financed rural electrification projects is being undertaken as a separate study.

### B. Scope and Coverage

4. The CAPE covers 1999–2009, but this SAPE covers ADB assistance to the power sector from 1994 to 2009 because ADB's energy sector assistance program started in 1994 and this is the first comprehensive evaluation undertaken on ADB assistance to the power sector in Bhutan. The SAPE covers all the lending operations and advisory TA grants provided to the power sector; project preparatory TA grants are covered to the extent that they contributed to the policy dialogue. The loans and advisory TA projects under implementation are assessed in terms of quality at entry and the likelihood of achieving the intended outcomes.

5. The scope of the SAPE focuses on the power sector. Bhutan does not have oil and gas resources, and depends exclusively on importing refined petroleum products from India.<sup>1</sup> ADB has not had any lending or nonlending interventions or even policy dialogue in relation to the petroleum industry, and ADB interventions have focused exclusively on the power sector. The petroleum sector has minimal linkages with the power sector, as less than 1% of power generation is based on fossil fuel.

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<sup>1</sup> Retail prices are maintained at about the same levels as in India.

## C. Summary of Previous Independent Evaluation Department Evaluations

### 1. Project Performance Audit Report for the Rural Electrification Project

6. The project performance audit report (PPAR)<sup>2</sup> for the Rural Electrification Project (first rural electrification project)<sup>3</sup> rated the project *relevant*, as it supported the government's rural electrification program under the 7th Five Year Plan, 1992–1997<sup>4</sup> and had design features to ensure equitable access to electricity and policy dialogue on key sector issues. However, the PPAR observed that the technical design of the first project was not appropriate to Bhutan's terrain and some of the new equipment introduced under the project could not be utilized because of inadequate training. The first project was rated *highly effective* as it achieved the output targets in terms of the number of household connections, but it was assessed *less efficient* because of implementation delays of more than 18 months. The sustainability of the project was rated *likely sustainable*. However, the financial sustainability was uncertain because of the need for cross-subsidies from urban and industrial consumers and lack of clarity over tariff adjustments at the time of the PPAR.

### 2. Technical Assistance Performance Audit Report

7. A TA performance audit report (TPAR) covered three advisory TA projects in Bhutan's power sector:<sup>5</sup> (i) Institutional and Financial Development of the Department of Power (DOP),<sup>6</sup> (ii) Policy and Legal Framework for Power Sector Development,<sup>7</sup> and (iii) Corporatization of the Division of Power.<sup>8</sup> The TPAR downgraded the Institutional and Financial Development TA to *partly successful* as the TA output on software modules for introducing an accrual corporate accounting system for the DOP could not be fully utilized because of inflexibility and inappropriateness of the software modules for the needs of the DOE. The TPAR noted that the national tariff study undertaken as part of the TA was the basis for the prevailing tariff structure, but the TA recommendation of full cost recovery of domestic electricity supply had not been accepted by the government at the time of the TPAR independent evaluation mission (IEM) in 2003.

8. The government had accepted and acted on two of the main recommendations of the Policy and Legal Framework for Power Sector Development TA (footnote 7): (i) to corporatize the utility function of the DOP, and (ii) to establish Bhutan Electricity Authority (BEA) as the sector regulator. The Electricity Act 2001 prepared under the TA was also approved by the National Assembly. Despite these outcomes, the TPAR downgraded the TA's rating to *partly successful* because it had failed to formulate an investment framework for attracting private sector investments for export-oriented hydropower projects, and the government was reluctant to fully accept the TA recommendation for establishing a holding company for state-owned hydropower plants (HPPs).

<sup>2</sup> ADB. 2004. *Project Performance Audit Report: Rural Electrification Project in Bhutan*. Manila.

<sup>3</sup> ADB. 1995. *Rural Electrification Project*. Manila.

<sup>4</sup> Government of Bhutan. 1992. *Seventh Five Year Plan (1992–1997)*. Thimphu.

<sup>5</sup> ADB. 2003. *Technical Assistance Performance Audit Report on Institutional Strengthening and Policy Support to the Power Sector in Bhutan*. Manila.

<sup>6</sup> ADB. 1995. *Institutional and Financial Development of Department of Power*. Manila (TA 2400-BHU approved for \$400,000 on 19 September).

<sup>7</sup> ADB. 1998. *Policy and Legal Framework for Power Sector Development*. Manila (TA 3112-BHU approved for \$500,000 on 8 December).

<sup>8</sup> ADB. 1999. *Corporatization of Division of Power*. Manila (TA 3307-BHU approved for \$600,000 on 25 November).

9. The TPAR confirmed the *successful* rating given by the TA completion report<sup>9</sup> for the Corporatization of the Division of Power TA following the successful establishment of Bhutan Power Corporation (BPC) as a corporate entity in July 2002 to take over the DOE's utility function. However, the project completion report (PCR) noted that the TA recommendations for commercial arrangements between different units of utility functions were too complex for the present structure of BPC as a state-owned company, as the government was intending to privatize power distribution. It also noted that the government had not accepted TA recommendations for transparent government subsidies for domestic electricity supply.

#### **D. Country Assistance Program Evaluation of ADB Assistance to Bhutan 2005**

10. The CAPE<sup>10</sup> for Bhutan circulated in 2005 concluded that the outcomes of ADB's lending and nonlending activities to the energy sector had been favorable. The CAPE assessed the first rural electrification project and the Sustainable Rural Electrification Project (second rural electrification project),<sup>11</sup> and concluded that these projects achieved the intended development outcomes and improved the capacity and efficiency of executing agencies (BPC) in project implementation in spite of project implementation delays. The 2005 CAPE also noted that ADB's Policy and Legal Framework TA (footnote 7) and the Corporatization of the DOP (footnote 8) contributed to the National Assembly's adoption of the Electricity Act in 2001 and the restructuring of the DOP. The CAPE reported that ADB's limited success in mobilizing private sector participation in the power sector was due to a variety of reasons, including lack of capacity in the domestic private sector, weakness in the enabling environment, and lack of investor appetite after the Asian financial crisis. However, ADB-financed rural electrification projects have strengthened the private sector construction industry's capacity to bid and projects financed by development partners. The 2005 CAPE concluded that ADB's sustained support to rural electrification, institutional reforms, and capacity building had achieved the intended outcomes, but promoting private sector involvement in the energy sector remained a challenge.

## **II. CONTEXT OF BHUTAN'S ENERGY SECTOR**

### **A. Institutional Context**

11. Electricity supply in Bhutan in the 1990s (including the operation of mini HPPs and diesel power plants) was the responsibility of the DOP, which was part of the Ministry of Trade and Investment. A major turning point in the overall development of the power sector was the commissioning of the 336 megawatt (MW) Chhukha Hydro Power Plant together with transmission links to connect the power station to both Bhutan's domestic network and the Indian grid in 1988. The project was implemented as a joint venture between the Government of India and the Government of Bhutan, and then incorporated in July 1991 under the Companies Act, 1989 as Chhukha Hydro Power Company (CHPC), a government-owned company.

12. The DOP, as a government organization, was funded directly by the Ministry of Finance from the national budget. The Ministry of Finance received (i) funds collected from domestic consumers from power sales, and (ii) dividends from the profits generated by CHPC's sales. In 2001, the government undertook far-reaching institutional reforms with the enactment of the

<sup>9</sup> ADB. 2003. *Technical Assistance Completion Report Corporatization of the Division of Power in Bhutan*. Manila (TA 3307).

<sup>10</sup> ADB. 2005. *Country Assistance Program Evaluation: Bhutan*. Manila.

<sup>11</sup> ADB. 1999. *Sustainable Rural Electrification Project*. Manila (Loan 1712-BHU[SF] approved for \$10.0 million on 25 November).

Electricity Act to increase the commercial orientation of the power sector entities; delineate the responsibilities for sector policy formulation, utility operation, and regulatory oversight; and improve the investment climate for new investments in the export-oriented power sector. The DOP was bifurcated into (i) BPC, a public utility; (ii) the DOE, a government department; and (iii) BEA, a regulatory body under the DOE.

13. BPC was established on 1 July 2002 under the Companies Act, 2000. Its mandate includes (i) the distribution of electricity for the entire country, (ii) the provision of transmission access for generating stations for both domestic and export supply, and (iii) the operation of embedded and off-grid mini and micro HPPs and diesel plants. The DOE was responsible for policy formulation, planning, and coordination of activities for the energy sector as well as the overall responsibility for implementing the government's ambitious rural electrification program and developing the new export-oriented hydropower projects.

14. The economic and technical regulation of power sector entities, including tariff setting and licensing, was entrusted to BEA, a functional autonomous agency established under the DOE in 2006 in accordance with the Electricity Act (Section 7). BEA became financially independent in 2007 while functioning as a division of the DOE. It became administratively independent in January 2010 when staff was de-linked from the civil service.

15. All export-oriented HPPs except Tala HPP were consolidated under Druk Green Power Corporation (DGPC) in 2008; Tala HPP was brought under DGPC in 2009. DGPC has the mandate to operate the country's existing hydropower resources and to act as the counterparty in developing new hydropower projects. The government's ownership of BPC and DGPC is consolidated under Druk Holding and Investments, a holding company set up in November 2007 to manage the government's existing and future investments. The company is responsible for corporate oversight and setting commercial targets for BPC, DGPC, and several other state-owned entities. Companies with primarily social mandates remained with the finance ministry. The National Environment Commission (NEC) retained responsibility for approval of the environment impact assessments and enforcing the environment safeguard requirements.

## **B. Sector Performance**

### **1. 1995–2002 Period**

16. **Power generation.** The country's total generation capacity in 1995 was 344 MW from hydroelectric generating stations (including 336 MW from Chhukha HPP) and around 7 MW from mini and micro hydro plants, in addition to 13 MW from diesel generator sets. The government initiated several export-oriented hydropower projects during 1995–2002. The 60 MW Kurichhu HPP, financed by the Government of India, was commissioned in 1999. Basochhu Hydro Power Project (64 MW), financed by Austria, was commissioned in September 2004 and construction of the Government of India-financed 1,020 MW Tala HPP commenced in 1997. The Government of India also financed a 132 kilovolt (KV) transmission network in eastern Bhutan connecting the main cities to Kurichhu HPP. The total power generation in Bhutan increased to about 2,060 gigawatt-hours (GWh) by 2002 and power exports rose to 1,500 GWh.

17. **Power transmission.** Bhutan's power transmission and distribution network in 1995 comprised (i) an interconnected grid of 220 kV transmission lines connecting Chhukha HPP with India and the two main cities of Bhutan (Thimphu and Phuntsholing) and a 66 kV network connecting several towns in the west of the country to Chhukha HPP; (ii) several 33 kV level cross-border connections with the Indian states of Assam and West Bengal; and (iii) isolated



networks at 6.6 kV level, supplying other towns and surrounding areas using diesel and mini HPPs.

18. **Power demand.** Domestic demand for electricity was about 280 GWh in 1995, which increased to over 500 GWh by 2002. The average generation of Chhukha HPP was about 1,500 GWh, and about 1,250 GWh was exported to India in 1995. The commissioning of Kurichhu and the first phase of Basochhu enabled Bhutan to maintain its power exports at around 1,500 GWh in spite of the increase in domestic demand. During the early 1990s, several energy-intensive industries were set up because of the cheap electricity in Bhutan since the commissioning of Chhukha HPP. These industries consumed about 80% of the domestic power consumption.

19. **Rural electrification.** During the 7th plan, over 5,500 households were electrified with the assistance of ADB (3,000 households), the Netherlands (1,550 households), and India (850 households); the remainder were electrified with domestic financing. The electrification rate increased to 22% by 1997 from 16% in 1994. The rural electrification program was expanded during the 8th Five Year Plan<sup>12</sup> and about 10,000 households were electrified at a cost of around \$15 million. The second rural electrification project (footnote 11) financed the electrification of 7,680 households as well as bilateral financial assistance from the Netherlands (500 households), India (1,000 households), and Austria (200 households). As a result, the electrification rate reached 27% by 2002 and the total number of consumers reached 38,700 compared to 21,800 in 1995.

20. Table 1 summarizes the key aspects of Bhutan's power sector performance during 1995–2002.

**Table 1: Bhutan Power Sector Performance, 1995–2002**

<b>Power Sector Attribute</b>	<b>1995</b>	<b>1997</b>	<b>1999</b>	<b>2002</b>
Installed Capacity (MW)	354	357	417	445
Power Exports (GWh)	1,328	1,466	1,625	1,508
Domestic Energy Sales (GWh)	281	366	396	510
Domestic Peak Demand (MW)	70.4	72	80	92.6
Number of Consumers	21,800	30,300	33,700	38,700
Electrification Rate (%)	16.8	22.7	24.7	27.6
Domestic Revenues (Nu million)	108	178	236	381
Electricity Export Revenues (Nu million)	664	1,466	2,437	2,262
Average tariff (Nu/kWh)	0.38	0.49	0.60	0.75
Export Prices (Nu/kWh)	0.5	1.0	1.5	1.5

GWh = gigawatt-hour, kWh = kilowatt-hour, MW = megawatt.

Source: Independent Evaluation Department staff estimates

21. **Power tariffs.** Fiscal revenues from domestic power sales increased with a rise in domestic consumption and a modest increase in the average domestic tariff from Nu0.38/kilowatt-hour (kWh) in 1995 to Nu0.75/kWh by 2002. The export price of electricity increased from Nu0.5/kWh in 1995 to Nu1.00/kWh in 1997 and Nu1.50/kWh in 1999, creating a substantial increase in export revenues. However, the government did not adjust the domestic power tariff in line with the increasing economic value of electricity (i.e., the opportunity cost of domestic power supply valued at the export price) or increase prices sufficiently to recover the costs of its expanding domestic network. The absence of separate accounting for the domestic power supply function carried out by the DOP, and the financing of DOP expenses through

<sup>12</sup> Royal Government of Bhutan. 1998. *Eighth Five Year Plan 1997-2002*. Thimpu.

budget allocations, resulted in significant fiscal subsidies to domestic power supplies while power exports became a significant contributor to fiscal revenues.

## 2. 2002–2009 Period

22. **Power generation.** The installed power generation capacity increased by 1,044 MW with the commissioning of Tala HPP (1,020 MW) in 2007 and the second phase of Basochhu HPP (24 MW) in 2004. The total power generation increased from 2,060 GWh in 2002 to 6,925 GWh in 2009 as a result of the commissioning of Tala HPP in 2007. The 114 MW Dagachhu HPP was structured as a PPP to pilot test the Sustainable Hydropower Development Policy<sup>13</sup> and it is expected to be commissioned in 2014. The government also entered into a memorandum of understanding with the Government of India to develop 10,000 MW of hydropower capacity, consisting of 11 mega-projects, under bilateral financing from the Government of India and through joint ventures with Indian public sector entities. The 1,200 MW Punatsangchhu-I HPP belonging to the 10,000 MW program is under construction with Government of India financing and is expected to be commissioned in 2016. Two other projects (990 MW Punatsangchhu-II HPP and 720 MW Mangdechhu HPP) are expected to begin construction in 2011 with Government of India financing and be commissioned in 2019.

23. **Power transmission.** Since its establishment in 2002, BPC has taken over responsibility for developing Bhutan's high voltage power transmission system. With the commissioning of the Tala HPP project in 2007, dedicated 400 kV transmission lines were built to evacuate power to India and an east–west 220 kV interconnection to connect the country's western and eastern grids is under construction. The development of a 10,000 MW hydropower program will also require extensive investments in power transmission at 400 kV and 220 kV levels to evacuate power to India and to connect the proposed power plants to Bhutan's domestic transmission network. While the transmission lines connecting the proposed HPPs with the Indian grid are expected to be financed as part of the HPP, the transmission lines connecting these HPPs with the domestic transmission network will be built by BPC as part of its investment program.

24. The expansion of the electricity network to rural areas has been undertaken in the context of operational improvements in network management in terms of system losses and supply reliability—transmission and distribution losses of domestic power supply decreased from 16.3% in 2004 to 6.8% in 2009 and supply interruptions per customer decreased from 38 in 2005 to 8 in 2009. The technical performance of Bhutan's power sector during 2004–2009 is summarized in Table 2.

**Table 2: Technical Data of Bhutan's Power System, 2004–2009**

Item	2004	2005	2006	2007	2008	2009
Installed Capacity (MW)	438	478	478	1,498	1,498	1,498
Generation Output (GWh)	2,427	2,685	3,673	6,427	7,162	6,925
Electricity Exports (GWh)	1,759	1,777	2,903	5,453	5,922	5,405
Domestic Sales (GWh)	680	708	715	947	1,125	1,414
Transmission Lines ( $\geq$ 66 kV, km)	737	757	757	802	815	855
Distribution Lines ( $\leq$ 33 kV, km)	3,932	4,139	4,623	5,729	5,897	7,136
Number of Consumers	46,103	50,515	61,382	70,870	77,274	83,601
Electrification Rate (%)	32.1	35.6	42.8	48.8	52.6	56.2
System losses (example: wheeling, %)	16.3	15.0	10.6	7.3	6.9	6.8
Interruptions per customer per year	N.A.	38.0	14.4	8.3	6.5	8.1

<sup>13</sup> Bhutan's Sustainable Hydropower Policy was formulated with support from Technical Assistance to Bhutan for *Preparing the Bhutan Power Development* (TA 49166, approved on 29 January 2007 for \$1.6 million). The hydropower policy is not yet a legal document since the government needs to endorse it.

GWh = gigawatt-hours, km = kilometer, kV = kilovolt, MW = megawatt, N.A. = not available  
Source: Bhutan Power Corporation.

25. **Rural electrification.** Since the formation of BPC in 2002, the rural electrification program has been accelerated to achieve the 60% electrification target set in the 9th Five Year Plan, 2002–2007.<sup>14</sup> About 16,000 households have been electrified at a cost of around \$24 million or an average cost of \$1,500 per household. The overall electrification rate increased to 57% by 2009 compared to 27% in 2002. The ADB-financed Rural Electrification and Network Expansion Project<sup>15</sup> (third rural electrification project) contributed to over 9,200 household connections; bilateral funding from the Government of Austria contributed 1,650 household connections and the Government of the Netherlands contributed 4,100 household connections. The Government of Bhutan (through budgetary allocations) and BPC (using its retained earnings) financed an additional 1,100 households during the 9th plan in addition to the connections financed by the development partners.

26. The 10th Five Year Plan, 2008–2013<sup>16</sup> targeted electrification of additional households to achieve an electrification rate of 80% by 2013. The electrification program under the 10th plan is estimated to cost \$82 million (average cost of \$3,280 per household) as the households remaining to be electrified are located in more remote areas. The rural electrification program under the 10th plan is expected to be financed by Japan International Cooperation Agency (JICA) (\$31.2 million), ADB under the Green Power Development Project<sup>17</sup> (\$25.3 million), Austrian bilateral financing (\$2.9 million), and the Government of Bhutan (\$24.5 million). Development partner funding for the 25,000 households program is fully committed and is being implemented. The government recently increased the target for electrification by 8,989 households under the 10th plan to achieve the ambitious target of 100% electrification by 2013. This will require additional funding of \$40 million, which is expected to be financed under a proposed ADB loan to be approved in 2010 or 2011 and additional financial commitments from JICA.

27. **Power tariffs.** With the corporatization of the power sector in 2002, a more cost-reflective tariff structure was adopted. An increasing block tariff structure was introduced in 2003 to the residential sector, with a lifeline block of 80 kWh at Nu0.6/kWh and consumption in excess of 200 kWh priced at Nu1.2/kWh. The industrial consumers supplied at high voltage were charged Nu0.9/kWh and a demand charge of Nu54/kWh to provide an incentive to reduce peak demand. Since 2003, regular tariff increases have been approved while maintaining the overall structure. During 2004–2009, the average electricity tariff increased by 66% at an annualized rate of 10.6% through a series of annual tariff adjustments. By 2009, the lifeline tariff had increased to Nu0.75/kWh; consumption in excess of 300 kWh was priced at Nu1.85/kWh for domestic consumers, and industrial consumers were charged Nu1.51/kWh as an energy charge and Nu85/kWh as a demand charge. Since July 2007, BEA started determining the electricity tariff in accordance with the provisions of the Electricity Act.

28. **Financial performance of BPC.** Since its establishment in 2003, BPC's financial performance has improved steadily. It has been profitable since 2006 and has been a net contributor to the government's fiscal revenues since 2007 through dividend and corporate tax payments. This improved profitability is due to (i) an annual increase in average domestic tariffs

<sup>14</sup> Government of Bhutan. 2001. *Ninth Five Year Plan (2002–2007)*. Thimphu.

<sup>15</sup> ADB. 2003. *Rural Electrification and Network Expansion*. Manila (Loan 2009-BHU(SF) approved for \$9.4 million on 30 September).

<sup>16</sup> Government of Bhutan. 2009. *Tenth Five Year Plan (2008–2013)*. Thimphu.

<sup>17</sup> ADB. 2008. *Green Power Development*. Manila (Grant 0119–BHU approved for \$25.3 million on 29 October).

since 2004 (from Nu0.94/kWh in 2004 to Nu1.47/kWh in 2008) and an almost flat purchase price of electricity of Nu0.3–Nu0.4 per kWh; (ii) a threefold increase (from Nu253 million in 2006 to Nu740 million in 2008) in the wheeling charges accruing to BPC without a corresponding increase in the operating cost since the commissioning of Tala HPP in 2006; and (iii) a twofold increase in domestic electricity sales since 2004 (from 589 GWh in 2004 to 1,072 GWh in 2008).

29. **Cross-subsidy.** The government introduced the concept of “royalty energy” at the tariff determination for 2007–2010 undertaken by the newly created BEA. It was decided that the royalty energy would be 15% of the electricity output from DGPC-operated export-oriented hydropower projects. The royalty energy is provided to BPC at a discounted price of Nu0.30/kWh for supplying domestic consumers. Any energy purchase above 15% of the generation output of DGPC has to be purchased by BPC at Nu1.2/kWh. The provision of royalty energy to BPC at a discounted price to the export price results in loss of export revenues (economic opportunity cost) and can be considered a subsidy from the export sector to the domestic sector. BPC also receives a fee (wheeling charges) for the use of Bhutan’s power transmission grid for power exports.

### III. KEY DEVELOPMENT CHALLENGES AND THE GOVERNMENT’S POLICY RESPONSE

#### 1. Development Challenges Faced by the Power Sector

30. The main development challenges faced by the power sector in the mid-1990s were the institutional weakness of the sector and its inability to assume the role of key growth driver in promoting economic development through power exports and the provision of electricity to rural consumers. An overview of Bhutan’s power sector is in Appendix 1. The development challenges can be summarized as follows:

- (i) weak institutional structure—as a government department, the sector lacked financial and managerial autonomy and incentives for improved performance;
- (ii) poor cost recovery from domestic power sales and very limited available information on the sector’s financial performance;
- (iii) a low electrification rate (below 20%) in spite of vast hydropower resources, and the lack of an integrated power transmission grid;
- (iv) weak human resources capacity within the sector to meet the challenges posed by the rapid expansion of its distribution network and the development of large-scale hydropower projects for power exports; and
- (v) high dependency on donor financing (with a high degree of grant financing) for future development of the sector.

31. The institutional reforms undertaken during 1999–2002, with the assistance of ADB and other development partners, addressed some of these challenges. However, the newly established power sector entities faced the challenge of transforming Bhutan’s power sector from a state department dependent on fiscal allocations to financially sustainable utilities. The key challenges faced by the sector entities in 2002 were as follows:

- (i) establishing new power sector entities with adequate and technically competent human resources to assume the responsibilities assigned under the Electricity Act (constrained by Bhutan’s limited pool of technically qualified human resources);
- (ii) maintaining the investments in network expansion to provide rural communities with access to power and transmission connectivity to evacuate power from proposed hydropower projects while implementing institutional transformation;

- (iii) mobilizing financing for the development of export-oriented hydropower and rural electrification projects in a financially sustainable manner; and
- (iv) improving the financial cost recovery of the sector through gradual tariff adjustments.

32. By 2009, the power sector entities in Bhutan had achieved an adequate level of institutional maturity and sophistication, with the exception of the power sector regulatory agency, which only became financially and administratively independent in 2010. Bhutan has committed to an ambitious agenda of developing over 10,000 MW of hydropower capacity with the assistance of the Government of India by 2020 and achieving 100% electrification by 2013. The outstanding development challenges of the sector are as follows:

- (i) mobilizing financing for large-scale development of hydropower for power exports to India—although most of the projects under the 10,000 MW program are to be financed through bilateral loans from the Government of India, several projects are to be developed as joint ventures between DGPC and Indian public sector entities; these projects require commercial financing as official bilateral financing from the Government of India may not be sufficient to the total investment commitment of about \$12 billion–\$15 billion;
- (ii) addressing the environmental and social issues associated with the large-scale development of hydropower in the context of possible changes to hydrology in the Himalayas as a result of climate change;
- (iii) ensuring the development of the high voltage (400 kV/220 kV) transmission network for power evacuation to India as well as supply of the load centers in Bhutan in parallel with implementation of the 10,000 MW hydropower program;
- (iv) developing non-hydro forms of renewable energy to complement the hydropower sources and diversify the country's energy mix to reduce over-dependence on hydropower and mitigate the hydrology risk;
- (v) developing an adequate level of firm power capacity through several hydropower projects, with storage to minimize power shortages during winter;
- (vi) scaling up of the rural electrification program from 15,000 households electrified under the 9th plan to over 45,000 household connections in more remote areas under the 10th plan;
- (vii) ensuring the financial viability of the sector in the context of a large increase in rural consumers with high connection costs and low per capita consumption through tariff adjustments and smart targeting of rural electrification subsidies;
- (viii) recruiting and retaining competent human resources to manage the rapid expansion of the power sector in light of the planned 10,000 MW hydropower developments and 100% electrification program; and
- (ix) instituting prudent and transparent financial management practices to utilize the substantial financial surplus from power exports to promote sustainable socioeconomic growth.

## **2. Government Priorities, Policy Responses, and Sector Strategies**

33. The government's development strategy during 1994–2009 recognized that development of the country's hydropower potential will enhance the central role of the power sector in promoting (i) fiscal revenues from power exports, (ii) economic development and the concomitant reduction of poverty incidence, (iii) balanced regional growth with the electrification of rural communities, and (iv) industrial investments based on cheap and reliable supply of electricity. To achieve these objectives, the government recognized the importance of improving the institutional capacity of power sector entities and the need to expand both the power

generation capacity through investments in large export-oriented hydropower projects and the reach of the power transmission and distribution network to rural areas.

34. The government has followed a consistent policy framework during 1994–2009 to achieve these strategic objectives. The five year plans during this period prioritized certain aspects of this strategy:

- (i) establishing a transparent governance framework for the sector by separating the policy making, sector regulation, and utility operation functions;
- (ii) increasing the commercial orientation and operational efficiency of the utility function of the power sector to expand the power transmission and distribution network for efficient evacuation of power from export-oriented HPPs and support electrification of rural communities;
- (iii) improving the financial performance and cost recovery of the sector through tariff adjustments while maintaining the government’s objective of providing electricity at an affordable price to low-income households;
- (iv) expanding the power distribution network to rural areas to increase access to electricity for rural communities; and
- (v) establishing a competent agency to consolidate government ownership in export-oriented hydropower projects and to act as a strategic partner in developing new export-oriented HPPs.

35. The 7th plan focused on scaling up the rural electrification program to electrify 5,500 households, completing the master plan for hydropower development and the feasibility study for Tala HPP project, initiating the construction of two medium hydropower projects (Basochhu HPP and Kurichhu HPP), and strengthening power transmission to Thimphu and load centers in southern Bhutan. The 8th plan prioritized construction of the Basochhu HPP and Kurichhu HPPs, commencing construction of Tala HPP, and providing 10,000 households with access to electricity. It also included the preparation of detailed feasibility studies for other large hydropower projects and the construction of other mini hydropower projects for domestic supply. During the 8th plan, the government decided to decentralize the implementation and operation of power distribution to district units.

36. The priority objectives under the 9th plan included rural electrification (100% by 2020) and economic self-reliance through hydropower exports. The following seven-point strategy was adopted to meet these objectives:

- (i) strengthening the institutional capacity of the sector following the provisions of the Electricity Act by empowering BEA as the regulatory body, the DOE as the policy maker and planning body, and BPC to manage the domestic power supply and transmission network operations;
- (ii) transparent tariff setting for domestic and export power sales based on economic considerations—this involves establishing a multiyear tariff setting formula to provide an adequate rate of return on investments to power sector entities after taking into account the implicit subsidies provided to rural electrification through royalty energy;
- (iii) prioritizing rural electrification as a means of equitably distributing the benefits of Bhutan’s hydropower resources—the 9th plan targeted 15,000 connections compared to 10,000 connections provided under the 8th plan; a comprehensive rural electrification master plan will be prepared for achieving 100% electrification by 2020 and the financial viability of the rural electrification program was ensured by allocating adequate power for the domestic market (i.e., royalty energy) at a deep discount from the export prices;

- (iv) formulating policy guidelines to encourage private sector participation in the hydropower sector as well as community participation in the implementation of rural electrification;
- (v) preparing an energy and water resource master plan for developing the hydropower sector in a sustainable manner;
- (vi) increasing the efficiency and reliability of the power supply by installing a Supervisory Control and Data Acquisition (SCADA) system; and
- (vii) establishing an interconnected transmission grid by integrating the western and eastern grid, and extending the power transmission grid to remote parts of the country.

37. The 10th plan has set ambitious targets for achieving the priority objectives identified under the 9th plan. These included 100% electrification by 2013 and developing 10,000 MW of hydropower generation capacity with the assistance of the Government of India. The 10th plan identified critical challenges associated with achieving these targets:

- (i) addressing the environmental impacts associated with hydropower development while ensuring the integrity of Bhutan's watersheds in the face of unprecedented development of hydropower resources in relatively small and ecologically sensitive areas and the potential adverse impacts of climate change (glacial outbursts in the Himalayan region);
- (ii) the high up-front investment cost of hydropower and the difficulty of mobilizing the requisite financial requirements;
- (iii) developing access and transport infrastructure to hydropower sites;
- (iv) high dependence of Bhutan's economy on the hydropower sector (by 2020, the hydropower sector is expected to contribute 50% of GDP and over 75% of fiscal revenues); and
- (v) the financial constraints faced by the rural electrification program and the continued availability of subsidies in the form of avoided power exports, which command a higher price than the price charged for rural consumers.

38. Other policy initiatives undertaken recently include

- (i) consolidating government ownership in export-oriented hydropower projects under DGPC (para. 19);
- (ii) preparing the sustainable hydropower development policy (footnote 11) to attract foreign investment from both public and private sources to export-oriented hydropower projects; and
- (iii) initiating the development of other forms of renewable energy (off-grid micro hydropower, solar, and biogas) to meet the energy needs of remote communities and grid-connected wind power to complement the hydropower resources, given the seasonality of hydro resources in Bhutan.

#### **IV. ADB ENERGY SECTOR STRATEGY AND PROGRAM**

##### **A. ADB's Energy Sector Strategy**

39. The country operation strategy (COS) for Bhutan, approved in 1991,<sup>18</sup> identified the following priority areas for ADB assistance: (i) diversifying the economy for increasing hard currency earning capacity, (ii) strengthening the government's capacity for development administration, (iii) improving the physical and social infrastructure, and (iv) protecting the environment. ADB's energy sector strategy for Bhutan during the period covered under the 1991

<sup>18</sup> ADB. 1991. *Country Operational Strategy: Bhutan*. Manila.

COS closely followed these objectives and the government's sector objectives under the 7th plan, with emphasis on supporting the scaling up of the rural electrification program and promoting institutional and regulatory reforms to improve the performance of the power sector. ADB also encouraged tariff reforms to improve the cost recovery of domestic power supply and to reduce the implicit subsidies to domestic consumers.

40. The 2000 COS continued this strategy, with increased emphasis on the following strategic areas:<sup>19</sup>

- (i) supporting the restructuring of the energy sector through corporatization of the DOP, and enacting a new Electricity Act that defines the responsibilities for national electricity sector policy making and sector regulation;
- (ii) providing capacity building for newly created agencies to build up the necessary staff skills;
- (iii) establishing a transparent and predictable tariff regime for domestic power supply to ensure the financial viability of the newly created power utility (BPC) and to provide economic signals to consumers based on the cost of supply while providing affordable electricity to the poor;
- (iv) expanding the rural electrification program to meet the targets set in the 8th plan and building on the progress achieved under the 7th plan with ADB assistance; and
- (v) developing policy guidelines to attract private sector investments in hydropower development based on the provisions under the Electricity Act, with measures for risk mitigation, taxation, and procedures for transparent solicitation of investments from private investors.

41. The 2005 country strategy and program (CSP)<sup>20</sup> took into account the progress made since implementation of the first generation reforms in 2002, and identified priority areas for ADB assistance during implementation period of the 9th plan:

- (i) continuing to support the rural electrification program that provides 15,000 household connections under the 9th plan, using both grid connections and off-grid renewable energy applications;
- (ii) institutional strengthening of the DOE to enhance its capacity to undertake national energy policy planning, development of renewable energy sources, and promoting an enabling environment for private sector investments;
- (iii) ensuring that BEA is capable of effectively exercising its mandate as the sector regulator, including tariff setting;
- (iv) supporting the institutional strengthening of BPC by promoting state-of-the-art utility management practices such as management information systems and inventory control systems; and
- (v) streamlining the operations of export-oriented hydropower projects by consolidating them under a single corporate entity.

## **B. ADB's Energy Sector Assistance Program**

42. ADB's assistance program for Bhutan's energy sector during 1992–2009 can be divided into three parallel but complementary thematic areas or subsectors: (i) encouraging policy, institutional, and legal reforms to improve the commercial orientation and financial performance of power sector entities through a series of TA grants and policy dialogue supported through targeted loan covenants; (ii) providing financial assistance to expand the distribution network to

<sup>19</sup> ADB. 2000. *Country Operational Strategy: Bhutan*. Manila.

<sup>20</sup> ADB. 2005. *Country Strategy and Program: Bhutan, 2006–2010*. Manila.



electricity to rural communities; and (iii) mobilizing investments to hydropower development through PPPs. The impacts realized and the outcomes achieved in each of the subsectors are described in Appendix 2.

43. During 1993–2009, ADB approved four lending operations amounting to \$134.2 million, consisting of a \$51 million loan from ADB’s ordinary capital resources (OCR), a hard term Asian Development Fund (ADF) loan of \$29 million, and three ADF loans of \$26.9 million and an ADF grant of \$25.3 million. ADB also provided nine advisory TA projects amounting to \$5.5 million during this period, five project preparatory TA projects amounting to \$4.0 million, a \$1.0 million grant from the Asian Clean Energy Fund under the Clean Energy Financing Partnership, and a Japan Fund for Poverty Reduction (JFPR) grant of \$1 million. An assessment of ADB’s lending interventions to Bhutan’s power sector is in Appendix 3 and its nonlending interventions are detailed in Appendix 4. ADB’s assistance program by subsector is summarized in Table 3.

**Table 3: ADB Energy Sector Assistance Program, 1992–2009**

Strategic Period	Intended Development Outcomes	Operations Approved
<b>1. Supporting institutional and legal reforms in the power sector</b>		
1992–2001	Establishing an institutional and legal framework for improved commercial operation, enhanced managerial efficiencies, better cost recovery, and improved quality of service—these reforms are also expected to facilitate private sector investments in the hydropower sector	<p>Power Sector Institutional and Financial Development<sup>a</sup> TA explored options for sector restructuring and identifying priority needs for capacity building of DOP</p> <p>Rural Electrification Project<sup>b</sup> loan covenants required the preparation of an action plan for sector restructuring and improved commercial operation through better financial management of DOP</p> <p>Institutional and Financial Development of Department of Power<sup>c</sup> TA undertook a tariff study and capacity building for DOP on financial management</p> <p>Policy and Legal Framework for Power Sector Development<sup>d</sup> TA made recommendations on sector restructuring, drafting of electricity law, and hydropower development policy for attracting private sector investments</p> <p>Sustainable Rural Electrification<sup>e</sup> loan covenants required the corporatization of DOP and tariff adjustments to ensure the financial viability of the corporatized utility</p> <p>Corporatization of the Department of Power<sup>f</sup> TA assisted the corporatization of DOP and establishment of BPC as a financially viable entity</p>
2002–2009	Improved capacity for newly established power sector entities to discharge the mandates assigned to them effectively	<p>Rural Electrification and Network Expansion<sup>g</sup> Loan covenants required the establishment of BEA as the sector regulator and the establishment of a corporate entity to consolidate the operations of hydropower plants</p> <p>Capacity Building of the Bhutan Electricity Authority<sup>h</sup> TA carried out institutional capacity building of BEA</p> <p>Establishing the Druk Hydropower Corporation<sup>i</sup> TA made recommendation to consolidate the operations of hydropower plants</p> <p>Capacity Building for the Bhutan Power Corporation<sup>j</sup> TA</p>

Strategic Period	Intended Development Outcomes	Operations Approved
		introduced state-of-the-art utility management practices to BPC for strategic management, budgetary controls, and inventory management
<b>2. Supporting the Rural Electrification Program</b>		
1992–2001	Increased financial and institutional capacity to implement the rural electrification programs under the 7th and 8th five year plans (15,000 household connections)	<p>Rural Electrification Project scaled up the rural electrification program by increasing the financial resources and introducing new practices for rural electrification</p> <p>Sustainable Rural Electrification Project maintained the momentum of the rural electrification program achieved under the 8th Five Year Plan, 1997–2002</p>
2002–2009	Providing access to electricity for more remote areas, using both on-grid and off-grid applications	<p>Rural Electrification and Network Expansion Project continued the electrification of rural areas with increased emphasis on connecting poor households</p> <p>Accelerated Rural Electrification<sup>k</sup> TA recommended new institutional models for reducing the connection cost of remote areas and introducing low-cost on- and off-grid techniques for electrifying remote areas</p> <p>Rural Electricians Training Program<sup>l</sup> grant facilitated capacity building of rural electrification to increase its sustainability, as the availability of skilled technicians in rural areas was a barrier</p> <p>Green Power Development<sup>m</sup> Project extended the electricity network to remote areas to achieve the government's electrification target under the 9th Five Year Plan, 2002–2007 and additional grant financing for off-grid solar-based electrification</p>
<b>3. Promoting investments in the hydropower sector</b>		
1992–2001	Establishing an enabling environment for private sector participation in the hydropower sector	Policy and Legal Framework for Power Sector Development TA included a component to prepare a hydropower development policy to facilitate private sector investments in hydropower
2002–2009	Supporting PPPs in the hydropower sector by demonstrating the feasibility of PPP transactions and capacity building of relevant agencies	<p>Preparing the Bhutan Power Development Project<sup>n</sup> TA prepared the sustainable hydropower policy for attracting public and private investments to the hydropower sector and structured Bhutan's first PPP transaction in the hydropower sector</p> <p>Green Power Development<sup>o</sup> Project provided equity and loan financing for Bhutan's first PPP transaction in the hydropower sector</p> <p>Promotion of Clean Power Export Development<sup>p</sup> TA is providing institutional capacity building to (i) DOE for developing further PPP transactions and investment appraisal, (ii) DGPC on undertaking preliminary studies on potential PPP hydropower projects and institutional capacity building, and (iii) exploring financing options for PPP transactions.</p>

BEA = Bhutan Electricity Regulator, BPC = Bhutan Power Corporation, DGPC = Druk Green Power Company, DOE = Department of Energy, DOP = Department of Power, JFPR = Japan Fund for Poverty Reduction, PPP = public-private partnership, TA = technical assistance.

Note: The project preparatory TA grants are not listed, except TA 7318, as the others resulted in lending operations. TA 7318 is ongoing and it is expected to prepare a lending operation for approval in the second half of 2010.

- <sup>a</sup> ADB. 1992. *Technical Assistance to Bhutan for Power Sector Institutional and Financial Development*. Manila (TA 1729).
- <sup>b</sup> ADB. 1995. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for the Rural Electrification Project*. Manila (Loan 1375).
- <sup>c</sup> ADB. 2003. *Technical Assistance to Bhutan for the Institutional and Financial Development of Department of Power*. Manila (TA 2400).
- <sup>d</sup> ADB. 1998. *Technical Assistance to Bhutan for Policy and Legal Framework for Power Sector Development*. Manila (TA 3112).
- <sup>e</sup> ADB. 1999. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for Sustainable Rural Electrification*. Manila (Loan 1712).
- <sup>f</sup> ADB. 2003. *Technical Assistance to Bhutan for the Corporatization of Department of Power*. Manila (TA 3307).
- <sup>g</sup> ADB. 2003. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for Rural Electrification and Network Expansion*. Manila (Loan 2009).
- <sup>h</sup> ADB. 2003. *Technical Assistance to Bhutan for Capacity Building of the Bhutan Electricity Authority*. Manila (TA 4188).
- <sup>i</sup> ADB. 2003. *Technical Assistance to Bhutan for Establishing the Druk Hydropower Corporation*. Manila (TA 4189).
- <sup>j</sup> ADB. 2005. *Technical Assistance to Bhutan for Capacity Building for the Bhutan Power Corporation*. Manila (TA 4599).
- <sup>k</sup> ADB. 2005. *Technical Assistance to Bhutan for Accelerated Rural Electrification*. Manila (TA 4766).
- <sup>l</sup> ADB. 2006. *Grant Assistance to Bhutan for Rural Electricians Training Program*. Manila. (JFPR Grant 9093)
- <sup>m</sup> ADB. 2008. *Grant Assistance to Bhutan for the Green Power Development*. Manila (Grant 0119).
- <sup>n</sup> ADB. 2007. *Technical Assistance to Bhutan for Preparing the Bhutan Power Development Project*. Manila (TA 4916).
- <sup>o</sup> ADB. 2008. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for Green Power Development*. Manila (Loans 2463/2464).
- <sup>p</sup> ADB. 2008. *Technical Assistance to Bhutan for the Promotion of Clean Power Export Development*. Manila (TA 7157).

## V. EVALUATION METHODOLOGY

### A. Evaluation Approach and Methods Adopted

44. The evaluation framework for the SAPE draws on ADB's revised guidelines for the preparation of country assistance program evaluation reports,<sup>21</sup> reflecting updates made in 2009 and the first half of 2010. The evaluation is undertaken based on information obtained from discussions with relevant ADB staff involved in designing and implementing ADB interventions in Bhutan's energy sector; review of ADB's internal documents including COSs, CSPs, project documents, and previous evaluations undertaken by IED; and review of external documents, including the government's five year plans. An IEM was fielded in February 2010. Consultations were undertaken with government officials involved in implementing ADB-assisted loans and TA projects, and with representatives of other major development partners based in Bhutan. Field visits were undertaken to some of the beneficiary villages of the rural electrification program. The SAPE has also benefited from extensive data collections and surveys undertaken as part of the RIE to assess the socioeconomic impacts of ADB-assisted rural electrification projects.

### B. Evaluation Criteria and Rating System

45. This SAPE has been prepared based on six evaluation criteria defined in the revised guidelines for the preparation of CAPEs (footnote 20): (i) five core criteria (relevance, efficiency, effectiveness, sustainability, and development impacts); and (ii) strategic positioning. To arrive

<sup>21</sup> ADB. *Revised Guidelines for the Preparation of Country Assistance Program Evaluations*. Work in progress.

at the overall sector rating, the following weights are assigned to the six criteria: strategic positioning 10%, program relevance 10%, efficiency 20%, effectiveness 20%, sustainability 20%, and development impacts 20%. ADB performance has been assessed separately but is not included in the rating system.

46. To assess ADB's energy sector assistance to Bhutan, it has been divided into three thematic areas (weighting in parentheses): (i) promoting institutional reforms and good governance in the power sector (35%), (ii) improving access to electricity (40%), and (iii) mobilizing investments for the hydropower sector (25%). The weighting factors were determined based on the relative share of ADB's lending and nonlending interventions, taking into account the relative importance and priority assigned to each subsector. Although the institutional reforms and good governance are supported through a series of nonlending interventions, this area was assigned a higher weighting because of the importance attached to institutional reforms in ADB's overall energy sector assistance program. The evaluation results are presented by these three thematic areas and ADB assistance for each theme (Table 3) is evaluated according to the five core evaluation criteria. The rating scheme adopted in the SAPE is in Table 5.

### **C. Key Evaluation Questions**

47. The SAPE addresses the following issues in greater depth:
- (i) At the strategic level, how ADB's energy sector strategies and programs outlined in the 1991 COS, the 2000 COS, and the 2005 CSP are positioned in relation to Bhutan's development challenges and priority needs.
  - (ii) At the program level, whether ADB's power sector interventions, consisting of project and program loans and advisory TA projects, were designed to be relevant to the COS and CPS objectives and whether they have been effectively implemented to achieve the development effectiveness (desired outcomes and impacts) in an efficient and sustainable manner.
  - (iii) ADB's performance as an institution (responsiveness to client needs, supervision policy dialogue, aid coordination) in its power sector operations.
48. The SAPE addresses the following sector issues in depth:
- (i) the financial and institutional sustainability of Bhutan's highly ambitious rural electrification program in the context of the high connection and operating cost and low per capita consumption in remote rural areas;
  - (ii) the overall macroeconomic impacts of the large investment program in export-oriented hydropower; and
  - (iii) the effectiveness of the power sector agencies and regulatory framework to meet the challenges of Bhutan's rapidly expanding power sector.

## **VI. SUMMARY OF EVALUATION FINDINGS AND PERFORMANCE RATINGS BY EVALUATION CRITERIA**

### **A. Strategic Positioning of Energy Sector Assistance Program**

#### **1. Relevance of ADB Energy Sector Assistance Program to Country Priorities**

49. The main development challenges and strategic priorities of Bhutan's power sector in the early 1990s were the need for establishing the institutional and legal framework to create an enabling environment for the power sector to be the country's main economic growth driver by exploiting Bhutan's primary resource—hydropower. Another government priority during this

period was using rural electrification to enhance living conditions and livelihood opportunities for rural communities. The sector's main development challenges of the sector were weak institutional capacity and the governance regime of the sector, lack of financial and managerial autonomy, poor commercial orientation, and inadequate cost recovery of the power sector.

50. ADB's strategy for Bhutan during 1994–2001 was designed to address these critical barriers in a gradual and phased manner. ADB's strategy identified the importance of institutional reforms and the introduction of commercial utility management practices in achieving the country's broader development objectives. It engaged decision makers in a policy dialogue to explore institutional models for sector reforms; once a consensus was reached, ADB took the lead in providing assistance to implement the institutional, legal, and regulatory reforms. ADB encouraged improved cost recovery of the sector through capacity building on financial management and tariff reforms based on economic principles.

51. After completion of the initial phase of institutional reforms in 2002, the newly established agencies faced human resources, capacity, and skills constraints. The government prioritized the need for institutional arrangements to streamline the operation of existing HPPs, and formulate a policy framework to mobilize resources from public and private sources in a sustainable manner to develop Bhutan's vast hydropower resource. The latter is of particular importance in the context of uncertainty over continued availability of official bilateral assistance from the Government of India after the completion of Tala HPP. Under the 9th and 10th five year plans, 2002–2013, the government placed increased emphasis on rapid scaling up of the rural electrification program to achieve 100% electrification by 2013.

52. ADB's strategy during 2002–2009 closely reflected these sector priorities. Given the government's prioritization of rural electrification to develop rural areas in successive five year plans, ADB took the lead in channeling development partner assistance to rural electrification during 1994–2009. ADB supported the newly established power sector entities through capacity building TA grants to assume new responsibilities, and the consolidation of the management of HPPs. ADB's strategy during last five years laced increased emphasis on diversifying the sources of financing for hydropower development from official bilateral assistance to more commercially oriented PPP, and developing the necessary skills and experience within the key government agencies for structuring such transactions. This strategy was highly relevant when there was uncertainty over the availability of Government of India financing for hydropower development during 2006–2007. However, the Government of India in 2008 reiterated its commitment to support the development of over 10,000 MW of hydropower capacity through official bilateral assistance as well as joint ventures between DGPC and Indian public sector power utilities—about 2,500 MW out of 10,000 MW are expected to be constructed as joint ventures. The experience gained in PPP transactions supported by ADB will be useful for Bhutan in structuring joint ventures with Indian public sector entities to develop the hydropower projects in the 10,000 MW program. ADB's strategy supported the government objectives of achieving 100% electrification by 2013 through a series of concessionary loans and grants while promoting low-cost technologies, including off-grid solutions, to limit the cost of electrifying remote communities.

## 2. Alignment of ADB's Energy Sector Strategy with ADB's Corporate Objectives

53. ADB's long-term strategic framework, 2001–2015<sup>22</sup> identified the importance of access to physical infrastructure, including energy, for sustainable economic growth. Promotion of good governance, including cost recovery of public utilities and institutional capacity building for public service delivery, were key themes of the framework. Strategy 2020 reiterated these objectives with increased emphasis on inclusive and environmentally sustainable economic growth.<sup>23</sup> It emphasized the importance of providing access to infrastructure services to the poor and vulnerable, and creating an enabling environment for private sector participation through PPPs in the provision of infrastructure services. Strategy 2020 also encourages ADB to support the shifting of its developing member countries to a low carbon growth path by promoting the use of clean energy resources such as hydropower.

54. Energy 2000 encouraged the removal of subsidies through tariff reforms as well as creating an enabling environment for private sector participation, structuring PPP transactions in the energy sector, and providing financing to PPP projects. Energy 2000 also supported rural electrification through both grid extension projects and off-grid projects for remote communities using renewable energy, and formulating policies for increasing the renewable energy utilization.<sup>24</sup>

55. The 2009 Energy Policy elaborated these strategies with emphasis on energy sector restructuring, regulatory reforms, and support for public sector utilities to improve the commercial orientation and cost recovery. Mitigating climate change by developing clean sources of electricity, such as hydropower (high-head run-of-river HPPs located in higher reaches of watersheds that do not require reservoirs), and providing electricity to rural communities are given high priority in Energy Policy 2009. The policy also encourages ADB support for promoting renewable energy to meet the energy needs of rural communities, especially the use of biogas and distributed generation such as solar power. Energy Policy 2009 strongly supported regional cooperation in the energy sector as an economically efficient means of ensuring regional energy security, using clean and renewable energy sources and achieving economies of scale for relatively small countries such as Bhutan. Power sector reform and restructuring is encouraged in Energy Policy 2009 to improve sector efficiency and enable private sector investments in the power sector.<sup>25</sup>

56. ADB's energy sector strategy for Bhutan is closely aligned with the objectives of ADB's corporate strategies (the 2001–2015 long-term strategic framework and Strategy 2020) and has taken into account the specific aspects of Energy 2000 and Energy Policy 2009. ADB support for power sector restructuring and advocacy of tariff reforms and promoting rural electrification, with strong emphasis on poverty targeting during 1995–2002, reflect ADB's institutional priorities as reflected in the Energy 2000 and Energy Policy 2009.

57. Since 2006 ADB has increased its support for hydropower and renewable energy to mitigate climate change by increasing hydropower exports to India (thereby helping India to reduce greenhouse gas emissions) and promoting PPP transactions in the hydropower sector.

<sup>22</sup> ADB. 2008. *Moving the Poverty Reduction Agenda Forward In Asia and the Pacific: The Long-Term Strategic Framework of the Asian Development Bank (2001–2015)*. Manila.

<sup>23</sup> ADB. 2008. *Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank, 2008–2020*. Manila.

<sup>24</sup> ADB. 2000. *Energy 2000 Review of the Energy Policy of the Asian Development Bank*. Manila.

<sup>25</sup> ADB. 2009. *Energy Policy*. Manila.

This reflects the importance of climate change and PPP in Strategy 2020 and Energy Policy 2009. ADB's continued support for rural electrification (using both grid and off-grid technologies) and capacity building of power sector utilities to improve the efficiency of utility management, are also in line with the 2009 Energy Policy. ADB support for formulating policies for attracting investments to the hydropower sector in a sustainable manner, and promoting renewable energy development as well as deploying cost-effective technologies and institutional models for utilizing renewable energy for off-grid applications, also demonstrate the high degree of alignment with the 2009 Energy Policy objectives.

### **3. Selectivity, Sequencing, and Country of ADB's Energy Sector Assistance Program**

58. ADB's energy sector strategy has demonstrated a high degree of selectivity in supporting rural electrification and institutional reforms in the power sector. This was justified by the high priority given to the rural electrification program by the government, and the weak institutional structure (para. 31) and capacity of the power sector that impeded it from being the main growth driver of the economy. ADB did not support power transmission (66 kV and above) and hydropower generation until 2007, as these subsectors received extensive assistance from bilateral development partners, especially India. However, after the commissioning of the Government of India-assisted Tala HPP in 2006, and in the context of uncertainty over further Indian bilateral assistance to the hydropower sector, ADB stepped up its support for the sector by promoting PPP transactions to attract the Indian private sector to invest in hydropower in Bhutan for the first time.

59. The rural electrification program has been one of the key areas that ADB has consistently supported through a series of lending operations, starting from the first rural electrification project in 1995. Although the government gave rural electrification a high priority, it could not be scaled up until 1995 as it depended on financial support provided by bilateral donors on an ad hoc basis. ADB support for rural electrification has taken a programmatic approach—ADB financed a significant proportion of households to be electrified under the 7<sup>th</sup> plan (lending operations approved in 1995), the 8th plan (lending operations approved in 1999), the 9th plan (lending operations approved in 2003), and the 10th plan (lending operations approved in 2008). Each lending operation was designed to expand the electricity grid progressively to more remote areas of the country, starting from suburban areas electrified under the first rural electrification project. Hence, ADB assistance to rural electrification has been properly sequenced and has maintained continuity while taking into account lessons learned from previous operations.

60. ADB support for institutional reforms, including capacity building of recently established power sector entities, has been appropriately sequenced and cohesive. ADB initially focused on improving financial management of the DOP and improving the commercial orientation in the DOP in preparation for its commercialization. During this phase (1995–2000), ADB engaged the government in policy dialogue regarding possible options for institutional reforms and the need for tariff reforms to ensure the financial viability of a reformed power sector. After a consensus was reached on the reform agenda, ADB continued to support the implementation of the reform program. Once the initial phase of reforms was implemented in 2002, ADB's strategy was to provide capacity building to the newly created agencies to enable them to assume the responsibilities assigned to them in the Electricity Act and to introduce modern utility management and regulatory practices to the sector.

61. It can be concluded that the strategic positioning of ADB's strategy for Bhutan is high and Table 4 summarizes the ratings for different attributes of the strategic positioning.

**Table 4: Assessment of Strategic Positioning of ADB Assistance**

<b>Sub Criteria</b>	<b>Rating</b>
Relevance of assistance program with country priorities	Highly Satisfactory
Alignment with ADB energy sector strategies	Satisfactory
Selectivity, Sequencing, and Continuity	Highly Satisfactory
<b>Overall Assessment of Positioning of Sector Assistance</b>	<b>Highly Satisfactory</b>

ADB = Asian Development Bank.

Source: Independent evaluation mission.

## **B. Program Relevance**

### **1. Promoting Institutional Reforms and Good Governance in Power Sector**

62. The initial focus of ADB operations in Bhutan's power sector was improving financial management of the DOP and preparing it for commercialization. The 7th plan had ambitious plans to expand the electrification coverage of the country, but the DOP lacked the institutional capacity and human resources, especially in financial management, to implement them. Tariffs were set without a firm understanding of the cost structure since the DOP did not maintain financial records to ascertain the cost of supply. The existing institutional structure was not appropriate to meet the development challenges of the time, and initiating dialogue with stakeholders was urgently needed to explore changes to the institutional and legal framework. ADB's strategy during 1993–1998 was to engage the government in policy dialogue to promote institutional reforms and provide immediate capacity building assistance to the DOP.

63. Power Sector Institutional and Financial Development<sup>26</sup> TA for the institutional and financial development of Bhutan's power sector was designed to explore institutional models for reforming the power sector and identifying the priority capacity building requirements of the DOP to improve its operational efficiency. The TA for institutional and financial development of the DOP (footnote 5) carried out a tariff study to propose cost-reflective tariff setting regime. The relevance of the financial management component of Institutional and Financial Development of Department of Power (footnote 5) is questionable as the DOP was not prepared institutionally to adopt modern financial management practices such as accrual accounting since it was managed as part of the government. ADB also extensively engaged the government in policy dialogue during 1995–2001 based on Institutional and Financial Development of Department of Power TA recommendations on the need for significant tariff adjustment to reduce subsidies to domestic consumers and to make the power sector attractive for private sector investments. As Bhutan's power sector is considered a major source of foreign exchange and fiscal revenues, with little prospect of private sector investments in domestic power supply, ADB should have taken into account the government's policy of providing electricity to domestic consumers at a discount to the cost of supply to improve the living conditions of rural communities. Since 2003, ADB has been more cognizant of government priorities while the government has taken action to reduce tariff distortions and better target subsidies to the rural poor.

64. During the 8th plan, the government decided to initiate the institutional and sector reforms but there was lack of clarity on aspects of legal framework and the sector's institutional

<sup>26</sup> ADB. 1992. *Technical Assistance to Bhutan for the Power Sector Institutional and Financial Development*. Manila (TA1729).



structure. Policy and Legal Framework for Power Sector Development (footnote 6) TA recommended options on establishing the legal and institutional framework for the restructured sector. Corporatization of the Department of Power (footnote 7) TA was designed to assist the government in establishing BPC as a commercial entity and in undertaking preparatory work to achieve a smooth transfer of the DOP's utility function to BPC in a financially and institutionally sustainable manner.

65. Given the weak capacity and human resource constraints, the newly created power sector entities required significant capacity building assistance to enable them to assume their mandates under the Electricity Act. The newly created power sector regulator, BEA, lacked the institutional capacity and technical competence to function effectively as a sector regulator. Capacity Building for the Bhutan Electricity Authority,<sup>27</sup> TA capacity building of BEA, was designed to assist BEA in this regard in parallel with the capacity building assistance provided to BEA by the Government of Norway on economic regulation. The institutional reforms undertaken in 2002 did not include the export-oriented hydropower sector, and given the importance of hydropower to Bhutan's economy, the operations of hydropower plants had to be streamlined by achieving economies of scale. TA for Establishing the Druk Hydropower Corporation,<sup>28</sup> was designed to explore institutional options for the hydropower sector and recommend an appropriate corporate entity to consolidate the operations of HPPs.

66. Building on the initial success of establishing BPC as a corporate entity and expanding the power distribution network to achieve an electrification rate of about 45% by 2005, the government has set ambitious targets for achieving 100% electrification by 2020 in the 9th plan. Having achieved the commissioning of the 1,020 MW Tala HPP in 2007, and with several projects in the planning and construction stage, the transmission network of BPC required further strengthening. The expansion of scale of BPC's operations during 2006–2015, as a result of these developments, required the introduction of modern utility management practices to BPC. The Capacity Building for Bhutan Power Corporation<sup>29</sup> was aimed at preparing BPC for meeting future challenges.

## 2. Improving Access to Electricity

67. ADB's lending program focused on supporting rural electrification, in recognition of the importance attached to rural electrification in the government's development program and ADB's energy sector strategy. Hence, ADB's lending support for rural electrification has been highly relevant to Bhutan's development priorities and ADB's energy sector strategy. However, there were several issues with the design and preparation of some of the lending interventions in support of rural electrification.

68. The design of Rural Electrification Project (footnote 3), ADB's initial lending intervention to the power sector in Bhutan approved in 1995, was based on adequate due diligence and the implementation arrangements took into account the institutional capacity of the DOP and its lack of experience in working with international agencies. Extensive analysis of the tariff issues was undertaken during project preparation and formed the basis for policy dialogue on tariff reforms during project implementation. The technical design of Rural Electrification Project, prepared by loan-financed consultants, was not appropriate for Bhutan and resulted in difficulties during

<sup>27</sup> ADB. 2003. *Technical Assistance to Bhutan for Capacity Building of the Bhutan Electricity Authority*. Manila (TA 4188).

<sup>28</sup> ADB. 2003. *Technical Assistance to Bhutan for Establishing the Druk Hydropower Plant*. Manila (TA4189).

<sup>29</sup> ADB. 2008. *Technical Assistance to Bhutan for Capacity Building of the Bhutan Power Corporation*. Manila (TA4599).

project implementation. These inappropriate design features included the use of larger and heavier transformers than required, and a sophisticated network protection system beyond the capacity of DOP/BPC to maintain it. The first rural electrification project did not include a design and monitoring framework<sup>30</sup> and did not have a project performance monitoring system.

69. Sustainable Rural Electrification Project (footnote 11) approved in 1999 was designed during the implementation phase of Rural Electrification Project to scale up the rural electrification program under the 8th plan. The design problems encountered in the Rural Electrification Project were addressed in the design of Sustainable Rural Electrification Project. The Sustainable Rural Electrification Project also included separate components to support solar panels to provide electricity to community facilities in remote areas not covered under the grid extension program, and to provide electrification kits for poor households to increase their connection rate. However, the design of the solar component did not take into account the maintenance requirement and an effective maintenance program was not incorporated in the design of solar panels distributed to community centers in remote areas. The design of electrification kits was not appropriate for Bhutan and the criteria used for distributing the electrification kits resulted in social discontent, so many poor households rejected these electrification kits. Sustainable Rural Electrification Project also included a SCADA system for Thimphu, but the design specifications did not take into account the ongoing network expansion. This resulted in implementation delays, as the design had to be revised during implementation.

70. During the preparation of Rural Electrification and Network Expansion Project (footnote 15) approved in 2003, an extensive socioeconomic survey was undertaken to ascertain the impact of rural electrification on the poor. The findings of this survey were used to design a targeting mechanism to subsidize the household wiring and connection costs of the rural poor. However, the targeting mechanism did not adequately take into account the problems encountered in distributing electrification kits to poor households under Sustainable Rural Electrification Project, and most of the rural electrification kits were either not distributed or rejected by the poor households. Rural Electrification and Network Expansion Project also contained a loan covenant to establish a project performance and monitoring system (PPMS) to monitor key indicators at project output, outcome, and impact levels compared to the baseline indicators established during the project preparation.

71. Because of the remoteness of Bhutan's rural population centers and the availability of small to medium-size hydropower resources in most parts of the country, off-grid renewable energy technologies—mini and micro hydro and solar—may have to be considered as one of the least-cost options for electrifying remote areas of the country. However, innovative institutional models and policy incentives are required to facilitate the development of off-grid rural electrification applications. Accelerated Rural Electrification<sup>31</sup> TA was designed to make recommendations to address these issues, as the rural electrification program is extended to more remote parts of the country under the 10th plan. The rural electrification component of Green Power Development Project (footnote 17) was designed taking into account some of these recommendations.

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<sup>30</sup> A design and monitoring framework was not a requirement at the time of approval of the Rural Electrification Project.

<sup>31</sup> ADB. 2006. *Technical Assistance to Bhutan for the Accelerated Rural Electrification*. Manila (TA4766).

### 3. Mobilizing Investments for the Hydropower Sector

72. ADB had attempted to engage the government in policy dialogue to establish an enabling environment for private sector investments in the hydropower sector and a component of Policy and Legal Framework for Power Sector Development TA (footnote 7) was for this purpose. However, the government did not consider the importance of private sector investments in the hydropower sector until 2006–2007, as the government priority until then was to commission Tala HPP built with Government of India assistance. The government's strategy changed after the completion of Tala HPP, as there was a need to attract private sector investments and commercial financing for further development of the hydropower sector since continued availability of bilateral financing was uncertain. In this context, Green Power Development Project (footnote 17) is highly relevant as it involved supporting a PPP transaction through an innovative financing mechanism for Dagachhu HPP. ADB undertook a thorough analysis of financing options for the Dagachhu HPP, taking into account the country's debt sustainability capacity and the foreign currency exposure.

73. ADB provided capacity development TA for the Promotion of Clean Power Export Development<sup>32</sup> to develop the capacity of government agencies in structuring PPP transactions, and develop other PPP transactions in the hydropower sector. The government selected several medium-size hydropower projects to be developed as PPP transactions with the assistance of Promotion of Clean Power Export Development. In 2008, the Government of India committed to finance 10,000 MW of hydropower capacity through a combination of official bilateral assistance and joint ventures between Indian public sector power utilities and DGPC. The capacity building and knowledge transfer on PPP acquired under Promotion of Clean Power Export Development will be useful for government counterparts in structuring joint ventures with Indian public sector power utilities for projects included in the 10,000 MW program, as some of the hydropower projects will be developed as joint ventures with Indian public sector power utilities.

74. Therefore, ADB assistance to institutional and policy reforms has been *highly relevant* as the reforms supported by ADB are critical to enable the power sector to meet Bhutan's development challenges. ADB assistance to rural electrification has been *relevant* in spite of issues with the design of some of the smaller components of rural electrification projects. ADB assistance to mobilizing investments to the hydropower sector is also rated *relevant*, as Dagachhu hydropower project developed under Green Power Development (footnote 17) met a critical need at its time of approval.

#### C. Efficiency

##### 1. Promoting Institutional Reforms and Good Governance in the Power Sector

75. ADB has supported institutional and legal reforms in the power sector through a series of advisory TA grants and policy dialogue. In general, the advisory TA grants have been completed within the allocated time and budget, and there were not many instances of changes to TA implementation arrangements or TA scope. A high degree of knowledge transfer and leveraging of TA resources has occurred through active involvement of counterpart staff in TA implementation. The institutional and regulatory reforms have also resulted in more efficient utilization of resources in the power sector, as management accounting and budgetary controls were introduced. However, the sector's overall economic efficiency continues to be affected by

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<sup>32</sup> ADB. 2008. *Technical Assistance to Bhutan for the Clean Power Export Development*. Manila (TA7157).

the continuation of the government's policy of providing implicit subsidies to domestic power supply via the royalty energy to BPC at a discount to the export price.

## 2. Improving Access to Electricity

76. The efficiency of the rural electrification projects supported by ADB is assessed based on the economic internal rate of return (EIRR) of each project. The economic benefits of rural electrification are due to resource cost savings (i.e., savings in the consumption of alternate forms of energy and incremental consumption for activities that were not possible without electricity [TV, electric appliances, etc.]). While the resource cost saving can be easily quantified using survey data on alternative forms of energy used by un-electrified households, the economic benefits due to incremental consumption is determined by estimating the area under the demand curve for electricity. The economic cost of electricity consumed by rural consumers is taken as the opportunity cost of power exports to India in the recalculated EIRR. The methodology for estimating the economic benefits caused by incremental consumption and the assumptions used in the computation are in Appendix 5.

77. There were several anomalies in the methodology for calculating the EIRR used in the RRP and PCR of rural electrification projects in Bhutan. These anomalies relate to assumptions regarding household electricity consumption, household energy consumption in the absence of electricity, the split between non-incremental and incremental benefits, the economic cost of electricity consumed by rural households, and the economic cost of kerosene replaced by electricity. Although most of the anomalies were corrected in the PCRs, the recent increase in kerosene prices has not been fully taken into account in the PCRs as the kerosene price increases happened after completion of the PCRs. This has resulted in underestimating both incremental and non-incremental economic benefits, and explains the increase in the recalculated EIRR of the SAPE compared to the EIRR estimates of PCRs. Based on the recalculated EIRR, it can be concluded that Rural Electrification Project (footnote 9) is *efficient* and Sustainable Rural Electrification Project (footnote 11) and Rural Electrification and Network Expansion Project (footnote 15) projects are *highly efficient*.

78. The likely economic efficiency of the rural electrification component of the ongoing Green Power Development grant (footnote 17) has been assessed using a set of assumptions consistent with those used for completed loans based on consumption data from IED surveys. The recalculated EIRR of the rural electrification component of the Green Power Development Project is 11.9%<sup>33</sup> and it is rated *likely* to be efficient, assuming that household electricity consumption will remain at the same level as households electrified under Sustainable Rural Electrification and Rural Electrification and Network Expansion. The EIRR estimates of the rural electrification projects at appraisal stage, PCR stage, PPER stage and the revised estimate made by IED during the preparation of SAPE are presented in Table 5.

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<sup>33</sup> The EIRR is highly sensitive to the household consumption and 11.9% of EIRR is arrived at by assuming average household consumption of 80 kWh/month which is same as the average consumption of completed rural electrification projects. As the household electrified under Green Power Development Project belongs to more remote villages, there is a possibility of average consumption of these households being less than the consumption of already electrified households.

**Table 5: Economic Internal Rate of Return Estimates of ADB-financed Rural Electrification Projects**

Loan No.	Project Name	Appraisal Estimate	PCR Estimate	PPER Estimate	Recalculated EIRR (SAPE Estimate)	Economic Efficiency
1375	Rural Electrification Project	11.9%	11.7%	12.5%	12.9%	Efficient
1712	Sustainable Rural Electrification	13.0%	14.9%	N.A.	23.0%	Highly Efficient
2009	Rural Electrification and Network Expansion	12.7%	24.4%	N.A.	21.7%	Highly Efficient
0119	Green Power Development	20.0%	N.A.	N.A.	11.9%	Likely Efficient

EIRR = economic internal rate of return, N.A. = Not available, PCR = project completion report, PPER = project performance evaluation report, SAPE = sector assistance program evaluation.

Sources: Independent Evaluation Department staff estimates.

79. The portfolio management of ADB's lending program to rural electrification has been satisfactory, especially in the absence of an ADB resident mission in Bhutan. ADB has undertaken regular project review missions and project implementation has improved steadily as the executing agencies gathered experience in ADB's procurement and disbursement procedures. Some initial procurement problems during the implementation of Rural Electrification Project (footnote 3) were caused by inappropriate packaging of bid documents. However, these were addressed in subsequent lending operations and no major issues have occurred in portfolio management (such as cost overruns, time delays, and procurement issues).

### 3. Mobilizing Investments for the Hydropower Sector

80. The export-oriented hydropower is economically efficient, as the prevailing prices in the Indian power market are more than sufficient to cover the cost of hydropower generation in Bhutan. Previously, hydropower projects in Bhutan were developed with highly concessionary financing provided by the Government of India (Tala HPP, Kuruchi HPP, and Chukka HPP). The export price of electricity from these plants is set at a rate that provides a significant cash surplus to Bhutan after meeting its debt service obligations. India also derives economic benefits from power imports, as Bhutan remains an economically attractive source of electricity compared to the other alternatives available to India. Hence, the development of the hydropower sector has been an economically efficient investment for Bhutan as well as India.

81. ADB was not a major player in the hydropower sector until 2006 when it started preparing the Dagachhu hydropower project, which was structured as a PPP and financed through a combination of debt and equity financing. The debt financing was sourced from ADB's OCR loans and Austrian suppliers' credit, and the equipment and construction contracts were awarded using competitive bidding. The cost of equipment per unit of capacity of the Dagachhu project is higher than previous hydropower projects because of the use of more advanced technology, which may reduce lifetime costs. The debt financing terms for equipment financed through export credit are not as attractive as the terms offered by the Government of India for earlier projects. However, the electricity off-take price of the Dagachhu hydropower project is higher (Nu2.35/kWh) than the existing projects (Nu1.85/kWh), and the higher off-take price is expected to offset the high construction and financing cost.

82. The economic benefits of the project to Bhutan are conservatively valued at the electricity export price and the EIRR is estimated to be 13.8%. When the economic benefits accruing to India (in terms of replacement of high cost fossil fuel-based power generation) are taken into account, the project's EIRR increases to 22%. The project is under construction and no adverse developments have warranted an adjustment of the EIRR estimates made at appraisal. The project has recently registered as a Clean Development Mechanism (CDM) project, which will result in additional cash flows and economic benefits to the country. Hence, it can be concluded that ADB interventions in the hydropower sector are *likely* to be efficient.

## **D. Effectiveness**

### **1. Promoting Institutional Reforms and Good Governance in the Power Sector**

83. ADB has supported institutional reforms in the power sector to achieve development outcomes in terms of improved sector governance, institutional capacity, financial sustainability, and establishing an enabling environment for mobilizing investments through a series of TA grants and policy dialogue. ADB's first intervention in the power sector, Power Sector Institutional and Financial Development TA (footnote 26), was of exploratory nature and was aimed at awareness building of policy makers about possible reform options for the power sector and to identify the immediate capacity building needs of the sector. Power Sector Institutional and Financial Development TA was effective in terms of its limited objectives, as it initiated the reform process that was finally implemented in 2002.

84. Institutional and Financial Development of Department of Power TA (footnote 6) was approved in 1995 to provide capacity building to the DOP in financial management, and undertake a tariff study to form the basis for tariff reforms to be undertaken prior to corporatization of the sector. However, Institutional and Financial Development of Department of Power TA was not immediately effective as the DOP was not institutionally capable of adopting modern financial management practices since it functioned as part of a government department. The decision makers were not convinced about the need for tariff reforms as the power sector was not financially independent. However, some of Institutional and Financial Development of Department of Power TA's recommendations, including tariff reforms, were adopted by BPC after its establishment in 2003.

85. Policy and Legal Framework for Power Sector Development TA (footnote 7) approved in 1998 and Corporatization of the Department of Power TA (footnote 8) approved in 1999 were highly effective in facilitating the far-reaching institutional reforms undertaken in 2002, including the corporatization of BPC, to take over the utility management function. Policy and Legal Framework for Power Sector Development TA assisted the government in formulating the legal framework and the organizational structure of the sector, and the recommendations of Corporatization of the Department of Power TA were highly useful to the government in implementing the corporatization of BPC. However, the hydropower policy component of Policy and Legal Framework for Power Sector Development TA to formulate a policy for attracting private sector investments to the hydropower sector was not effective, as the government did not see the need for private sector investments at the time since concessionary financing was available from bilateral donors.

86. ADB approved in 2003 Capacity Building of Bhutan Electricity Authority TA (footnote 27) for institutional capacity building of the newly established regulatory agency for the power sector (BEA), and Establishing the Druk Hydropower Corporation TA (footnote 28) for recommending institutional options to consolidate HPP operations. Although Capacity Building of the Bhutan

Electricity Authority TA delivered its expected outputs, the TA has not been effective in institutional strengthening of BEA because of BEA's human resources constraints. The government recently made BEA an autonomous agency and it is expected that it will be able to recruit and retain competent staff. The government has consolidated the ownership and management of hydropower plants under DGPC in 2008, and Establishing Druk Hydropower Corporation TA has been effective in making recommendations regarding the institutional structure of DGPC and transfer of assets and liabilities to DGPC.

87. Capacity Building for Bhutan Power Corporation TA (footnote 29) approved in 2005 has been effective in facilitating the introduction of modern management practices such as management information systems, enterprise resource planning, integrated inventory control systems, budgetary controls, and cost center accounting. ADB's TA has made a significant contribution to facilitating the transition of Bhutan's power sector from a government department lacking financial autonomy to a highly competent utility management structure with clearly delineated responsibilities for policy formulation, utility management, state oversight, and sector regulation. Hence, ADB assistance for institutional reforms can be considered *highly effective*.

## 2. Improving Access to Electricity

88. ADB has supported the rural electrification program in Bhutan through four separate lending operations; each lending operation financed a significant proportion of investments earmarked for rural electrification in the 7th–10th plans. Rural Electrification Project (footnote 3) approved in 1995 was the first major intervention by a development partner to support rural electrification; Rural Electrification Project financed the electrification of 3,100 households out of 5,500 households electrified under the 7th Five Year Plan. In spite of the implementation delays caused by DOP staff's unfamiliarity with ADB procedures, inappropriate packaging of bid documents, and technical designs by project implementation consultants, the project was completed within the allocated budget and delivered the intended outcomes. The project was also effective in scaling up the project implementation capacity of Bhutan's power sector, as indicated by the electrification of a greater number of households in subsequent five year plan periods (the 8th–10th plans).

89. Subsequent lending operations to Rural Electrification consisting of Sustainable Rural Electrification Project (footnote 11, approved in 1999) and Rural Electrification and Network Expansion Project (footnote 15, approved in 2003) have been implemented smoothly without significant implementation delays or cost overruns. Sustainable Rural Electrification Project exceeded the output target of providing 6,000 household connections by over 25% and contributed to over 75% of household connections provided during the 8th plan period. Rural Electrification and Network Expansion Project exceeded the output target of 8,000 household connections by 15% and financed the connection of over 55% of household connections provided during the 9th plan period. Green Power Development (footnote 17), supporting the electrification target under the 10th plan, is being implemented.

90. ADB-financed rural electrification projects have been *highly effective* in meeting the output targets and contributing to the improved rural living conditions. However, the PPMS incorporated in Rural Electrification and Network Expansion Project to monitor the socioeconomic benefits resulting from rural electrification has not been implemented. ADB assistance to rural electrification has been *effective* in mobilizing resources from other bilateral financiers as co-financiers. The improved project preparation and implementation capacity acquired by BPC in implementing ADB-financed rural electrification projects enabled BPC to mobilize a significant amount of financing from JICA to meet the rural electrification targets

under the 10th plan. ADB also promoted the use of renewable energy for electrifying remote areas through Accelerated Rural Electrification TA (footnote 30) and project preparatory TA for Rural Renewable Energy Development.<sup>34</sup> However, these technologies have not yet been deployed at any significant scale in Bhutan and it remains to be seen whether off-grid renewable energy technologies will be effective in meeting the energy needs of remote communities in Bhutan.

### 3. Mobilizing Investments for the Hydropower Sector

91. Bhutan has been depending on official bilateral development partner financing for its hydropower sector. ADB attempted to engage the government in policy dialogue to establish an enabling policy framework to attract private sector investment in the hydropower sector through Policy and Legal Framework for Power Sector Development TA (footnote 7) approved in 1998. However, this was not effective at the time as the government was preoccupied with restructuring the domestic power supply and the need for attracting private sector investment in the hydropower sector was not a priority. ADB has since reengaged the government regarding the need for an enabling policy framework for private sector investment in the hydropower sector through PPTA for Bhutan Power Development Project<sup>35</sup> approved in 2007.

92. PPTA for Bhutan Power Development Project has been effective in formulating the Sustainable Hydropower Development Policy, which provides clear guidelines on (i) the roles and responsibilities of each relevant government agency; (ii) the ownership structures allowed for hydropower projects of different capacities; (iii) the pre-qualification and project allotment process; (iv) terms for royalty energy and other payments payable by the developers; (v) fiscal incentives and foreign exchange privileges; (vi) regulatory and off-take terms; and (vii) environmental and social considerations. PPTA for Bhutan Power Development has also been effective in structuring Bhutan's first PPP transaction, with a reputed investor as the private sector participant.

93. Green Power Development Project (footnote 32) approved in 2008 has been effective in demonstrating the feasibility of PPP transactions in Bhutan. The financial plan of the project has been structured to attract equity financing from a strategic foreign investor (Tata Power) as well as institutional investors from Bhutan (pension fund) and a strategic domestic investor (DGPC), and debt financing from ADB and the Austrian Export Import Bank. ADB played a key role in structuring the financing plan, finalizing a bankable off-take agreement with a reputed off-taker from India (Tata Power Trading Company) and ensuring financial closure. ADB also played a key role in successfully registering Dagachhu hydropower project as the first ever cross-border CDM project. However, the financial structure of the project leaves Bhutan exposed to foreign exchange risk as the government has relented US dollar- and Euro-denominated loans to the project company while the revenues of the project company are denominated in Indian rupees. There has been partial hedging of Euro-denominated loans because of the availability of CDM revenues denominated in Euro. A reserve account has been set up to absorb short-term foreign currency fluctuations to mitigate the risk to the government. Nonetheless, residual foreign currency and convertibility risk remains with the government in the event of default by DGPC.

94. Given the difficulties associated with structuring PPP transactions in Bhutan, with an underdeveloped capital market, ADB has been *highly effective* in facilitating a PPP transaction. It has provided, Promotion of Clean Power Export Development TA (footnote 33) approved in

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<sup>34</sup> ADB. 2009. *Technical Assistance to Bhutan for the Rural Renewable Energy Development*. Manila (TA 7318).

<sup>35</sup> ADB. 2007. *Technical Assistance to Bhutan for Preparing the Bhutan Power Development*. Manila (TA4916).



2009 for further capacity building on mobilizing investment through PPP transactions and preparation of several follow-up PPP transactions. It remains to be seen whether Promotion of Clean Power Export Development will be effective in facilitating follow-up PPP transactions in the hydropower sector given the high priority assigned by the government to developing over 10,000 MW of hydropower capacity financed by the Government of India through official bilateral assistance.

## **E. Sustainability**

### **1. Promoting Institutional Reforms and Good Governance in the Power Sector**

95. The sustainability of institutional strengthening and reforms undertaken with ADB assistance is assessed in terms of the institutional and financial sustainability of the key power sector entities supported by ADB. These include BPC, supported by Corporatization of Department of Power TA (footnote 9) and Capacity Building for Bhutan Power Corporation TA (footnote 29); DGPC, supported by Capacity Building of the Bhutan Electricity Authority (footnote 27) and Promotion of Clean Power Export Development TA (footnote 28); supported by Establishing the Druk Hydropower Corporation TA (footnote 28); and DOE, supported by Policy and Legal Framework for Power Sector Development TA (footnote 7) and Promotion of Clean Power Export Development (footnote 33).

96. BPC, which has taken over the responsibility for domestic power supply and operation of transmission lines evacuating electricity to India, is among the best performing utilities in ADB's developing member countries. It has improved its managerial performance by adopting modern utility management practices such as enterprise resource planning, integrated inventory control, budgetary control, and management information systems. BPC has also gained experience in successfully managing the construction of high voltage power transmission lines and rural electrification schemes. It has managed to attract and retain competent and motivated staff, who have received performance-related incentives to encourage improved performance. BPC's operational performance has improved steadily, as measured by the reduction in transmission and distribution losses and improved reliability indicators. It has been financially sustainable, achieving profitability since 2006, and started paying dividends and taxes in 2007 (Appendix 6). Subject to the continued availability of royalty energy to BPC for domestic supply at a discount to export prices, BPC is likely to remain financially sustainable.

97. Since its establishment in 2008, DGPC has achieved a high degree of professional competence and institutional strength in operating the existing HPPs. It has centralized financial management while delegating day-to-day plant management, and is establishing centers of excellence to ensure the sustainable operation of existing HPPs. DGPC has been highly profitable, given the attractive financing and off-take arrangements offered by the Government of India to existing hydropower projects, and it has been the biggest contributor to government revenues in the form of dividends and taxes.

98. The DOE has effectively taken over the state management function of the power sector, including policy formulation, responsibility for implementing the rural electrification program, and the 10,000 MW hydropower program supported by the Government of India. The DOE has also built up adequate institutional capacity by retaining a competent set of civil servants. Although BEA was established in 2006, it has not yet reached institutional maturity as it was a division of the DOE until the end of 2009. BEA became administratively independent in January 2010 when it was de-linked from the civil service.

## 2. Improving Access to Electricity

99. Bhutan's rural electrification program has been justified on the grounds of social equity, rural development, and poverty alleviation. The rural electrification projects were expected to result in positive net economic benefits. Rural electrification was not expected to result in positive financial returns to the power utility, and rural electrification was projected to require continuous cross-subsidies from power exports and urban and industrial consumers because of (i) the high cost of connecting rural consumers as a result of difficult terrain and low population densities in rural areas; (ii) low consumption in rural areas; and (iii) lower tariffs applicable to rural consumers as the average consumption in rural households is below the lifeline block of 80 kWh per month.

100. The financial sustainability of the rural electrification program is assessed in the same manner as other forms of rural development programs (i.e., based on the ability of the government to provide an adequate level of funds to cover the recurrent expenses of service delivery and to maintain the assets). However, in contrast to other similar rural service delivery programs (such as rural roads and rural water supply), rural electrification has positive operating cash flows. This indicates that rural electrification does not require subsidies to cover recurrent expenses and the power utility (i.e., BPC) does not need to cross-subsidize rural electrification on a recurrent basis. However, BPC does not generate adequate cash flows from rural consumers to recover the capital expenses it incurred on rural electrification. The concessionary loans (Rural Electrification Project (footnote 2), Sustainable Rural Electrification Project (footnote 7), and Rural Electrification and Network Expansion Project (footnote 15) under ADF terms) as well as ADF grant under Green Power Development Project (footnote 17) are relented by the government to BPC and BPC is required to pay back these loans with interest to the government.

101. The financial internal rate of return (FIRR) of rural electrification projects is critically dependent on the lending terms offered by the government to BPC. This is highlighted for the ADB-financed rural electrification projects in Table 6. Although the FIRR values indicate the rural electrification projects are financially unviable from the point of view of BPC under the scenario of 100% capital cost recovery by the government, the government could make rural electrification a financially attractive proposition to BPC by reducing the capital cost recovery.

**Table 6: Financial Analysis of ADB-financed Rural Electrification Projects**

Loan No.	Project Name	FIRR with full capacity recovery	FIRR with 50% capital cost recovery	FIRR with 25% capital cost recovery
1375	Rural Electrification Project	-4.1%	-0.5%	3.3%
1712	Sustainable Rural Electrification	0.7%	4.8%	9.6%
2009	Rural Electrification and Network Expansion	1.0%	5.4%	10.7%
0119	Green Power Development	-4.0%	0.3%	3.9%

FIRR = financial internal rate of return.

Source: Independent Evaluation Department staff estimates.

102. The overall sustainability of the rural electrification program depends on the institutional and financial sustainability of BPC, as it is institutionally responsible for maintaining the program. BPC has established a dedicated Rural Electrification Department with district level offices to implement the rural electrification program. BPC's Distribution and Customer Service

Department is responsible for operation and maintenance of the rural electrification network, and maintains separate offices for customer services and maintenance in each district. BPC is adopting modern utility management practices, such as state-of-the-art enterprise resource planning to streamline its operations and integrate the district offices with its head office in Thimphu.

103. The sustainability of past attempts to promote off-grid renewable energy technologies in rural areas has been poor, mainly because of lack of capacity in rural areas for maintaining off-grid systems. ADB's attempt to train village female solar technicians to install and maintain solar systems through a JFPR grant<sup>36</sup> was unsuccessful. It remains to be seen whether the new initiatives, to be undertaken with the active involvement of BPC for maintaining the off-grid technologies deployed for electrifying over 4,000 households, will be successful. Special attention may need to be paid to the sustainability of off-grid technologies from an institutional and technical point of view before making a decision to deploy off-grid technologies on a significant scale.

104. The government has taken several measures to ensure the financial sustainability of BPC despite the negative cash flows associated with rural electrification. These measures include

- (i) a steady increase in electricity tariffs to industrial consumers and residential consumers with a monthly consumption exceeding the lifeline block;
- (ii) provision of royalty energy (defined as 15% of the country's total electricity generation) to BPC at Nu0.3/kWh compared to the average export price of Nu1.8/kWh, which amounts to a subsidy from the power exports to domestic power supply as the country is incurring a financial cost in terms of reduced power exports; and
- (iii) wheeling charges (transmission charges for power exports) set at a level higher than the cost recovery level (debt service associated with transmission assets and operating and maintenance cost of transmission assets).

105. The total cross-subsidy to the domestic power supply consists of a subsidy on power purchase and the cash surplus from wheeling charges. The total subsidy to domestic power supply has increased from Nu1,260 million in 2005 to Nu2,131 million by 2009. In 2009, 50% of the subsidy amounting to Nu1,076 million was allocated to consumers supplied at low voltage (households and small businesses). The large industries, supplied at higher voltages and consuming more than 79% of domestic power consumption, received only 32% of the subsidy. The rural electrification program is expected to be completed by 2013, when the total subsidy requirement of the household sector will increase to Nu923 million; this will amount to over 68% of the implied subsidy provided through royalty energy. However, the subsidy requirement for the domestic power supply will constitute only 22% of the total cash surplus arising from power exports in 2014. The overall financial sustainability of these measures is analyzed in Appendix 7.

106. The sustainability of the domestic power supply in the context of the high-cost rural electrification program critically depends on the continued availability of royalty energy to domestic power supply at a discounted price to the economic cost of electricity (i.e., the opportunity cost in terms of forgone electricity exports). Under the prevailing policy of providing the royalty energy to BPC at Nu0.3/kWh and the domestic energy requirement in excess of royalty energy at Nu1.2/kWh, with modest increases in domestic tariffs (4% per annum), the

<sup>36</sup> ADB. 2003. *Grant Assistance to Bhutan for the Rural Electricians Training Program*. Manila (JPPR 9093).

cross-subsidy from the power exports is more than sufficient to cover the cost of supply of both residential and industrial consumers. With the commissioning of large HPPs such as Punatsangchhu I in 2016, the cash surplus in the export sector continues to increase and the power export sector will be in a position to subsidize the domestic sector while providing an increasing contribution to the country's overall fiscal revenues after meeting the debt service obligations of export-oriented HPPs.

### **3. Mobilizing Investments for the Hydropower Sector**

107. Dagachhu HPP will be operated by a joint venture company consisting of DGPC and Tata Power Company of India, both of which have extensive experience in operating hydropower projects in an environmentally and socially sustainable manner. The financial sustainability of the project is ensured through an off-take agreement at an attractive rate, the continued need for power imports to meet rapidly growing demand in India, and the competitiveness of Dagachhu HPP compared with alternatives available in India. An ESMAP study<sup>37</sup> concluded that the North India power grid is likely to have power shortages in the medium term, and power exports from Bhutan (at about Rs2.4/kWh) are cheaper than thermal power generated using imported LNG ( Liquid Natural Gas) (Rs3.5/kWh) and imported coal (Rs3.0/kWh).

108. The Sustainable Hydropower Development Policy, developed with ADB assistance, is meant to establish an enabling environment for attracting private sector investments to the power sector in a transparent manner, encourage the establishment of PPPs for larger hydropower projects, and ensure the environmental and social sustainability of the hydropower sector. Although the investment mobilization aspects of the Sustainable Hydropower Policy are not a government priority because of the availability of bilateral financing from the Government of India for the 10,000 MW hydropower program, the policy can be adopted to ensure the environmental and social sustainability of the hydropower projects included in the 10,000 MW program.

109. Because of the run-of-river nature, low population density, and lack of multilateral development bank financing, hydropower projects in Bhutan have not attracted the same level of adverse publicity as similar size projects in other countries such as the Lao People's Democratic Republic. Hence, there has been little interest from the donor community and international and domestic civil society regarding the environmental and social sustainability of existing hydropower projects. Although the adverse impacts are mitigated to an extent because of the run-of-river nature of the hydropower projects in Bhutan, the projects are bound to have caused some adverse environment impacts. The environmental management of existing hydropower projects is undertaken by dedicated environment management units at the plant level. However, monitoring and enforcement of environment management of the hydropower sector by the NEC is lacking. This is a concern when Bhutan is embarking on a highly ambitious and large hydropower development program.

## **F. Development Impacts**

### **1. Promoting Institutional Reforms and Good Governance in the Power Sector**

110. The overall energy sector governance and regulatory framework has improved significantly since restructuring of the power sector in 2002, with the delineation of the responsibilities of policy formulation to the DOE, sector regulation to BEA, and utility operation to BPC. The technical and financial performance of BPC has improved significantly since its

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<sup>37</sup> ESMAP Technical Paper 119/07. *Bhutan Hydropower Sector Study: Opportunities and Strategic Options*.

establishment, as demonstrated by its financial and operational performance indicators. BPC has demonstrated its capacity to implement both rural electrification and transmission expansion projects, and has acquired a significant self-financing capability. In addition to its policy formulation function, the DOE is closely involved in monitoring progress in the rural electrification program and coordinating the development of the country's hydropower resources in a sustainable manner. However, BEA has not yet reached the institutional capability to function as an independent entity and has been heavily dependent on the DOE for institutional support. The operations of hydropower plants have also been streamlined since the establishment of DGPC, which is building its capacity as a center of excellence for HPP operations in the Himalayas.

111. ADB has made a substantial contribution to establishing a sound institutional and sector governance framework (Appendix 4 details the impacts of advisory TA grants). This includes input provided through policy dialogue and targeted TA for exploring institutional models and undertaking advisory studies, such as tariff and cost of supply studies, to support policy dialogue and policy formulation. ADB's capacity building TA to BPC, DGPC, and BEA made a substantial contribution to improving the institutional performance of these newly created agencies, with the possible exception of BEA. ADB also contributed to the energy sector policy formulation by engaging the DOE in preparing an enabling policy framework for mobilizing private sector resources for sustainable development of the hydropower sector. ADB is assisting in preparing a policy framework for promoting renewable energy development.

## **2. Improving Access to Electricity**

112. Prior to ADB's involvement, rural electrification in Bhutan was undertaken in an ad hoc manner subject to the availability of donor financing, and the government was not in a position to undertake a programmatic approach to rural electrification. At the start of ADB's intervention in 1995, rural electrification was about 17%; it increased to about 60% by 2009 after four rural electrification projects supported by ADB. Since 1995, ADB has anchored the rural electrification program with a dedicated rural electrification lending operation in support of each five year plan; this enabled bilateral development partners to complement the financial assistance provided by ADB to rural electrification. The engagement of consultants for project preparation and implementation of ADB projects resulted in knowledge transfer to BPC staff and benefited the rural electrification projects supported by bilateral donors. Since 2007 ADB has promoted the use of renewable energy technologies for off-grid connections but these technologies are yet to be deployed on a significant scale. The socioeconomic impacts of rural electrification in Bhutan at a household level are assessed in detail in the RIE being undertaken by IED.

113. The findings of the RIE indicate that electrified households enjoy a better quality of life and most of the economic, social, and health outcomes are better in electrified households than un-electrified households. Economic benefits, in terms of increased nonfarm incomes, are modestly higher in electrified households than un-electrified households. Electrification also substantially reduced smoke-induced health problems and incidences of cough, respiratory ailments, eye irritation, and headache were less prevalent in electrified households than un-electrified households. The number of workdays missed because of illness was also lower in electrified households. Children in electrified households completed more years of schooling. Girls benefited more from electrification than boys. Time spent on collecting fuel wood also decreased substantially in electrified households. Women in electrified households played a significant role in household decisions, particularly regarding children's education and family health compared to their counterparts in un-electrified households.

114. Several policy implications stem from the RIE results. An important policy action could be to roll out an awareness program about the use of electricity for cooking and heating in electrified villages. The majority of electrified households still use fuel wood and analysis of their electricity consumption reveals that electricity is mainly used for lighting. The scale of microenterprise activities in rural areas is very low, and it is likely that a skills deficit is preventing rural households from reaping the full benefits of electricity.

### 3. Mobilizing Investments for the Hydropower Sector

115. ADB has played a highly significant role in facilitating the Dagachhu HPP, initially as a transaction adviser and subsequently as a project financier providing both debt and equity financing. In the absence of ADB support, the Dagachhu HPP—the only hydropower project to be commissioned during 2007–2015—would not have happened. However, the experience gained in the Dagachhu HPP and the ongoing capacity building assistance provided by ADB will help Bhutan in developing follow-up PPP transactions with private sector investors. The successful registration of the Dagachhu HPP project as a CDM project may also enable hydropower projects under development to access carbon markets for additional revenues.

### G. Overall Rating and Assessment of ADB Energy Sector Assistance to Bhutan

116. The overall assessment of ADB's energy sector assistance to Bhutan in terms of the six evaluation criteria and the three subsectors is illustrated in Table 7. The strategic positioning of ADB's energy sector program has been rated *highly satisfactory* and the program is rated *relevant, highly effective, efficient, and likely to be sustainable* with substantial development impacts. Based on the combined rating score of 2.50, the overall performance of ADB's energy sector assistance to Bhutan is rated *satisfactory*. ADB assistance to institutional reforms has been rated *highly satisfactory* and assistance for rural electrification and hydropower have been rated *satisfactory* based on subsector rating scores of 2.8 for promoting institutional reforms and good governance, 2.5 for improving access to electricity, and 2.0 for mobilizing investments for hydropower.

**Table 7: Summary Rating for Each Thematic and Overall Rating**

Evaluation Criteria	Criteria Weight	Thematic Percentage Shares						All Sectors Combined	
		Institutional Reform 35%		Rural Electrification 40%		Mobilization of Investments for Hydropower 25%			
		Rating	WAS	Rating	WAS	Rating	WAS	Rating	WAS
Strategic Positioning	0.10	3	0.30	3	0.30	3	0.30	<b>3.00</b>	0.30
Program Relevance	0.10	3	0.30	2	0.20	2	0.20	<b>2.35</b>	0.23
Efficiency	0.20	2	0.40	2	0.40	2	0.40	<b>2.00</b>	0.40
Effectiveness	0.20	3	0.60	3	0.60	2	0.40	<b>2.75</b>	0.55
Sustainability	0.20	3	0.60	2	0.40	2	0.40	<b>2.35</b>	0.47
Development Impacts	0.20	3	0.60	3	0.60	2	0.40	<b>2.75</b>	0.55
<b>Overall Assessment</b>	<b>1.00</b>		<b>2.80</b>		<b>2.50</b>		<b>2.00</b>		<b>2.50</b>

WAS = weighted average score.

Note: If the combined WAS for the overall performance or for a particular sector is (i) greater than 2.7, it is rated *highly satisfactory*; (ii) from 1.6 to 2.7, it is rated *satisfactory*; (iii) from 0.8 to 1.6, it is rated *partially satisfactory*; and (iv) less than 0.8, it is rated *unsatisfactory*.

Source: IED Staff estimates.

## **H. ADB Performance**

### **1. ADB Role in Building Government and Client Ownership**

117. ADB's lending program for rural electrification has enjoyed a high degree of country ownership, as demonstrated by the priority given to rural electrification in the government's five year plans since 1994. Starting with the second rural electrification project approved in 1999, projects have been implemented by executing agency staff without the assistance of project implementation consultants. Since its establishment in 2002, BPC has demonstrated strong ownership in project implementation and preparation by undertaking the initial surveys and project designs for rural electrification projects implemented since 2004 supported by ADB. BPC has established a dedicated rural electrification department with a presence in each district to ensure the smooth implementation of the rural electrification program. Since 2007 ADB supported the deployment of renewable energy technologies for electrifying remote parts of the country and the DOE is participating in pilot testing these technologies and community-based institutional models.

118. The country ownership of the institutional reforms has been high, following extensive consultations and consensus building among policy makers on the reform agenda. The ownership is further demonstrated by the strong commitment and leadership shown by senior policy makers to implement the reforms in a relatively short time (2001–2003) and the absence of significant policy reversals. After initial reservations and discussions with ADB on the need and level of tariff reforms required, the government realized the importance of gradual but regular tariff adjustments to ensure the financial viability of the sector in the face of higher costs from the extension of the electricity network to remote parts. Since 2003, the government has initiated regular tariff adjustments, and since 2007 BEA has been responsible for setting tariffs in a transparent manner. The government has also shown commitment and interest in structuring PPP transactions in the hydropower sector when there was uncertainty over continued availability of bilateral funding for hydropower development.

### **2. ADB Response to Client Needs**

119. ADB has consistently responded to the client's needs, given the close alignment of ADB's energy sector strategy with the government's strategic agenda for the energy sector. During 1995–2000, the power sector in Bhutan suffered from weak institutional capacity and required extensive assistance to upgrade the utility management practices to facilitate its transition to a commercial utility. The government also required assistance in implementing the reform program and ADB responded by providing a series of TA grants to meet the government's urgent needs. Since 2006, ADB has responded to the need for diversifying the sources of financing for hydropower development. This included policy and transaction advice on structuring PPP transactions in the hydropower sector, and debt and equity financing for the project company when mobilizing limited recourse financing became a binding constraint.

120. In recognition of the high priority assigned to rural electrification by the government, ADB has been a major partner in the rural electrification program of each five year plan since the 7th plan. The government in 2008 decided to accelerate the rural electrification program to achieve 100% electrification by 2013. In addition, an extra funding requirement of over \$40 million, innovative approaches to reduce the cost of electrifying remote areas with low population density, and use of off-grid renewable energy technologies are also needed. ADB has responded by expediting the processing of the next rural electrification loan to meet the funding

gap of \$40 million, and provided TA to explore new approaches and technologies to reduce the cost of electrifying remote areas.

### **3. Value Addition from ADB Interventions**

121. The value addition of the ADB assistance to the rural electrification program is mainly the increased institutional capacity for project implementation within BPC as a result of the experience gained in implementing ADB-financed projects. This has enabled BPC to implement several power transmission and power distribution projects successfully using its own resources and financing from bilateral donors. In the absence of ADB financing for rural electrification, BPC would not have been able to scale up the rural electrification because of lack of continuity and scale in financing, which were available from bilateral sources. ADB has also encouraged the use of private contractors for constructing rural electricity schemes, contributing to the development of private sector contractors.

122. The policy dialogue and targeted TA provided for sector reforms and institutional capacity building have complemented the commitment and enthusiasm of Bhutanese counterparts for implementing the sector reforms by sharing experience from other parts of the world and introducing modern utility management practices. Value addition from ADB is high in structuring a PPP transaction in the hydropower sector for the first time in Bhutan. ADB has been instrumental in developing the project from a conceptual stage to financial closure, attracting the private sector investor and/or off-taker to the transaction, negotiating the commercial agreements, and acting as the lead financier for equity and debt financing. Bhutanese officials from the power sector as well as the Ministry of Finance have gained exposure to the commercial and financial issues associated with project financing, and ADB has acted as an honest broker in advising the government of possible options for hedging foreign exchange risks. However, at the time of the IEM, a satisfactory mechanism to minimize Bhutan's exposure to the foreign exchange risk from the Dagachhu HPP had not been put in place. ADB should continue to engage the regulatory agencies in India to explore possibilities for converting the US dollar liabilities of the Dagachhu HPP to Indian rupees, as the revenue flows of the project are in Indian rupees. This will benefit ADB's potential OCR and non-sovereign lending operations to the hydropower sector in Bhutan.

### **4. ADB's role in Aid Coordination**

123. In the absence of World Bank participation in Bhutan's power sector, ADB has assumed the role of lead multilateral development agency for the sector since the mid-1990s. Although there was no formal mechanism for coordinating development partner activities in Bhutan, there was a high degree of coordination in the rural electrification program. The DOE has been instrumental in allocating funding from different development partners to different parts of the country for rural electrification. Since 2007 ADB has closely coordinated its assistance to rural electrification with JICA which has become a significant partner in rural electrification since 2007. The rural electrification component of Green Power Development Project (footnote 17) and the proposed rural electrification loan expected to be approved in the second half of 2010 have been prepared and will be implemented as a single project with two different financing partners (ADB and JICA). As the lead donor to the power sector, there is scope for ADB to assume a lead role in coordinating the development partner assistance to the power sector.

124. There is very little support from other development partners for institutional reforms and capacity building of power sector entities. Only the Government of Norway has provided support for capacity building of BEA on economic regulation. Although India has been the biggest



development partner to the power sector throughout the period under consideration, there has been little coordination or overlap with the activities financed by India and ADB. Most of the assistance provided by the Government of India was to hydropower development and high voltage power transmission (66 kV and above) while ADB focused on rural electrification and institutional reforms. With the increasing involvement of ADB in the hydropower sector and the need for extensive investments in power transmission, ADB will have to increase its interaction and coordination with the Government of India. This will enable ADB to finance hydropower and power transmission projects to the mutual benefit of India and Bhutan, since India will continue to be the major market for Bhutan's hydropower exports as well as the main financier of Bhutan's power sector. ADB's performance is summarized in Table 8.

**Table 8: Assessment of ADB Performance to Bhutan's Energy Sector**

<b>ADB Performance Evaluation Criteria</b>	<b>Rating</b>
ADB's Role in Building Client Ownership	Satisfactory
ADB's Response to Client Needs	Highly Satisfactory
Value Addition from ADB Interventions	Satisfactory
ADB's Role in Aid Coordination	Satisfactory
<b>ADB's Overall Performance</b>	<b>Satisfactory</b>

ADB = Asian Development Bank.

Source: Independent evaluation mission.

## VII. KEY FINDINGS, LESSONS, AND OUTSTANDING ISSUES

### A. Key Findings

125. **Institutional reforms and corporatization.** Institutional reforms and corporatization of the sector facilitated successful implementation of the rural electrification program. Prior to the establishment of BPC with ADB assistance as a corporate entity in 2002, the power sector in Bhutan was managed as part of the government under civil service rules and regulations. There was lack of flexibility, managerial autonomy, and financial independence as the sector was dependent on annual fiscal allocations. It would have been difficult to scale up the rural electrification program in the absence of flexibility introduced under the new corporate structure and a more enterprising corporate culture. The use of private contractors for installation work, decentralization of project implementation, and timely provision of counterpart funds would have been difficult under the previous organizational structure.

126. **Cost recovery.** There has been increased emphasis on cost recovery since commercialization of the sector. When the power sector was managed as part of the government, there was lack of awareness regarding the cost of supply and the need to achieve an adequate return on investments. ADB's attempts to convince policy makers to establish a cost-reflective tariff structure prior to 2001 were unsuccessful, as electricity supply was considered a social service to be provided by the government at a minimal cost to consumers. Since the establishment of BPC in 2002, there has been a better understanding of the financial and economic cost of electricity supply to different categories of consumers and the government has introduced steady tariff adjustments to improve cost recovery and better target the subsidies to residential consumers consuming less than the lifeline block (i.e., less than 80 kWh per month).

127. **Financial sustainability.** Rural electrification is likely to be financially sustainable in the long run in the context of an increasing cash surplus in the power sector. Electricity consumption in rural areas is less than 1.5% of total generation and 6% of total domestic power

consumption in 2009. With the completion of the rural electrification program in 2013, rural electricity consumption is expected to double from present levels. Electricity for the domestic power supply is provided at a deep discount to the export price; the implicit subsidy to domestic power supply amounted to Nu2,130 million in 2009. The bulk of this subsidy is allocated to rural residential consumers because of low tariffs applicable to rural consumers and the high cost of supply to rural areas. However, the power sector contributed over Nu5,000 million to government revenues after providing the implicit subsidy to domestic power supply. The cash surplus in the power sector is expected to increase to over Nu23,000 million and the subsidy requirement for domestic power supply will be less than Nu3,000 million by 2016. Hence, the power sector in Bhutan can continue to absorb the high cost of rural electrification provided the government continues to provide electricity for domestic supply at a discount to export price.

128. **Grid extension and off-grid renewable energy.** There is scope for judicious use of grid extension and off-grid renewable energy applications for achieving 100% electrification. Bhutan has achieved an electrification rate of around 60%, mostly with grid extensions, at an average cost of connection per household of \$1,500. The rural electrification projects completed to date have an adequate economic rate of return. The government in 2008 launched an ambitious plan to achieve 100% electrification by 2013. As more remote and sparsely populated areas are being electrified, there is increasing scope for using economically efficient off-grid renewable energy applications as the grid extensions may become economically less efficient beyond a certain threshold value of cost of connection per household. A detailed analysis of alternatives would help in informing the decision making.

## **B. Lessons Learned**

129. **Continuity.** Long-term continuity in supporting institutional building and sector investments, such as rural electrification, has been highly effective. ADB has maintained continuity in its support for institutional building and financial assistance for rural electrification. This has built up a high degree of trust and confidence in ADB by government counterparts. ADB's record of financing a major share of the rural electrification target under each five year plan since 1995 has enabled the government to plan ahead with certainty over the availability of financing. The presence of ADB as the anchor financier for the rural electrification program also provided comfort to bilateral development partners to provide funding to complement ADB financing, and share project preparation and implementation arrangements with ADB-financed larger rural electrification projects.

130. **Socioeconomic and cultural context.** Poverty and gender targeting should be based on extensive understanding of the country's socioeconomic and cultural context. ADB-financed rural electrification projects in 1999 and 2003 attempted to target the rural electrification benefits to poor households by providing pre-designed household wiring kits to poor households. ADB also attempted to train female technicians to install and maintain solar panels in remote areas to increase the gender focus of the rural electrification program. Although these initiatives were designed based on socioeconomic surveys, they have not been effective as expected as the cultural context and social prejudices in the case of wiring kits, and institutional and financial sustainability in the case of village-based technicians, were not fully taken into account.

131. **Ownership.** Increased ownership of TA by the executing agencies results in more effective TA implementation and sustainable TA outcomes. Executing agencies have shown a high degree of ownership in identifying the need for TA, defining the scope of the TA projects, and in TA implementation. Selectively increasing their role in TA management, based on their record in TA implementation, could increase the effectiveness of TA as it provides an increased

sense of ownership and responsibility. The IEM has noted that several executing agencies in the energy sector are highly competent and familiar with ADB TA administration procedures.

### C. Key Issues

132. **Environmental and social issues.** Environmental and social issues associated with the large-scale development of hydropower must be addressed in the context of possible changes to hydrology in the Himalayas as a result of climate change. The NEC, which has the primary responsibility for monitoring and enforcing mitigating measures for the adverse environment impacts of large hydropower projects, lacks the institutional capacity to discharge its responsibilities effectively given the scale of proposed hydropower development in Bhutan. There is also an absence of basin-wide studies to assess the cumulative impacts of the development of hydropower projects in cascade along the same river basin, and a need for environmental flows to ensure the ecological integrity of river basins. ADB has provided several TA projects, including the ongoing TA<sup>38</sup> for institutional capacity building of the NEC, to institutionalize mechanisms for climate change adaptation and developing CDM projects. The NEC needs more focused capacity building on river basin management and monitoring, and enforcement of environmental management of large-scale hydropower projects as Bhutan is embarking on a large-scale hydropower development program.

133. **High voltage transmission network.** Ensuring the development of the high voltage (400 kV/220 kV) transmission network in parallel with implementation of the 10,000 MW hydropower program remains a challenging task. Tala HPP and Chukka HPP had dedicated transmission lines to evacuate power to India. However, with the development of over 10,000 MW of hydropower capacity consisting of over 10 separate projects during the next 10–15 years, a holistic approach must be taken to development of the transmission network. This would enable Bhutan to minimize the investment requirement in the transmission network while providing adequate redundancy in the network to ensure network reliability while providing connectivity to domestic load centers and collecting substations across the border in India. The adverse impacts on biodiversity corridors can also be reduced by minimizing the transmission corridors through protected areas.

134. **Seasonal variations.** The availability of hydropower is seasonal and Bhutan is experiencing difficulties in meeting its domestic power demand during winter. Hence, an adequate level of firm power capacity must be developed through several hydropower projects, with storage to minimize power shortages during winter. Another option is to develop non-hydro forms of renewable energy (such as wind power) to complement hydropower and diversify the country's energy mix to reduce over-dependency on hydropower and mitigate the hydrology risk. However, development of the renewable energy in Bhutan is limited by lack of data and feasibility studies on potential renewable energy projects, including small hydropower projects (i.e., below 25 MW), transmission network connectivity constraints, and financial constraints. It is expected that some of the policy barriers to renewable energy development will be addressed in the renewable energy policy under preparation with ADB assistance.

135. **Economic importance of hydropower.** The predominance of the hydropower sector in the national economy is expected to increase during the next 10 years. Commissioning of Tala HPP (1,020 MW) in 2007 had a major impact on both GDP and exports, with exports rising to over Nu10 billion. The power export in 2008–2009 was 45% of total exports and the power

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<sup>38</sup> ADB. 2009. *Technical Assistance to Bhutan for Capacity Building of the National Environment Commission on Climate Change*. Manila.

sector contributed over 40% of fiscal revenues (over Nu5 billion). Power sector-related debt consisted of 55% of external debt as of 2009. The addition of debt from Tala HPP and the expected addition of further debt from new hydropower projects to be commissioned during 2014–2019 will see a substantial buildup in external debt. Hydropower-related debt will amount to about 80% of GDP by 2017 and the debt service will increase to about 50% of total exports by 2020.

136. The increased debt burden will be accompanied by an rise in fiscal revenues from hydropower exports. After meeting debt service obligations, the net cash surplus of the power export sector in 2017 will be Nu24 billion (22.5% of the projected GDP in 2017) and this will increase to Nu45 billion in 2020 (31% of projected GDP in 2020). Instituting prudent and transparent financial management practices to utilize the substantial financial surplus from power exports to promote the overall economic growth and socioeconomic well-being of Bhutan in a sustainable manner will be a challenge for the government (Appendix 8).

## VIII. RECOMMENDATIONS

137. **Consider supporting the development of the renewable energy sector by addressing policy, institutional, financial, and technical barriers.** The renewable energy policy under preparation with ADB assistance is expected to address policy and institutional barriers to increased private sector investment in grid-connected wind and small hydropower projects (i.e., below 25 MW). However, there is a critical need for undertaking feasibility studies for such projects to identify potential project sites to facilitate soliciting investments in a transparent manner. Given the underdeveloped capital markets in Bhutan, there is a need for external financing—especially debt financing—to complement equity financing by the private sector. The transmission connectivity also needs to be strengthened and the network coverage expanded to facilitate the evacuation of power from the renewable energy projects.

138. **Building on the success of structuring the Dagachhu HPP as a PPP transaction, ADB should increase efforts to develop follow-up PPP transactions in the hydropower sector.** There is scope to develop medium size (50 MW–200 MW) hydropower projects through private sector investments under the PPP model to complement the 10,000 MW hydropower development program supported by the Government of India. ADB can assist the government in undertaking feasibility studies, soliciting investments from reputed private sector investors, structuring PPP transactions with appropriate risk allocation to the government and private investors, and mobilizing debt financing through private sector operations. ADB is ideally positioned to support such projects by sharing political and commercial risks through private sector and nonsovereign operations.

139. **Provide extensive capacity building assistance to understand the long-term environment impacts and implement effective mitigation measures associated with large-scale development of hydropower.** There is an urgent need to enhance the capacity of the NEC in undertaking cumulative and strategic environment assessments of river basins identified for hydropower development in addition to the project level environment impact assessment studies undertaken as part of project preparation (para. 134). This will enable the NEC to introduce effective measures to introduce river basin-wide mitigation measures. Given the capacity and skill shortages in Bhutan, ADB may consider complementing TA for specific studies with long-term resident advisers on environmental safeguards to key institutions such as the NEC and DGPC as a follow-up to the ongoing Capacity Building of the National Environment Commission in Climate Change TA (footnote 38).

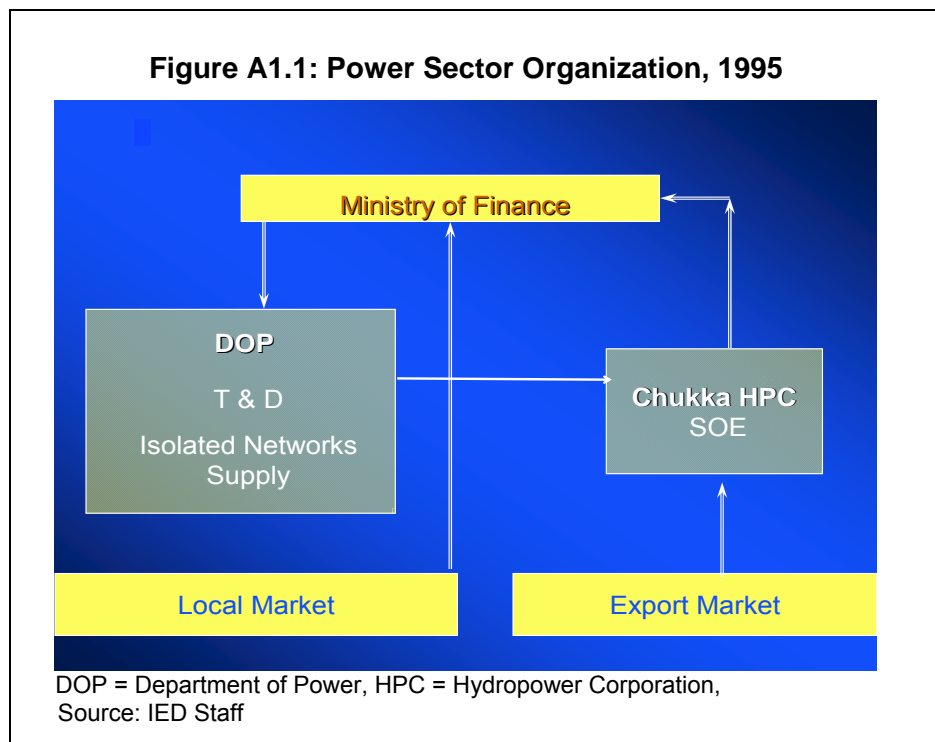
## OVERVIEW OF BHUTAN'S POWER SECTOR, 1995–2009

### A. Status of Power Sector prior to 1995

1. Electricity was introduced to Bhutan in the 1960s when diesel generating sets were installed in major towns, including Thimphu. Starting in 1967, mini hydropower plants (HPPs) were installed to complement the diesel generating sets where possible with the assistance of the Government of India. Several towns in southern Bhutan were electrified using connections to neighboring Indian states (i.e., West Bengal and Assam). Electricity supply in Bhutan in the 1990s, including the operation of mini HPPs and diesel power plants, was the responsibility of the Department of Power (DOP), which was part of the Ministry of Trade and Investment and functioned as part of the government.

2. A major turning point in the overall development of the power sector was the commissioning of the run-of-river 318 megawatt (MW) Chukka HPP in 1988 on the Wangdechu River, together with a transmission system to connect the power station to the major load centers in Bhutan and the Indian power grid. The project was implemented as a joint venture between the Government of India and the Government of Bhutan (the Chukka Hydro Power Authority) and incorporated in July 1991 under the Bhutan Companies Act 1989 as the Chukka Hydro Power Corporation (CHPC). The Chukka HPP was funded by the Government of India (60% grant and 40% loan).

3. The organizational structure and cash flows of the power sector as of 1995 are shown in Figure A1.1. The operational and investment expenses of the DOP were funded directly from the national budget by the Ministry of Finance, which was the recipient of funds collected from domestic consumers and dividends from the profits generated by CHPC's sales. The payments flow from the DOP to CHPC represents purchases of power used by the DOP to supply the domestic network.



4. During 1998–1995, over 90% of the electricity generated from Chukka HPP was exported to India and electricity exports became the largest foreign exchange earner. During 1987–1992, several mini and micro HPPs were commissioned with the assistance of Japan in relatively remote areas. The country's total generation capacity amounted to 338 MW, consisting of 318 MW from Chukka HPP, 13 MW from diesel plants, and 7 MW from mini/micro HPPs. In 1995, Bhutan's power transmission and distribution network comprised (i) an interconnected grid of 220 kilovolt (kV) transmission lines connecting Chukka HPP with India and the two main cities of Bhutan (Thimphu and Phuntsholing) and a 66 kV network connecting several towns in the west of the country to Chukka HPP; (ii) several 33 kV connections linking border areas with the Indian states of Assam and West Bengal; and (iii) isolated network supplying other towns and surrounding areas using diesel and mini HPPs. At the end of 1994, 37 towns and 282 villages were electrified and the total number of consumers was about 20,000 including over 16,500 residential consumers. The rate of electrification was about 16%.

5. Domestic demand for electricity was about 280 gigawatt-hours (GWh) in 1995; Chukka HPP provided over 97% of the demand and mini hydro and diesel plants provided about 12 GWh. The average generation of Chukka HPP was about 1,800 GWh and around 1,500 GWh was exported to India. During the early 1990s, several energy-intensive industries were set up in Bhutan because of the cheap electricity prices since the commissioning of Chukka HPP, and these industries consumed about 80% of the domestic power consumption. Domestic electricity prices were set at Nu0.4 per kilowatt-hour (kWh) and the power export to India was priced at Nu0.5/kWh. In 1995, domestic prices were increased to the same rate as the export prices.

## **B. Power Sector Performance, 1995–2002**

6. The power sector faced challenges of financing and implementing a capital-intensive rural electrification program in a relatively isolated and mountainous region, and attracting investments to export-oriented HPPs as the country's major economic growth driver. In the generation sector, the Government of India agreed to organize and finance (i) Tala Hydro Power Project (1,020 MW),<sup>1</sup> and (ii) Kurichu Hydro Power Project (45 MW). Construction of Tala HPP started in 1997 and ended in 2007, 2 years behind schedule. Basochhu Hydro Power Project (60.8 MW) started operations in 2001, funded with assistance from Austria. The implementation of these hydropower projects was a noteworthy accomplishment. Several more energy-intensive industries were attracted to Bhutan during 1995–1997, the share of industrial consumption was 82% in 1997, and domestic electricity consumption increased to 366 GWh in 1997 compared to 280 MW in 1995.

7. The rate of rural electrification increased significantly with the approval of the first ADB loan for rural electrification in 1995.<sup>2</sup> Prior to 1995, rural electrification was carried out in an ad hoc manner depending on the availability of bilateral donor assistance. During the 7th plan, 1992–1997 over 5,500 households were electrified with the assistance of ADB (3,000 households), the Netherlands (1,550 households), and India (850 households); the remainder were electrified with domestic financing. The electrification rate increased to 22% by 1997 from 16% in 1994. The mountainous terrain, lack of road access, and low population density resulted in a high capital cost per consumer connection and slowed the rate of network

<sup>1</sup> Tala was estimated to cost \$670 million and be funded with a 60% grant and 40% loan at 9% per annum.

<sup>2</sup> ADB. 1995. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for the Rural Electrification Project*. Manila.

expansion because of logistical problems. The institutional setup of the power sector as a government department with civil service regulations governing procurement and expenditure management, and the dependence on fiscal allocations for both capital and operational expenses, complicated implementation of the rural electrification program.

8. The rural electrification program was expanded during the 8th plan, 1997–2002 and about 10,000 households were electrified at a cost of about \$15 million under the plan. The second ADB loan approved in 1999 (Sustainable Rural Electrification Project)<sup>3</sup> financed the electrification of 7,680 households as well as bilateral financial assistance from the Netherlands (500 households), India (1,000 households), and Austria (200 households). As a result, the electrification rate reached 27% by 2002 and the total number of consumers reached 38,700 by 2002 compared to 21,800 in 1995. Domestic consumption increased to over 500 GWh by 2002. The key aspects of Bhutan's power sector during 1995–2002 are summarized in Table A1.1.

**Table A1.1: Bhutan's Power Sector Performance, 1995–2002**

<b>Sector Performance Indicator</b>	<b>1995</b>	<b>1997</b>	<b>1999</b>	<b>2002</b>
Installed Capacity (MW)				
Large HPP	336	336	396	420
Mini hydros	6.1	8.3	8.3	8.7
Diesel	12.3	12.3	12.3	16.4
Domestic Energy Supply (GWh)				
Chukka	286.8	360.6	397.0	534.2
Mini hydro	5.9	10.2	13.1	15.7
Diesel	0.2	0.1	0.1	0.5
Power imports	5.4	7.0	8.1	6.9
Power Exports (GWh)	1,328	1,466	1,625	1,508
Domestic Energy Sales (GWh)	281	366	396	510
Transmission & Distribution losses	7.3%	4.4%	6.5%	11.8%
Domestic Peak Demand (MW)	70.4	72	80	92.6
Number of Consumers	21,800	30,300	33,700	38,700
Number of Villages Electrified	297	363	443	690
Domestic Revenues (Nu million)	108	178	236	381
Average Tariff (Nu/kWh)	0.38	0.49	0.60	0.75
Export Prices (Nu/kWh)	0.5	1.0	1.5	1.5

HPP = hydropower plants, GWh – gigawatt hour, kWh = kilowatt hour, MW = megawatt.

Source: IED staff estimates based on ADB official documents.

9. The salient features during the period leading up to the restructuring/reforms of 2002 were as follows.

<sup>3</sup> ADB. 1999. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for the Sustainable Rural Electrification*. Manila.

## 1. Power Supply Functions

- (i) Modest imports from India were required to assist CHPC in meeting peak demand in the dry season and to help supply isolated eastern areas that were connected to Bhutan's grid via the Indian grid.
- (ii) The operation of transmission network was divided between the DOP (domestic) and CHPC (mainly export).
- (iii) The DOP was responsible for the supply of electricity to most domestic consumers (other than some supplied directly by CHPC) but depended on the Ministry of Finance for operational and investment expenses.

## 2. Regulatory and Legal Framework

- (i) The DOP formulated policy, undertook power system planning, and managed domestic power supply.
- (ii) CHPC was managed as a state-owned company.
- (iii) Domestic prices were set administratively—the main tariff setting criterion was the affordability of electricity to domestic and industrial consumers.

## 3. Financial Management

- (i) The Ministry of Finance funded the DOP as a government department and the DOP was not required to make a profit or earn a return on its assets used for domestic power distribution.
- (ii) CHPC was controlled by ex-officio directors with mixed social and commercial objectives, i.e., power was sold to the DOP at a discount to the export price to India on terms agreed with India.
- (iii) The low price charged by CHPC for domestic power supply enabled lower domestic tariffs.
- (iv) The financial performance of the domestic power supply system was unclear as there were no registers of power system assets and no financial accounts for power system operations.

10. Export returns were boosted by tariff increases—the export tariffs set in 1989 yielded a modest average return to CHPC of Rs0.19 per kWh, but by 1995 the tariff had been raised to Rs0.50 per kWh. In April 1997, the export tariff was raised to Rs1.00/kWh and in July 1999 to Rs1.50/kWh. These increases significantly raised the economic opportunity cost of domestic power supply and had a beneficial impact on CHPC's earnings, government revenues, and on Bhutan's GDP. However, export tariffs were still well below the level (estimated in 1999 at Nu3/kWh)<sup>4</sup> that would attract private investment for power generation. The export prices fully cover the operational cost and debt service of CHPC because of the 60% grant financing provided by the Government of India.

11. The government did not adjust domestic power prices (i.e., average domestic tariff from Nu0.38/kWh in 1995 to Nu0.75/kWh by 2002) in line with the increasing economic value of electricity (i.e., the opportunity cost of domestic power supply with electrical energy valued at its export prices) or increase prices sufficiently to recover the costs of its expanding domestic network and the costs of supplying domestic industries—the main driver of domestic demand.

<sup>4</sup> ADB. 1999. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for Sustainable Rural Electrification*. Manila.



At the start of 1995, the power prices paid by India for Bhutan's surplus electricity (Nu0.37/kWh equivalent) were on a par with the prevailing local market retail tariff (Nu0.4/kWh). However, by July 2002 when the export power tariff was set at Nu1.50/kWh, the domestic retail tariff (Nu0.75/kWh) was below the opportunity cost of energy and well below total costs of supply.

### C. Power Sector Performance, 2003–2009

12. The operational and financial performance of Bhutan's power sector improved significantly with the corporatization of domestic power supply (i.e., transmission and distribution) under Bhutan Power Corporation (BPC) and the power sector policy making under the Department of Energy (DOE) in 2002, as provided under the Electricity Act, 2001. Power sector regulation was entrusted to Bhutan Electricity Authority (BEA), which was established under the DOE in 2006 and made a financially independent agency in July 2007. The export-oriented HPPs, except Tala HPP, were consolidated under Druk Green Power Company (DGPC) in 2007; Tala HPP was brought under DGPC in 2009.

13. The installed power generation capacity has increased by 1,044 MW with the commissioning of Tala HPP (1,020 MW) and the second phase of Basochuu HPP (24 MW) in 2004. Total power generation has increased significantly since 2007 as a result of the commissioning of Tala HPP from 2,427 GWh in 2004 to 6,925 GWh in 2009. The energy balance of Bhutan's power sector since 2004 is shown in Table A1.2.

**Table A1.2: Energy Balance for Bhutan Power Sector, 2004–2009**

<b>Power Generation Data</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>
Generation Output (GWh)						
Chukka HPP ( 336 MW)	1,928	1,831	1,878	1,788	1,802	1,808
Basochuu HPP (64 MW)	131	304	327	314	336	323
Kuruchuu HPP ( 60 MW)	345	366	365	380	386	370
Tala HPP ( 1,020 MW)		164	1,080	3,919	4,611	4,396
Mini Hydro	20	17	20	21	23	25
Diesel Plants	1	1	1	2	1	
Power Imports (GWh)	2	2	3	3	3	3
Total Power Supply (GWh)	2,427	2,685	3,673	6,427	7,162	6,925
Power Exports to India (GWh)	1,759	1,777	2,903	5,453	5,922	5,405
Power Sales to BPC (GWh)	680	708	715	947	1,125	1,414
Exports as a % of total generation	73.2%	66.7%	79.0%	84.8%	82.7%	78.1%
Power Sales to BPC as a % of Generation	28.0%	26.4%	19.5%	14.7%	15.7%	20.4%

BPC = Bhutan Power Corporation, gWh = gigawatt hour, MW = megawatt.

Source: Independent Evaluation Department staff estimates.

14. After the commissioning of Tala HPP in 2006, with the assistance of ADB, the government prepared the sustainable hydropower policy to attract private investments to export-oriented hydropower projects. The 114 MW Dagachhu HPP was structured as a public-private partnership (PPP) to pilot test the new policy and it is expected to be commissioned in 2014. The government has also entered into a memorandum of understanding with the Government of India to develop 10,000 MW of hydropower capacity consisting of 11 mega-projects under bilateral financing from the Government of India and through the joint venture modality with Indian public sector entities. The 1,200 MW Punatsangchhu-I HPP under the 10,000 MW program is under construction with Government of India financing, and it is expected to be

commissioned in 2016; two other projects (the 990 MW Punatsangchhu-II HPP and the 720 MW Mangdechhu HPP) are expected to begin construction in 2011 with Government of India financing and be commissioned in 2019. Details of the HPPs under construction and at an advanced stage of preparation are summarized in Table A1.3.

**Table A1.3: Details of Hydropower Projects to be Commissioned, 2010–2020**

Projects	Output (GWh)	Cost (\$ million)	Financing Modality <sup>a</sup>	Construction Schedule
Dagachhu HPP 114 MW		201	Joint venture (Tata Power and DGPC) debt–equity 70: 30 and ADB OCR loan and Austrian export credit	2008–2014
Punatsangchhu –I 1,200 MW	5,700	850	Government of India financing (60% loan at 10% interest rate and 40% grant financing)	2008–2016
Punatsangchhu –II 990 MW	4,150	1,215	Government of India financing (70% loan at 11% interest rate and 30% grant financing)	2012–2019
Mangdechhu 720 MW	2,920	875	Government of India financing (70% loan at 11% interest rate and 30% grant financing)	2012–2019

<sup>a</sup>The financial structure of Punatsangchhu–II HPP and Mangdechhu HPP are indicative and subject to finalization. ADB = Asian Development Bank, DGPC= Druk Green Power Corporation, HPP = hydropower plants, MW = megawatt.

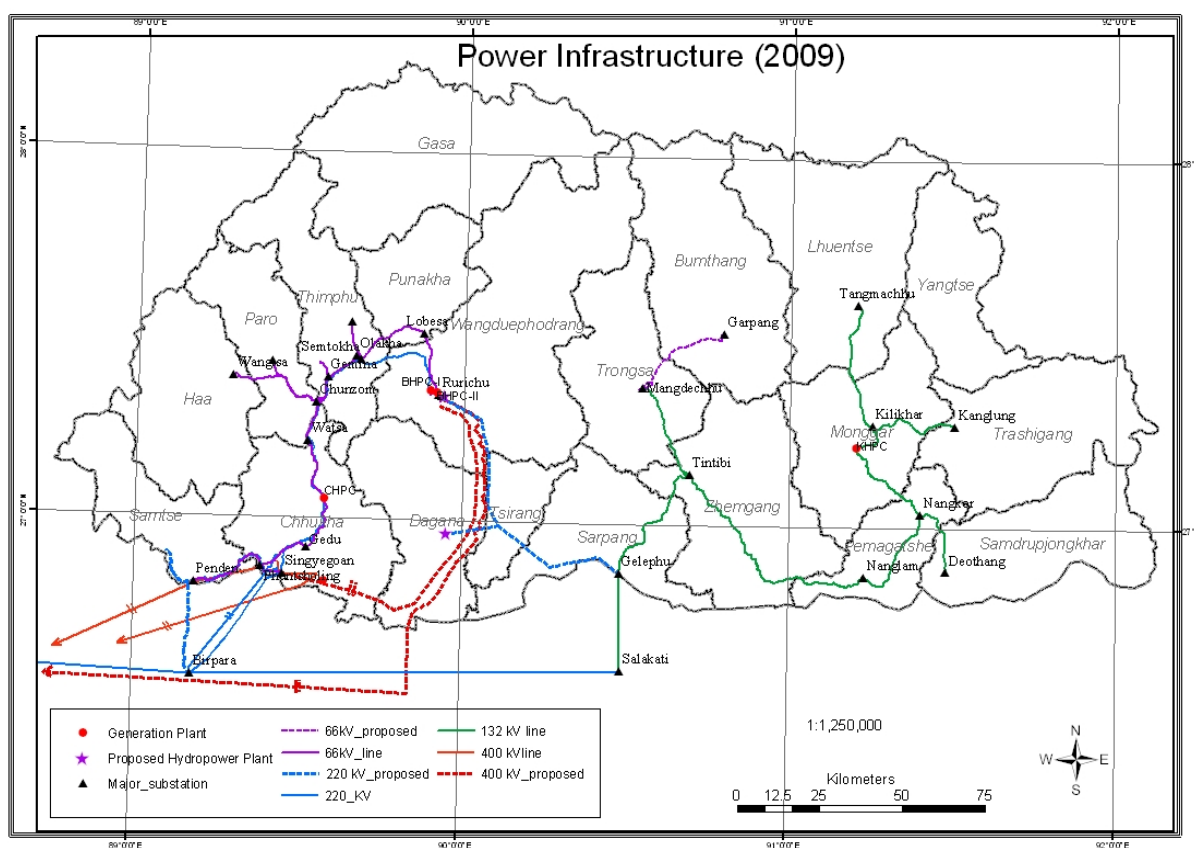
Source: IED Staff estimates.

15. Since 2002, BPC has taken over responsibility for developing Bhutan’s high voltage power transmission system. With the commissioning of the Tala HPP project in 2007, 400 kV transmission lines were built to evacuate power to India via Malbase 400/220 kV substation with supply connections to industries located in southern Bhutan. The 220 kV network was extended from Simtokha to Ruchiru to evacuate power from Basochuu HPP commissioned in 2004. As of 2009, Bhutan had two separate power grids: (i) a 220 kV/66 kV network connecting load centers in western Bhutan (Thimphu, Puntsholing, Paro, and Punakaka) with Chukka HPP, Basochuu HPP, and with connectivity to 400 kV transmission lines evacuating power at Malbase; and (ii) a 132 kV network in eastern Bhutan connecting Kuruchhu HPP with India and load centers in Monggar, Trongsa, and Zhemgang.

16. The 220 KV transmission network is being extended from Ruchiru to Tsirang (Dagna) to provide connectivity to Dagachhu HPP, which is under construction. It will be further extended to connect with the eastern network at Gelephu substation. The Punatsangchhu 1 and II HPP projects and the Mangedechuu HPP will be connected to Alipur Duar pooling substation in India through dedicated 400 kV double circuit transmission lines to be built during 2014–2019.

17. As Bhutan’s hydropower is mainly generated from run-of-river plants with little storage, relatively little generation occurs during the winter months of December–March and most of the generation occurs during June–October. At the same time, the residential demand doubles during winter compared to summer. Although the impact of residential demand on the overall domestic demand is less in Bhutan, as the residential sector contributes less than 20% of the total domestic demand, Bhutan is suffering from capacity shortages during the peak time of winter months until Dagachhu and Punatshanchuu I HPPs are commissioned as the firm capacity available during winter is not sufficient to meet the peak demand.

Figure A1.2: Bhutan Power Transmission Grid, 2009



Source: Department of Energy Bhutan.

18. Since the formation of BPC in 2002, the rural electrification program has been accelerated to achieve the 60% electrification target set in the 9th plan, 2002–2007. About 16,000 households have been electrified at a cost of around \$24 million (average cost of \$1,500 per household). The overall electrification rate increased to 60% by 2009 compared to 27% in 2002, and over 50% of households in rural areas and over 90% of urban households are electrified. The ADB-financed Rural Electrification and Network Expansion Project<sup>5</sup> has contributed to over 9,200 household connections; bilateral funding from the Netherlands contributed 4,100 household connections and Austria contributed 1,650 household connections. The government, through budgetary allocations, and BPC, using its retained earnings, have financed 1,100 more households during the 9th plan period.

19. The 10th plan originally targeted electrification of a further 25,000 households to achieve an electrification rate of 80%. The electrification program under the 10th plan is estimated to cost \$82 million (average cost of \$3,280 per household) as the households remaining to be electrified are in more remote areas. The rural electrification program under the 10th plan is expected to be financed by Japan International Cooperation Agency (\$31.2 million), ADB under Grant 0119 (\$23.8 million), Austrian bilateral financing (\$2.9 million), and the government (\$24.5 million). Development partner funding for the 25,000 households program is fully committed and the implementation is in progress.

<sup>5</sup> ADB. 2003. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for the Rural Electrification and Network Expansion*. Manila.

20. The government in 2008 increased the target for electrification under the 10th plan by 18,700 to achieve the ambitious target of 100% electrification by 2013. It is estimated that 8,950 households will be electrified by extending the distribution network to remote areas at a cost of \$33 million (\$3,700 per household), 6,000 households within the existing network at a cost of \$10.9 million (\$1,800 per household), and an additional 3,600 households using solar photovoltaic systems and about 100 households using off-grid hydro plants. The government is undertaking preparation work for the accelerated rural electrification program to achieve 100% electrification. As the funding is not yet fully committed for the accelerated rural electrification program, it is unlikely that the 100% electrification target will be achieved by 2013. However, given Bhutan's impressive record of project implementation, it is likely that it will achieve 100% electrification by 2016.

**Table A1.4: Breakdown of Electricity Sales Since 2004**

Item	2004	2005	2006	2007	2008	2009
No. of Residential Consumers						
Rural	24,504	26,179	34,225	40,954	43,709	47,755
Urban	17,077	18,963	20,794	22,973	25,531	27,288
Residential Sales (GWh)	80.4	89.0	97.6	108.5	122.2	130.7
Other Low Voltage Sales (GWh)	84	102	117	122	137	144
High Voltage Industrial Sales (GWh)	424	429	446	672	813	1,067
Total Electricity Sales (GWh)	589	619	660	902	1,072	1,344
Growth in Residential Sales		11.2%	9.7%	11.1%	12.6%	6.9%
Growth in total electricity Sales		3.3%	6.6%	36.7%	18.8%	25.4%

GWh = gigawatt-hour.

Source :Bhutan Power Corporation.

21. As a result of the rural electrification program undertaken during 2004–2009, the total number of rural consumers increased at an annualized rate of 14.3% and the total number of residential consumers increased at an annualized rate of 12.5% from 2004 to 2009. Electricity sales to the residential sector increased at an annualized rate of 10.2% and total electricity sales increased at an annualized rate of 17.9% as a result of the large increase in electricity sales to the industrial sector during 2007–2009 after the commissioning of Tala HPP.

**ADB ASSISTANCE PROGRAM TO BHUTAN'S ENERGY SECTOR, 1993–2009**

Development Impacts Contributed to by Sector Outcomes Supported by ADB	Outcomes Achieved Resulting from Outputs of ADB's Cumulative Interventions	Outputs of ADB Interventions in the Sector	ADB Interventions (Inputs)	Inputs from other Development Partners
<b>1. Supporting Institutional and Legal Reforms to Increase the Commercial Orientation of the Power Sector</b>				
<p>Enhanced commercial orientation and cost recovery as reflected in the increased profitability and net contributions to government revenues</p> <p>Improved institutional capacity to enable power sector to be the main growth driver of the economy by exploiting the country's hydropower resources in a sustainable manner and for providing access to affordable and reliable energy supply</p> <p>The net profits of BPC has reached Nu669 million in 2008 and contributed Nu5,400 million (37% of total revenues) to fiscal revenues in 2008. The power sector has grown at an average rate of 16.7% during 1997–2007 and the rate of electrification reached 60% by 2009.</p>	<p>The power sector was restructured in 2002 to delineate the responsibilities for utility management (BPC), regulation (BEA), and policy formulation and state oversight (DOE). The operations of HPPs are consolidated under DGPC to enable pooling of expertise and resources to act as counterparty to foreign partners.</p> <p>The institutional capacity of newly created agencies has been enhanced for improved utility management (BPC), establishing a transparent and cost-reflective tariff regime (BEA), and effective policy making in the sector (DOE). This has enabled the sector to attract investments to the hydropower sector from both development partners and the private sector and to scale up the rural electrification program.</p> <p>The sector is well on course to achieve the ambitious targets sets for completion of</p>	<p>Preparation of action plan on sector restructuring</p> <p>Capacity building of DOP on financial management was a prerequisite for its corporatization</p> <p>Tariff study to ascertain the cost of electricity supply and to form a basis for tariff adjustments to ensure the financial viability of the power sector after its corporatization</p> <p>Recommendations of sector restructuring, including the delineation of responsibilities among the newly created entities and establishment of a legal and regulatory framework</p>	<p>Power Sector Institutional and Financial Development TA<sup>a</sup> and Rural Electrification Project<sup>b</sup> (through loan covenants requiring adoption of action plan for sector reforms)</p> <p>Power Sector Institutional and Financial Development TA and Institutional and Financial Development of Department of Power TA<sup>c</sup></p> <p>Institutional and Financial Development of Department of Power TA and Rural Electrification Project through loan covenants requiring the adoption of action plan for tariff adjustments</p> <p>Policy and Legal Framework for Power Sector Development TA<sup>d</sup> and Sustainable Rural Electrification Project<sup>e</sup> loan covenants requiring corporatization and tariff adjustments)</p>	

Development Impacts Contributed to by Sector Outcomes Supported by ADB	Outcomes Achieved Resulting from Outputs of ADB's Cumulative Interventions	Outputs of ADB Interventions in the Sector	ADB Interventions (Inputs)	Inputs from other Development Partners
	100% of the rural electrification program by 2013 possibly with a delay of 1- 2 years andy 2020.	<p>Facilitating corporatization of DOP's utility function and establishing BPC as a financially viable entity with appropriate tariff adjustments</p> <p>Supporting the establishment of BEA as the regulatory agency with capacity building on technical regulation</p> <p>Supporting the consolidation of HPPs by establishing DGPC with an appropriate organizational structure</p> <p>Introducing state-of-the-art utility management practices such as budgetary controls, cost center accounting, integrated inventory control, and enterprise resource planning to BPC</p>	<p>Corporatization of the Department of Power<sup>f</sup> TA for corporatization of DOP and establishing BPC</p> <p>Capacity Building of the Bhutan Electricity Authority TA<sup>g</sup> and Rural Electrification and Network Expansion Project<sup>j</sup> through loan covenants requiring the establishment of BEA</p> <p>Establishing the Druk Hydropower CorporationTA<sup>h</sup></p> <p>Capacity Building for the Bhutan Power Corporation TA<sup>i</sup></p>	Norwegian bilateral support for capacity building on economic regulation to BEA
<b>2. Supporting the Rural Electrification Program</b>				
<p>Improved living conditions, including better health and education outcomes for rural communities</p> <p>The human development index increased from 0.521 in 1998 to 0.613 in 2006.</p>	Significant scaling up of the rural electrification program through increased financial resources and institutional capacity. This is indicated by 5,500 households electrified during the 7th Five Year Plan, 1992–1997; 10,000 during	<p>Financing of electrification of over 3,000 households during the 7th plan.</p> <p>Financing of electrification of</p>	<p>Rural Electrification Project<sup>b</sup> for scaling up rural electrification under the 7th plan</p> <p>Sustainable Rural</p>	The Netherlands (1,550 households) and India (850 households) contributed to rural electrification during the 7th plan.

Development Impacts Contributed to by Sector Outcomes Supported by ADB	Outcomes Achieved Resulting from Outputs of ADB's Cumulative Interventions	Outputs of ADB Interventions in the Sector	ADB Interventions (Inputs)	Inputs from other Development Partners
<p>The literacy rate rose to 59.5%. Infant mortality rates fell from 79.7 in 1997 to 40.1 in 2007, and maternal mortality rates fell from 96.9 in 1997 to 61.5 in 2007.</p> <p>Increase in economic activities in rural areas and reduction in rural poverty through the use of electricity for income-generating activities</p> <p>Poverty in Bhutan has reduced from 36% in 2000 to 23% by 2007 and GDP has grown at an average rate of 8.2% during 1997–2007.</p>	<p>the 8th plan, 1997–2002; 16,000 under the 9th plan, 2002–2007; and over 25,000 to be electrified during the 10th plan, 2008–2013. As a result, the rate of electrification increased from around 17% in 1995 to close to 60% by 2008.</p>	<p>over 7,650 households during the 8th plan.</p> <p>Financing of electrification of over 9,200 households during the 9th plan.</p> <p>Financing of electrification of over 8,800 households during the 10th plan</p>	<p>Electrification Project<sup>e</sup> for maintaining the momentum of the rural electrification program under the 8th plan</p> <p>Rural Electrification and Network Expansion Project<sup>i</sup> for continuing the rural electrification program with emphasis on the poor under the 9th plan</p> <p>Green Power Development Project<sup>k</sup> for extending the electricity network to more remote areas under the 10th plan</p>	<p>The Netherlands (500 households), India (1,000 households), and Austria (200 households) contributed to rural electrification during the 8th plan. India also financed the 132 kV transmission systems in the eastern part of the country during the 8th plan.</p> <p>The Netherlands (4,100 households) and Austria (1,650 households) contributed to rural electrification during the 9th plan. Japan financed the preparation of the rural electrification master plan during the 9th plan.</p> <p>Japan (15,000 households) and Austria (800 households) contributed to rural electrification during the 10th plan.</p>

Development Impacts Contributed to by Sector Outcomes Supported by ADB	Outcomes Achieved Resulting from Outputs of ADB's Cumulative Interventions	Outputs of ADB Interventions in the Sector	ADB Interventions (Inputs)	Inputs from other Development Partners
		Introducing new institutional and technical approaches for electrifying the remote communities using off-grid renewable energy technologies	Accelerated Rural Electrification TA <sup>l</sup>	
<b>3. Promoting Investments in the Hydropower Sector</b>				
<p>Increased contribution to national income through power exports and promoting investments in energy-intensive manufacturing industries.</p> <p>The power export in 2008 reached 5,400 GWh compared to 1,300 GWh in 1995 and contributed to 45% of exports and 37.5% of fiscal revenues in 2008. GDP growth averaged 8.2%, the manufacturing sector growth rate averaged 7.1% during 1997–2007, and the electricity sector growth rate averaged 16.7% during the same period.</p>	<p>Established an enabling environment for diversifying the sources of financing for the hydropower sector by formulating a policy framework</p> <p>Demonstrated the feasibility of PPPs in the hydropower sector</p> <p>Enhanced the capacity of relevant government agencies (DOE and DGPC) for structuring further PPP transactions</p>	<p>Preparation of a policy framework for mobilizing private sector financing for the hydropower sector in a sustainable manner</p> <p>Financed construction of the 114 MW Dagachhu HPP as a PPP—the project is under construction</p> <p>Preparation of follow-up projects to Dagachhu HPP, institutional capacity building to DGPC, and assisting DOE in structuring PPP transactions</p>	<p>Although this was included as a component in Policy and Legal Framework for Power Sector Development TA, it was finally completed under Preparing the Bhutan Power Development Project<sup>m</sup></p> <p>Green Power Development<sup>n</sup> financed government equity and project debt for Dagachhu HPP</p> <p>Rural Renewable Energy Development TA<sup>o</sup> for capacity building on hydropower project development</p>	<p>India has financed the 61 MW Kurichhu HPP commissioned in 1999.</p> <p>Austria financed construction of the 64 MW Basochhu HPP commissioned in two stages in 2002 and 2004.</p> <p>India financed the 1,020 MW Tala HPP commissioned in 2006.</p> <p>Austria cofinanced the Dagachhu HPP.</p> <p>Japan and Norway has undertaken the feasibility studies for Punatsangchhu and Mangdechhu HPPs.</p> <p>India has committed financing for</p>



Development Impacts Contributed to by Sector Outcomes Supported by ADB	Outcomes Achieved Resulting from Outputs of ADB's Cumulative Interventions	Outputs of ADB Interventions in the Sector	ADB Interventions (Inputs)	Inputs from other Development Partners
				Punatsangchhu I (1,096 MW) HPP. The project is under construction.

ADB = Asian Development Bank, BPC = Bhutan Power Corporation, BEA = Bhutan Electricity Authority, DOE = Department of Energy, DGPC = Druk Green Power Corporation, DOP = Department of Energy, TA = technical assistance, MW = megawatt, GDP = gross domestic product, kV = kilo volt, GWh = gigawatt-hour, PPP = public-private partnership, HPP = hydropower plant.

<sup>a</sup> ADB. 1992. *Technical Assistance to Bhutan for Power Sector Institutional and Financial Development*. Manila (TA 1729).

<sup>b</sup> ADB. 1995. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for the Rural Electrification Project*. Manila (Loan 1375).

<sup>c</sup> ADB. 2003. *Technical Assistance to Bhutan for the Institutional and Financial Development of Department of Power*. Manila (TA 2400).

<sup>d</sup> ADB. 1998. *Technical Assistance to Bhutan for Policy and Legal Framework for Power Sector Development*. Manila (TA 3112).

<sup>e</sup> ADB. 1999. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for Sustainable Rural Electrification*. Manila (Loan 1712).

<sup>f</sup> ADB. 2003. *Technical Assistance to Bhutan for the Corporatization of Department of Power*. Manila (TA 3307).

<sup>g</sup> ADB. 2003. *Technical Assistance to Bhutan for Capacity Building of the Bhutan Electricity Authority*. Manila (TA 4188).

<sup>h</sup> ADB. 2003. *Technical Assistance to Bhutan for Establishing the Druk Hydropower Corporation*. Manila (TA 4189).

<sup>i</sup> ADB. 2005. *Technical Assistance to Bhutan for Capacity Building for the Bhutan Power Corporation*. Manila (TA 4599).

<sup>j</sup> ADB. 2003. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for Rural Electrification and Network Expansion*. Manila (Loan 2009).

<sup>k</sup> ADB. 2008. *Grant Assistance to Bhutan for the Green Power Development*. Manila (Grant 0119).

<sup>l</sup> ADB. 2005. *Technical Assistance to Bhutan for Accelerated Rural Electrification*. Manila (TA 4766).

<sup>m</sup> ADB. 2007. *Technical Assistance to Bhutan for Preparing the Bhutan Power Development Project*. Manila (TA 4916).

<sup>n</sup> ADB. 2008. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for Green Power Development*. Manila (Loans 2463/2464).

<sup>p</sup> ADB. 2009. *Technical Assistance to Bhutan for Rural Renewable Energy Development*. Manila (TA 7318).

Source: IED Staff Estimates.

## ASSESSMENT OF LENDING INTERVENTIONS TO BHUTAN'S POWER SECTOR

### A. Rural Electrification Project<sup>1</sup>

#### 1. Basic Project Data

Date Approved	19 September 1995
Date Effective	8 February 1996
Date Closed	6 April 2000
Approved Amount	\$7.5 million
Amount Disbursed	\$6.64 million
Attached advisory technical assistance (TA)	Institutional and Financial Development of the Department of Power (DOP): TA 2400
Executing Agency	DOP

1. **Project objectives.** The objective was to provide indigenously generated hydropower to the domestic market in Bhutan to promote economic development, reduce the domestic need for fuel wood, and cut expenditure on imported kerosene.

2. **Project components.** The project consisted of the following components:

- (i) installation of 150 kilometers (km) of medium voltage lines, including 32 pole-mounted load break switches and 12 auto-reclosers;
- (ii) two 66/33 kilovolt (kV) substations;
- (iii) service connections for 3,100 households in seven districts;
- (iv) 25 circuit-kilometers of feeder and 5 circuit-kilometers of spur 11 kV overhead lines;
- (v) 206 km of low-voltage bundled conductors;
- (vi) 8,090 kilovolt-amperes (kVA) of 33/0.4 kV and 1,170 kVA of 11 kV/0.4 pole-mounted distribution transformers (the actual capacity of substations installed was 4,900 kVA); and
- (vii) supply of vehicles, office equipment, and a warehouse.

3. **Implementation.** The Rural Electrification Project required scaling up of the DOP's project implementation capabilities. The project was the first Asian Development Bank (ADB) loan to the sector and the DOP had to become familiar with ADB procurement procedures. This lack of familiarity resulted in procurement delays but project implementation seminars and ADB assistance expedited the learning process. Strong ownership of the DOP helped it to overcome gestation difficulties and the DOP was well-versed in ADB procedures by the next rural electrification project.

4. The project introduced the DOP to new, but not necessarily better, designs. Some new equipment introduced was not compatible with the country's terrain and did not take into account that equipment had to be installed in mountainous areas with no access roads. Auto-reclosers were introduced but the type that was installed was more sophisticated than the type recommended by the feasibility study. The consultants were unable to calibrate the units properly and the DOP had no capability to operate or calibrate them. These auto-reclosers were decommissioned after project completion.

<sup>1</sup> ADB. 1995. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for the Rural Electrification Project*. Manila.

5. A transformer supplied by a contractor was too heavy for Bhutan's conditions, since in some areas transformers need to be transported manually. The performance of smaller (below 50 kVA) transformers was not satisfactory, resulting in frequent failures.

6. **Assessment at project completion and post-project completion.** The project was completed in December 1999 and financially closed in April 2000. The project completion report (PCR)<sup>2</sup> circulated in January 2002 rated the project *successful*.

7. A post-project completion evaluation was carried out in 2003, 3 years after project completion. The findings of the evaluation are recorded in a project performance audit report (PPAR).<sup>3</sup> The PPAR agreed with the PCR findings that (i) the outputs produced were generally in line with those envisaged at approval, and (ii) the project was *successful*. While not explicitly disagreeing with the PCR's *satisfactory* rating of the consultant's performance, the PPAR highlighted DOP's dissatisfaction with the consultant because of the consultant's lack of familiarity with local conditions. The PCR and PPAR noted the commitment of the DOP in ensuring the successful completion of the project. The DOP overcame initial difficulties dealing with ADB procurement procedures.

8. **Overall project assessment.** The project is rated *relevant* to Bhutan's development needs and fully consistent with the government's 7th Five Year Plan, 1992–1997<sup>4</sup> and ADB's energy sector strategy for promoting access to modern forms of energy. The project has introduced the DOP to project management practices of multilateral development financial institutions for the first time, and facilitated policy dialogue for promoting institutional reforms and commercialization of energy sector. Although the technical design of some of the equipment was not appropriate for Bhutan, the overall project concept and implementation arrangements were appropriate to the circumstances prevailing in Bhutan at the time.

9. Despite the initial problems in procurement and implementation delays, the project is rated *effective* in achieving the electrification target of 3,100 households at the time of the PPAR (4 years after project completion). The project was also instrumental in preparing the DOP for significant scaling up of the rural electrification program in Bhutan, which happened after corporatization of the power sector.

10. Although the project economic internal rate of return (EIRR) computed for the PPAR is 12.5%, the project is rated *less efficient* because of implementation delays of 18 months. The cost per household connection (\$2,650 in 1998 prices) was significantly higher than the unit cost of electrification in Bhutan for subsequent ADB-financed projects serving more remote areas. This was mainly due to the inappropriate design by the loan-financed consultants.

11. There has been a significant improvement in the operational and financial performance of Bhutan's power sector as a result of the corporatization of the DOP in 2002. The successor entity to DOP (Bhutan Power Corporation [BPC]) is a highly competent and profitable agency under the prevailing government policy of providing electricity to BPC at a discount to export price. As the government is likely to continue this policy, the project outcomes are *most likely* to be sustainable.

<sup>2</sup> ADB. 2002. *Completion Report: Rural Electrification Project in Bhutan*. Manila.

<sup>3</sup> ADB. 2004. *Project Performance Audit Report: Rural Electrification Project in Bhutan*. Manila.

<sup>4</sup> Government of Bhutan. 1992. *Seventh Five Year Plan (1992–1997)*. Thimphu.

12. The overall assessment of the project is *successful*, as it has achieved its key development outcomes in a sustainable manner despite its less efficient technical design and implementation delays.

## B. Sustainable Rural Electrification Project<sup>5</sup>

### 1. Basic Project Data

Date Approved	25 November 1999
Date Effective	14 January 2000
Date Closed	12 January 2006
Approved Amount	\$10 million
Amount Disbursed	\$9.2 million
Attached advisory TA	Corporatization of the Division of Power (TA 3307)
Executing Agency	DOP (before 1 July 2002) BPC (after 30 June 2002)

13. **Project objectives.** The primary objectives of the Sustainable Rural Electrification Project were improved quality of life and enhanced income-generating activities to rural communities of Bhutan through access to the electricity network. The secondary objectives are improved education and health facilities to communities in remote areas through the use of solar power for public services, preservation of forestry resources by discouraging the use of fuel wood, and improved performance of the power distribution system by introducing the supervisory control and data acquisition (SCADA) system. The project also supported institutional reform of the power sector through the associated TA grant for Corporatization of the Division of Power.<sup>6</sup>

14. **Project components.** The project consisted of three major components:

- (i) Component A:
  - (a) expanding the medium voltage network (33 kV and 11 kV) by 390 km. At project completion, 416 km of medium voltage lines were installed;
  - (b) expanding the medium voltage network by 350 km—at project completion, 758 km of low voltage lines were installed;
  - (c) installing 9,926 kVA of medium voltage and low voltage substations—at project completion, 15,980 kVA of medium voltage and low voltage substation capacity was installed; and
  - (d) electrification of 6,000 households in 16 districts—at project completion, 8,090 connections were provided.
- (ii) Component B:
  - (a) installation of 28 solar systems for three remote districts for local community centers, including schools and hospitals—during project implementation, 100 solar systems were procured and provided to the district authorities for installation in community facilities.
- (iii) Component C:
  - (a) a small-scale pilot SCADA system for substations close to Thimpu—the scope of the SCADA system is expanded to include more substations as well as remote control of substations.

<sup>5</sup> ADB. 1999. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for the Sustainable Rural Electrification Project*. Manila.

<sup>6</sup> ADB. 1999. *Technical Assistance to Bhutan for Corporatization of the Division of Power*. Manila (TA 3307).

15. **Implementation.** At the time of loan effectiveness, the executing agency was the DOP. Following the unbundling of the DOP on 1 July 2002, BPC became the executing agency for the project. The change in institutional arrangements did not disrupt project implementation. Implementation consultants were not engaged for the Sustainable Rural Electrification Project as BPC considered that it had built sufficient capability from implementing the Rural Electrification Project to implement the project efficiently and effectively. Lessons learned from the Rural Electrification Project were incorporated in the technical design of the distribution network. Procurement problems encountered in the Rural Electrification Project, especially those related to packaging, were corrected under the Sustainable Rural Electrification Project.

16. Except for implementation of the SCADA system, all other project components were implemented on schedule. Installation of the SCADA system was completed after a delay of almost 3 years because of the need to revise the specification and the failure of the SCADA supplier to provide the equipment on time. The delay in the SCADA component had no impact on the other project components.

17. **Assessment at project completion.** The project was completed in December 2005 and financially closed in January 2006, with a delay of 21 months. The PCR,<sup>7</sup> circulated in September 2007, gave the project an overall rating of *successful*. It was also found to be *highly relevant, effective, efficient, and likely* to be sustainable.

18. Two project outputs fell short of expectations. One hundred solar panels were issued to district administration authorities for installation but no further monitoring was carried out. Some customers provided with solar panels have subsequently connected to the grid and the solar systems installed under the project have presumably been relocated. Provision of free housing kits under the project had limited success, partly because of (i) the limited capacity of the kits, which limits future increases in a household's electricity usage; and (ii) the social stigma that comes with being identified as poor and in need of charity.

19. **Overall project assessment.** The project is *relevant* to the government's strategy of rapid rural electrification under the 8th plan, 1997–2002 as a means to improving the living conditions of the rural population as well as to ADB's operational strategy for Bhutan for fostering pro-poor growth. The project also provided critical TA to facilitate the smooth unbundling of Bhutan's power sector and the establishment of BPC as a financially viable utility. However, some of the design features of the smaller components (i.e., free electrification kits for poor households and solar systems for community facilities in remote provinces) were not effective in Bhutan.

20. The project is *highly effective* as it exceeded its key development outcomes of providing 6,000 household connections by providing over 8,000 connections. The project has made a significant contribution to increasing the electrification rate from 24% to 32% during the 8th plan. Although the solar panels for community facilities in remote locations and electrification kits for poor households were not very effective, they constitute less than 1% of the total project cost and did not materially affect the overall effectiveness of the project. The associated TA for Corporatization of the Division of Power was *highly effective* in facilitating the establishment of BPC as a viable entity.

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<sup>7</sup> ADB. 2007. *Completion Report: Sustainable Rural Electrification Project in Bhutan*. Manila.

21. The project is rated *highly efficient* as it has exceeded its main outputs at a cost below the original estimate and within the original time schedule, except the SCADA system. The delay in SCADA system was due to the change in specifications to increase its functional utility to the expanding power system in Thimphu. The cost per household (\$1,340) is substantially lower than the cost per household under Loan 1375, and the EIRR of the project exceeded 12% (the threshold 12% EIRR is a per household cost of about \$2,700).

22. Given the strong financial and operational performance of BPC since its inception and the strong likelihood of continued supply of royalty energy for domestic supply at a deep discount to export prices, the project outcomes are *most likely* to be sustainable.

23. Based on the highly effective and highly efficient implementation of the project and its strong likelihood to be sustainable, the project is rated *highly successful*. The lack of acceptance of electrification kits provided under the project by poor households did not affect the overall success of the project, as most of these households obtained electricity connections at their own cost.

### C. Rural Electrification and Network Expansion Project<sup>8</sup>

#### 1. Basic Project Data

Date Approved	30 September 2003
Date Effective	31 March 2004
Date Closed	19 December 2006
Approved Amount	\$9.4 million
Amount Disbursed	\$9.759 million
Attached advisory TA	Capacity Building of the Bhutan Electricity Authority (TA 4188) Establishing the Druk Hydropower Corporation (TA 4189)
Executing Agency	BPC

24. **Project objectives.** The objectives of the Rural Electrification and Network Expansion Project were (i) to expand the availability of electricity from existing transmission and distribution networks to connect about 8,000 new rural consumers in eight of Bhutan's 20 districts as part of the 9th plan target of 15,000 household connections; and (ii) to promote local economic development through the provision of electricity to previously unserved rural areas.

25. **Project components.** The project consisted of the following components:

- (i) 390 km of 33 kV overhead lines and 300 km of 11 kV overhead lines (210 km of 33 kV lines and 227 km of 11 kV lines were laid at project completion);
- (ii) installation of 160 33/0.4 kV and 170 11/0.4 kV distribution transformers with associated drop-out fuse assemblies and low voltage boards (at project completion, 7,800 kVA of 33/LV substations and 9,800 kVA of 11 /LV substations were installed);
- (iii) installation of 570 km of low voltage aerial-bundled conductors (at project completion, 906 km of low voltage lines were laid); and

<sup>8</sup> ADB. 2003. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for the Rural Electrification and Network Expansion Project*. Manila.

- (iv) installation of service cables and energy meters to 8,000 customers (at project completion, 9,200 household connections were provided).

26. **Implementation.** BPC was the executing agency for the project, and the Rural Electrification Department was the project implementation unit. An experienced project manager from the Rural Electrification Department was directly responsible for the project. Award of the international consultants' contract was delayed as a result of a delay in loan effectiveness. During the delay, BPC carried out most of the procurement work for the project, which was to be one of the main tasks for the consultants. A reduced scope of work was drawn up for the international consultants but a contract could not be agreed, so BPC, with ADB agreement, decided that there was no need to engage international consultants and BPC carried out all of the work with its own resources. BPC did not engage local consultants to assist in preparation of the project performance monitoring system (PPMS) and elected to carry it out with its own resources. As a result, no monitoring and evaluation was performed on the social and poverty benefits of the project as BPC focused on the physical progress in project implementation.

27. **Assessment at project completion.** The project was physically and financially completed in December 2006. The PCR,<sup>9</sup> gave the project an overall rating of *highly successful*. It was also found it to be *highly relevant, highly effective, highly efficient, and likely* to be sustainable. This is the third rural electrification loan to Bhutan and BPC had become very familiar with ADB procedures. BPC also proved to be very capable in managing rural electrification projects and demonstrated its technical competence during implementation.

28. **Overall project assessment.** Given the availability of low-cost hydropower in Bhutan, the government identified rural electrification as one of the key instruments of socioeconomic development of rural communities. The 9th plan set an ambitious target of providing 15,000 household connections to increase the electrification rate to 60% and the Rural Electrification and Network Expansion Project was designed to provide 8,000 of these connections. The project design has taken into account the lessons learned in previous projects. It also included advisory TA to further the power sector reforms by strengthening the sector regulator and consolidating the operation of export-oriented hydropower plants. The project is rated *highly relevant*.

29. The project is rated *effective* in achieving its intended outcomes. It exceeded the appraisal expectation of 8,000 households by 15% (i.e., 9,200 households connected). However, the project has not established a PPMS as required under the loan covenants to facilitate the monitoring of achievement of socioeconomic outcomes. The advisory TA projects associated with the projects were instrumental in consolidating the operations of export-oriented hydropower plants under Druk Green Power Corporation (DGPC) and establishing the power sector regulator (Bhutan Electricity Authority [BEA]).

30. The project was implemented within the original schedule and below the appraisal cost estimates. As the number households exceeded the original estimate, the cost per household is less than the original estimate and is roughly equal to the cost per household under the first Rural Electrification Project (\$1,400) and substantially below the threshold value for 12% EIRR (\$2,700). The PCR calculated the project EIRR to be about 24%, so the project is rated *highly efficient*.

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<sup>9</sup> ADB. 2008. *Completion Report: Rural Electrification and Network Expansion Project in Bhutan*. Manila.

31. Although the cost of supply to rural consumers exceeds the average tariff from rural consumers, the rural consumers are subsidized through the royalty energy provided to BPC at a deep discount to the export price. As this policy is expected to continue and Bhutan's hydropower generation is projected to increase with the commissioning of large hydropower plants during 2015–2019, the project outcomes are *most likely* to be sustainable.

32. Based on the *highly effective* and *highly efficient* implementation of the project, and its strong likelihood to be sustainable, the project is rated *highly successful*.

#### D. Green Power Development Project<sup>10</sup>

##### 1. Basic Project Data

Date Approved	29 October 2008 for Loans 2463 and 2464 and Grant 0119 26 December 2008 for Grant 0141
Date Effective	4 May 2009
Date Closed	31 December 2013 (expected)
Approved Amount	\$51 million from ADB's ordinary capital resources (Loan 2463) <sup>11</sup> \$28.28 million from the Asian Development Fund (Grant 0119) <sup>12</sup> \$1 million from the Asian Clean Energy Fund-Clean Energy Financing Partnership Facility
Amount Disbursed	\$43 million (as of 5 April 2010)
Attached advisory TA	TA 7157: Promotion of Clean Power Export Development
Executing Agency	Druk Green Power Corporation and Department of Energy

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33. **Project objectives.** The Green Power Development Project aimed to promote sustainable development of hydropower resources in Bhutan as a major export industry and a source of revenue for the government, and to promote private sector investments in Bhutan's hydropower sector for the first time in the form of public–private partnerships (PPPs). The project also continued ADB assistance to the government's rural electrification program under the 10th plan, 2008–2013, which proposed to provide electricity connections to communities in remote areas to achieve the 10th plan's target of 80% electrification by 2013 which was subsequently increased to 100%.

34. **Project components.** The project consists of the following components.

- (i) Dagachhu HPP: a run-of-river 114 megawatt (MW) hydropower project will be developed under this component as a PPP—ADB is financing part of the equity contribution of public sector agencies (hard term Asian Development Fund [ADF] loan) and part of the debt financing (ordinary capital resources [OCR] loan) of the joint venture company undertaking the hydropower project;
- (ii) financing of the electrification of 8,767 households using an extension of medium voltage and low voltage network (ADF grant); and
- (iii) providing off-grid electricity to 119 community facilities in remote areas.

<sup>10</sup> ADB. 2008. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for the Green Power Development Project*. Manila.

<sup>11</sup> Hard-term loan from the Asian Development Fund with a 32-year term including a grace period of 8 years and a fixed interest rate of 3.15% per annum.

<sup>12</sup> Grant from the Asian Development Fund.



35. **Implementation.** The Dagachhu HPP is being implemented by **Dagachhu Hydro Power Corporation Limited (DHPC)**, the joint venture company set up for the project. The main civil works contract was awarded in June 2009 and the contractor was mobilized in October 2009 after some delays owing to the withdrawal of the first ranked contractor because of reasons unrelated to the project. The contractor is presently engaged in setting up labor camps, tunnel access points, etc. Most of the preconstruction works, such as access roads, were constructed before loan approval. Under the Rural Electrification Project component, the procurement of material and recruitment of local contractors for installation work was completed.

36. **Preliminary project assessment.** The long-term economic growth of Bhutan is highly dependent on the sustainable development of hydropower resources, as hydropower is probably the only resource in Bhutan that can be developed as a major export commodity. However, hydropower development in Bhutan had been dependent on bilateral assistance from the Government of India and there was a critical need for mobilizing additional financing resources from the private sector. The project was a learning exercise for Bhutan in PPP and facilitated investments from the private sector and debt financing under commercial terms for the first time for a hydropower project in Bhutan. The rural electrification component of the project is a continuation of ADB assistance to the government's ambitious rural electrification program. The project is fully consistent with the government strategy of developing the hydropower sector in a sustainable manner through public and private investments, and promoting access to electricity. It is also consistent with ADB's energy sector strategy of facilitating PPPs in infrastructure development, sustainable development of hydropower to mitigate greenhouse gas emissions in South Asia, regional trading in energy, and promoting private sector investment flows between developing member countries. Hence, the project is rated *highly relevant*.

37. Project implementation is on schedule and Dagachhu HPP is expected to achieve the expected level of energy output. Several other hydropower projects are expected to be developed under PPP arrangements using lessons learned during implementation of the project. Given BPC's impressive record in implementing rural electrification projects, the rural electrification project is likely to be effective. Hence, the overall project is *likely* to be effective.

38. Although the capital cost per MW of the Dagachhu hydropower project is higher than other hydropower projects in Bhutan, the project has an EIRR of 13.8% at appraisal. There has not been any adverse development since project appraisal to warrant a downgrade of the EIRR estimates. The likely economic efficiency of the rural electrification component of ongoing Grant 0119 (footnote 15) has also been assessed, using a set of assumptions consistent with those used for completed loans based on the consumption data from surveys undertaken by the Independent Evaluation Department. The recalculated EIRR of the rural electrification component of the Green Power Development Project is 11.9% and is rated *likely* to be efficient assuming that household electricity consumption remains at the same level as households electrified under Loan 1712 and Loan 2009.

39. The environmental and social sustainability of the hydropower component of the project depends on strict adherence to the environment management plan and resettlement plans during project construction and operation. DGPC has adequate experience and capacity to operate the existing hydropower plants in a sustainable manner and it is likely that Dagachhu HPP will be operated in a similar manner. The financial and institutional sustainability of the hydropower component and the rural electrification component are not a concern given the

highly professional management of DGPC and BPC. Hence, the project is rated *likely* to be sustainable.

40. The overall assessment of the project is *likely* to be successful based on its high relevance at the time of approval, progress in implementation at the time of the independent evaluation mission, and the record of its implementing agencies.

## ASSESSMENT OF NONLENDING INTERVENTIONS TO BHUTAN'S POWER SECTOR

### A. Power Sector Institutional and Financial Development

#### 1. Basic Project Data

Date Approved	9 July 1992
Date Effective	13 October 1992
Date Closed	30 April 1998
Approved Amount	\$500,000.00
Amount Disbursed	\$476,711.80
Related Loan	None
Executing Agency	Department of Power (DOP)

#### 2. Rationale

1. The government's development strategy during 1992–1997 as articulated in the 7th Five Year Plan, 1992–1997 recognized the central role of the power sector in promoting economic development and poverty alleviation in an environmentally sustainable manner by exploiting the abundant hydropower potential for export of power, providing incentives to investors in manufacturing industries through cheap electricity, and providing access to electricity to the rural population. To achieve these objectives, the government recognized the importance of improving the institutional capacity of power sector entities to expand both the power generation capacity through investments in large hydropower projects aimed at power exports, and the reach of the power transmission and distribution network to rural areas. Providing recommendations on how to restructure the sector into a more commercially oriented institution, awareness building among decision makers of possible reform options, and identifying the immediate capacity building needs to improve the performance of the DOP were the main objectives of the Power Sector Institutional and Financial Development technical assistance (TA).<sup>1</sup>

#### 3. Objectives and Scope of the Technical Assistance

2. The objectives of the TA were to explore options for strengthening the sector's institutional and regulatory framework, and to improve the utility function of providing electricity to domestic consumers undertaken by the DOP at the time of TA formulation. The TA recommendations were expected to form the basis for subsequent policy dialogue on sector and institutional reforms as well as improvement in utility operation practices. The scope of the TA was to examine and make recommendations on (i) institutional arrangements for the sector, including the desirability of separating the regulatory and utility functions of the DOP; (ii) institutional arrangements for new power sector utilities, including functional unbundling; (iii) developing a regulatory framework for private sector participation in hydropower development; and (iv) capacity building to improve the financial performance of the DOP to facilitate its subsequent conversion to an utility.

#### 4. Implementation and Financing Arrangements

3. The approval of the TA on 9 July 1992 ushered in the first Asian Development Bank (ADB) power sector operation in Bhutan. The TA was financed by the Government of Norway under the Norwegian TA Grant Fund on a grant basis and was administered by ADB. It became

<sup>1</sup> ADB. 1992. *Technical Assistance to Bhutan for the Power Sector Institutional and Financial Development*. Manila (TA 1729).

effective on 13 October 1992, and was completed on 8 March 1994. The DOP of the Ministry of Trade and Industry was the executing and implementing agency for the TA. The consultants commenced their work in November 1992 and all TA activities were completed by the first quarter of 1994. The total amount disbursed was \$503,000 (3.3% below the cost estimate).

## 5. Key Outputs of the Technical Assistance

4. The outputs of the TA (in terms of written reports, knowledge transfer, and on-the-job training to relevant staff from executive agencies) have in general met expectations. The TA reviewed different institutional models to increase the commercial orientation of the sector and the regulatory oversight. Although the TA did not result in institutional reforms in the power sector immediately after its completion, it created awareness about different institutional reform options among policy makers, which paved way for subsequent sector reforms. The TA also included the development of management and financial information systems of the DOP to improve its operational efficiency, and a financial model to identify the tariff adjustments required to ensure the financial sustainability of the sector.

## 6. Overall Assessment

5. The TA is rated *highly relevant*. Its objectives were consistent with government and ADB priorities in the sector at the time of appraisal, and the design was appropriate for the desired TA outcome and outputs.

6. The TA is rated *effective*. There was sufficient diagnostic evaluation. The training programs were implemented and the TA brought about increased awareness of the need for structural reforms. Although the computer and management information systems proposed could not be applied to cover all the areas of DOP operations because of capacity and network limitations, and have already been overtaken by developments in technology, they introduced modern utility management practices to the DOP that were subsequently adopted by the corporatized Bhutan Power Corporation (BPC).

7. The TA is rated *efficient*. DOP ownership and interest in implementing the TA were high. ADB's management of the TA was adequate, even though the TA was a learning process of ADB procedures for the DOP. The TA was completed within the budget and time schedule.

8. The impact of the TA is rated *substantial* as the TA was instrumental in identifying the road map for subsequent institutional reforms in the sector, and it formed the basis for subsequent ADB assistance which played a key role in the successful implementation of sector reforms.

9. The TA is *likely* sustainable. The sustainability of the TA outcomes has been proven by the successful implementation of institutional reforms undertaken after completion of the TA, broadly along the lines of TA recommendations.

10. Overall, the TA is rated *successful*.

## B. Institutional and Financial Development of Department of Power

### 1. Basic Project Data

Date Approved	19 September 1995
Date Effective	17 November 1995
Date Closed	31 March 2000

Approved Amount	\$400,000.00
Amount Disbursed	\$392,098.56
Related Loan	Rural Electrification (Loan 1375-BHU)
Executing Agency	DOP

## 2. Rationale

1. The Power Sector Institutional and Financial Development TA (footnote 1) identified the need for improving financial management of the DOP and improving the commercial orientation within the DOP in preparation for its commercialization. The government had ambitious plans to improve electrification of the country in the 7th plan. The DOP, which was responsible for power distribution, lacked the institutional capacity and human resources in financial management to undertake the government's plans. The national electricity tariffs were set without a firm understanding of the underlying cost structure of supplying electricity, as the DOP did not maintain financial records to ascertain the cost of supply, and revenues from electricity sales were considered just another source of government revenues. The TA on Institutional and Financial Development of the DOP<sup>2</sup> was formulated with the aim of improving the overall financial cost recovery of the power sector through tariff reforms, and financial management and reporting of the DOP in preparation for commercialization and corporatization of the DOP's utility function.

## 3. Objectives and Scope of the Technical Assistance

2. The main objective of the TA was to improve financial management of the DOP and cost recovery of the power sector. The expected impact of the TA was a financially viable power sector managed under commercial principles. The TA consisted of two components: (i) financial management and reporting improvement through the introduction of computerized accounting modules and capacity building of DOP staff; and (ii) a national tariff study based on the long-run marginal cost of electricity supply, affordability and willingness to pay of the end users to ensure cost recovery, and the financial sustainability of the power sector.

## 4. Implementation and Financing Arrangements

3. The TA became effective on 17 November 1995. It was expected to be completed in January 1997 and a draft final report was submitted in accordance with this schedule. At the tripartite meeting in February 1997, the DOP requested an extension of the scope of work to provide for further training of DOP staff as well as hardware and software support for a limited period. ADB and the government approved the request. The final report was completed in March 1997 and the TA was financially closed on 31 March 2000. The DOP was the executing agency. Total disbursements amounted to \$392,098.56 (2% below the cost estimate).

## 5. Assessment Key Outputs of the Technical Assistance

4. The TA on Institutional and Financial Development of the DOP was designed as a follow-up to the Power Sector Institutional and Financial Development TA (i) to establish a computerized accounting system with emphasis on revenue management and customer billing; and (ii) to undertake a tariff study to prepare a tariff structure based on the long-run marginal cost. The tariff study formed the basis for the tariff structure adopted after the formation of BPC in 2002, with revised tariff levels based on the recommendation of the subsequent Corporatization of Division of Power TA. However, the computerized accounting system developed under the TA for Institutional and Financial Development of the DOP could not be

<sup>2</sup> ADB. 1995. *Technical Assistance to Bhutan for the Institutional and Financial Development of Department of Power*. Manila (TA 2400).

utilized as it was not compatible with DOP's cash accounting system prior to its corporatization and because of lack of flexibility. These issues were resolved after the formation of BPC, with the assistance of consultants recruited under the project preparatory TA (footnote 2) for the Sustainable Rural Electrification Project;<sup>3</sup> and the charter of accounts, cash management system, and the fixed assets register developed under the TA were adopted by BPC with appropriate software upgrades. However, the purchase and inventory module developed under the TA could not be utilized because of lack of flexibility. The computerized billing system procured under the TA was deployed in all the distribution zones after the establishment of BPC.

## 6. Overall Assessment

5. The Institutional and Financial Development of the DOP TA is rated *partly relevant* as the computerized accounting system and tariff reforms proposed under the TA were not considered priorities by the government under the prevailing institutional context of the power sector at the time of the TA approval. At that time, the government had not made a firm decision regarding corporatization of the power sector and the systems designed under the TA were adopted only after the establishment of BPC. This indicates that the TA was not appropriately timed.

6. The TA is rated *less effective* as the computerized accounting system and tariff reforms were not immediately adopted by the DOP, and a considerable amount of additional inputs had to be provided by subsequent TA to make use of the TA outputs.

7. The TA is rated *less efficient* as it could not achieve the desired outcomes within the TA budget and desired time frame.

8. The impact of the TA is rated *moderate* as its outputs were not adopted by the DOP at the time of TA completion. Subsequent adoption of some of the TA outputs was due to the efforts of BPC staff and subsequent TA projects provided by ADB.

9. The outputs of the TA are *likely* to be sustainable as they have been consistently used by BPC. However, at the time of TA completion, the sustainability of TA outputs were doubtful as the TA had not been effective in achieving the desired outcomes.

10. The overall assessment of the TA is *partly successful*.

## C. Policy and Legal Framework for Power Sector Development

### 1. Basic Project Data

Date Approved	8 December 1998
Date Effective	1 March 1999
Date Closed	31 August 2002
Approved Amount	\$500,000.00
Amount Disbursed	\$433,342.26
Related Loan	None
Executing Agency	DOP

<sup>3</sup> ADB. 1999. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Bhutan for the Sustainable Rural Electrification Project*. Manila.

## 2. Rationale

11. ADB's strategy for Bhutan's energy sector consisted of encouraging policy, institutional, and legal reforms to improve the commercial orientation and financial performance of power sector entities; and the establishment of a legal and institutional framework for facilitating private sector investments in export-oriented hydropower projects through a series of TA grants and policy dialogue. The Policy and Legal Framework for Power Sector Development TA<sup>4</sup> was prepared with the objective of establishing the policy and legal framework for power sector development through corporatization of the DOP; and encouraging private sector participation in the power sector, especially in hydropower generation development.

## 3. Objectives and Scope of the Technical Assistance

12. The scope of the TA included (i) the drafting of a new Electricity Law and subsidiary legislation with respect to tariff regulation and tariff setting, and review and approval of investment proposals; (ii) technical and accounting standards for the sector; (iii) recommendations on the sector structure, regulatory framework, organizational structure, and staffing patterns for sector entities to be created; and (iv) the hydropower development policy with respect to legal, financial, and technical and environmental aspects to facilitate private sector investments.

## 4. Implementation and Financing Arrangements

13. The TA was financed by the Japan Special Fund and administered by ADB. It became effective on 1 March 1999. The consultant's final report was submitted in October 2000, 7 months later than expected. All activities, including the workshop and study tour, were completed in March 2001, 1 year after the original closing date. The TA was financially closed on 31 August 2002. Total disbursements reached \$433,342.26 (13% lower than cost estimates). The DOP was the executing agency for the TA.

## 5. Assessment Key Outputs of the Technical Assistance

14. The main output of the TA was the draft electricity act, which formed the basis for subsequent institutional reforms in the power sector—resulting in the establishment of BPC as a corporate entity, Bhutan Electricity Authority (BEA) as a power sector regulator, and DGPC as the holding company for state-owned export-oriented hydropower plants (HPPs). The consultant's final report under the TA included two versions of the act (a comprehensive version containing all the relevant laws and a truncated version relying on the existing laws) and recommended that the former be adopted. However, the government decided to adopt the latter with some modifications. The electricity codes prepared under the TA were not appropriate for Bhutan (they were based on the electricity codes of the consultant's home country). Similarly, the hydropower development policy developed under the TA was aimed at mitigating risks for private sector investors although hydropower development had been undertaken in Bhutan by the public sector with the assistance of bilateral development partners.

## 6. Overall Assessment

15. The TA is rated *relevant* as it was fully consistent with government and ADB sector strategies and priorities of establishing the legal framework for power sector reforms and making recommendations on the institutional structure for the power sector. However, the development of hydropower policy for attracting private sector investments was not considered

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<sup>4</sup> ADB. 1998. *Technical Assistance to Bhutan for the Policy and Legal Framework for Power Sector Development*. Manila (TA 3112).

a strategic priority by the government at the time of TA approval, as Bhutan was constructing several export-oriented hydropower projects with bilateral assistance.

16. The TA is rated *effective* as it has achieved its main outcomes—providing significant inputs to drafting of the Electricity Act and to the establishment of a new institutional structure for the power sector entities. However, the hydropower power policy prepared under the TA was not adopted by the government as the government did not consider attracting private sector investments to the hydropower sector a priority.

17. Although the TA encountered significant delays because of the high level of consensus building required on the consultants' final recommendations, the TA is considered *efficient* as it achieved its intended outcomes within the allocated TA resources.

18. The impact of the TA is *significant* as it contributed directly to the legal and institutional reforms undertaken in Bhutan's power sector, and because of the resultant improvement in operational performance.

19. The TA outcomes are *most likely* to be sustainable as the power sector reform process has now been completed broadly in accordance with TA recommendations and the newly created institutions (i.e., BPC, Department of Energy [DOE], DGPC, and BEA) have built up institutional capacity and financial strength as viable entities.

20. The overall assessment of the TA is *highly successful*.

## D. Corporatization of Division of Power

### 1. Basic Project Data

Date Approved	25 November 1999
Date Effective	26 January 2000
Date Closed	31 October 2002
Approved Amount	\$600,000.00
Amount Disbursed	\$597,744.50
Related Loan	Sustainable Rural Electrification Project (Loan 1712)
Executing Agency	DOP

### 2. Rationale

21. The government took a policy decision to proceed with corporatization of the DOP's utility management function in 1998, taking into account the recommendations of the Policy and Legal Framework for Power Sector Development TA. The decision was based on the weakness of the existing institutional structure and its inability to meet the challenge of implementing the government's ambitious rural electrification program. The TA for the Corporatization of the Department of Power<sup>5</sup> was designed to assist the government in undertaking the essential preparatory tasks for corporatizing a government department into a commercial undertaking.

### 3. Objectives and Scope of the Technical Assistance

22. The objective of the TA was to accomplish the transfer of the utility function of the DOP to BPC to take over the power transmission and distribution inside Bhutan, and the operation of mini hydro plants and small thermal plants supplying domestic consumers. The scope of the TA included (i) establishing the debt–equity structure of BPC based on an updated asset and

<sup>5</sup> ADB. 1999. *Technical Assistance to Bhutan for Corporatization of Division of Power*. Manila (TA 3307).



liability register to ensure BPC's financial viability; (ii) proposing a tariff adjustment plan based on the long-run marginal cost to ensure BPC's long-term financial viability; (iii) preparing the corporate documents to enable registration of the DOP in accordance with the Electricity Act and Companies Act 2001; (iv) formulating an organizational structure and human resources development plan for BPC; and (v) providing training to BPC staff on financial management and accounting.

#### 4. Implementation and Financing Arrangements

23. The TA was financed by the Japan Special Fund and administered by ADB. It became effective on 26 January 2000. Most of the planned activities were completed on time. The TA was expected to be completed in December 2001. The consultants submitted the draft final report in November 2001 and the final report was submitted in May 2002. The TA was financially closed in October 2002. Total disbursements reached \$597,744.50 (0.4% lower than cost estimates). The DOP was the executing agency.

#### 5. Assessment Key Outputs of the Technical Assistance

24. The TA produced a comprehensive action plan for corporatization of the DOP to create BPC to undertake power distribution and transmission within Bhutan. The TA outputs included (i) the valuation of BPC's asset base and opening financial statements; (ii) a human resources plan; (iii) a financial management system; and (iv) tariff adjustments required to ensure the sustainability of BPC. These outputs were used in the establishment of BPC as a successor entity to the DOP shortly after TA completion. The TA had recommended contractually defined commercial relationships between the functional units of BPC to facilitate subsequent privatization of some of these functional units. However, the government adopted a simpler corporate structure for BPC, which is more appropriate for a state-owned utility operated under commercial principles.

#### 6. Overall Assessment

25. The TA is rated *highly relevant* as it provided essential and critical inputs to achieve corporatization of the DOP. The government did not have the capacity to undertake the preparatory work required for achieving the smooth transition of the utility function from the DOP to BPC, and in the absence of the TA, the corporatization process may not have succeeded.

26. The TA is rated *highly effective* in achieving its intended outcome of establishment of BPC as a commercially viable entity. However, some of the TA recommendations to set up transparent internal cash transfer mechanisms were not adopted by the government.

27. The TA is rated *efficient* as it achieved its objectives within the TA budget. The consultant recruitment was expedited through the use of single source selection procedures based on the close relationship with the Policy and Legal Framework for Power Sector Development TA.

28. The impact of the TA is rated *substantial* as it made a significant contribution to the establishment of BPC as a competent and viable electricity utility.

29. The TA outcomes are *most likely* to be sustainable based on the highly commendable performance of BPC since its inception in terms of the operational and financial performance and institutional and human resource capacity build-up.

30. The overall assessment of the TA is *successful*.

## E. Capacity Building of Bhutan Electricity Authority

### 1. Basic Project Data

Date Approved	30 September 2003
Date Effective	7 November 2003
Date Closed	21 June 2007
Approved Amount	\$400,000.00
Amount Disbursed	\$397,135.14
Related Loan	Rural Electrification and Network Expansion (Loan 2009)
Executing Agency	DOE

### 2. Rationale

31. Unlike DOE and BPC, which started operating as separate entities soon after they were established, BEA as a sector regulator became effective through a government notification in June 2005. The delay in establishing BEA was due to a lack of capacity and clarity regarding the role of BEA as a sector regulator as well as the government's prioritization of the establishment of BPC. BEA was initially supported by Norwegian bilateral assistance, especially in relation to the economic regulation of power utilities. However, there was an urgent need for institutional capacity building of BEA to enable it to recruit competent staff, to undertake technical regulation, and to develop an outreach and awareness strategy to engage the stakeholders of the power sector effectively as a sector regulator. TA for Capacity Building of BEA<sup>6</sup> was approved in 2003.

### 3. Objectives and Scope

32. The main objective of the TA was to improve the regulatory capacity of the newly formed BEA to function effectively as the sector regulator. The scope of the TA included (i) conducting a needs assessment of BEA's institutional requirements; (ii) developing a medium- and short-term training program for BEA staff; (iii) assisting BEA in preparing national performance standards and codes for the power sector; (iv) designing and implementing a national outreach strategy to increase awareness of BEA's role and responsibilities to stakeholders; and (v) exploring the possibility of consolidating the regulatory bodies in Bhutan to cover all the public utility services.

### 4. Implementation Schedule and Financing Arrangements

33. The TA's contract was signed with an international consulting firm and the consultants were mobilized on 1 March 2004. The TA envisioned a total of 10 person-months of international consultants' inputs over 18 months for a total contract amount of \$395,000. The actual time spent was 10.1 person-months, and the final revised contract amount was \$397,135. While the actual input person-months and costs were very close to the original ones, the period of the TA was extended three times for an additional 18 months. The director of the DOE had overall responsibility for the TA while the head of BEA was tasked with the day-to-day project coordination, including overseeing the consultants and coordination among relevant government agencies and stakeholders.

34. The TA completion was delayed by 18 months due to, among others, delay in the completion of the training needs assessment and works on the grid code. The initial training needs assessment was received in November 2004, but it was not sufficiently detailed and had to undergo major revisions. The revised assessment was received in April 2005 after appointing an additional consultant to assess training capacity building needs. The engagement of

<sup>6</sup> ADB. 2003. *Technical Assistance for Capacity Building of the Bhutan Electricity Authority*. Manila (TA 4188).

consultants for the grid code was delayed by about 4 months because of cost considerations. Initial quotations obtained from prospective consultants were above cost estimates and new proposals had to be solicited.

## 5. Assessment Key Outputs of the Technical Assistance

35. The TA undertook a comprehensive capacity building needs assessment of the newly created BEA, and prepared a short- and medium- training plan for BEA staff. It also made recommendations with regard to the optimal institutional structure and internal working arrangements for BEA, and explored the possibilities of having a combined regulatory body for public utilities. The TA prepared technical codes, and performance and standards for Bhutan's power sector, including the grid code. A national outreach strategy was prepared under the TA to increase awareness among stakeholders about the role and responsibilities of BEA as the power sector regulator. The outreach activities were put on hold because of decisions regarding BEA's autonomy, but they were carried out after completion of the TA by BEA staff when the government finalized BEA's institutional arrangements. A study tour of five countries was financed under the TA for senior staff of BEA to familiarize them with regulatory practices adopted in other Asian countries.

36. According to TA recommendations, BEA was to become an independent regulatory authority with all the necessary skills and capability to carry out its duties and functions as defined in the Electricity Act by 2008. The board was to comprise a part-time chairperson, three part-time members, and the chief executive officer (CEO). The government has accepted these recommendations and they were implemented during 2006–2010. Although BEA was established as a division of the DOE in 2006, in accordance with the TA recommendations, it only became a fully autonomous body in 2010 and the CEO's position of BEA was filled in May 2010.

## 6. Overall Assessment

37. The TA was consistent with both government and ADB priorities and strategies, and the timing was appropriate, having been approved shortly after enactment of the Electricity Act and the establishment of BPC as a corporate entity. The TA also complements the assistance provided by Norway on economic regulation. It is therefore rated *relevant*.

38. The TA is rated *less effective*. BEA was established as an independent entity with considerable delays. The institutional sustainability of BEA is not yet fully established.

39. The outputs were delivered, except for the assessment of establishing a multisector national regulatory body. The TA is assessed as *efficient* as the outputs were delivered within the cost estimates and complemented the assistance provided by bilateral donors.

40. The outcome of the TA is *likely* to be sustainable provided that BEA continues to receive capacity building assistance as it broadens its mandate.

41. The impact of the TA is *moderate* as BEA has not yet achieved the institutional capabilities to carry out its mandate as an effective power sector regulator.

42. The overall assessment of the TA is *partly successful*.

## 7. Outstanding Issues

43. It has taken a long time for BEA to be established as a fully autonomous and effective regulatory agency. At the time of the independent evaluation mission (IEM), the position of CEO

remained vacant but an active search was ongoing and the government informed the IEM that it is open to filling the position with an expatriate if a suitable local candidate cannot be found. BEA remained understaffed and attracting qualified candidates and keeping them is a challenge. The Independent Evaluation Department (IED) has been informed that the CEO position was filled in May 2010.

## **F. Establishing Druk Hydropower Corporation**

### **1. Basic Project Data**

Date Approved	30 September 2003
Date Effective	7 November 2003
Date Closed	29 May 2006
Approved Amount	\$500,000.00
Amount Disbursed	\$479,216.75
Related Loan	Rural Electrification and Network Expansion (Loan 2009)
Executing Agency	Department of Energy

### **2. Rationale**

44. Given the importance of state-owned export-oriented HPPs to Bhutan's economy, there was an urgent need to streamline their operations for better coordination as well as for achieving operational efficiencies through economies of scale. A corporate entity was also needed to hold the government's stakes in new hydropower projects developed as public-private partnerships (PPPs) and joint ventures with foreign investors. The government planned to consolidate the ownership of export-oriented hydropower stations to streamline the operations of these plants and exploit economies of scale. It decided to create Druk Hydropower Corporation (DHPC) as a consolidated entity to own export-oriented hydropower stations and to be responsible for operating the existing plants and representing the government's equity interests in new hydropower projects. However, there was a difference of opinion regarding the optimum corporate structure to be set up and TA for Establishing the Druk Hydropower Corporation<sup>7</sup> was provided to make recommendations regarding institutional arrangements for consolidating government holdings in export-oriented hydropower projects.

### **3. Objectives and Scope**

45. The objectives of the TA were to make recommendations on the institutional, technical, and financial aspects of establishing a holding company to consolidate the operation and management of state-owned export-oriented hydropower projects. The intended outcome of the TA was to improve the operation of existing hydropower companies and to establish a corporate entity to represent the government effectively in future development of the hydropower sector. The scope of the TA included (i) a hydropower sector policy review and analysis of options for consolidating export-oriented hydropower companies to make recommendations on the structure of DHPC; and (ii) based on the consensus reached with stakeholders, to make recommendations on the institutional, financial, and human resource structure of DHPC.

### **4. Implementation Schedule and Financing Arrangements**

46. The TA was designed in a phased manner to undertake a thorough review of options for setting up of DHPC in the context of prevailing government policies and the expected development of hydropower sector in Bhutan. The DOE was the executing agency, and the

<sup>7</sup> ADB. 2003. *Technical Assistance to Bhutan for Establishing the Druk Hydropower Corporation*. Manila (TA 4189).

director of the DOE had overall responsibility for the TA. The implementing agency was Chukhha Hydropower Corporation (CHPC) and representatives from other hydropower companies were actively involved in the TA implementation. The institutional framework and organizational structure of DHPC was prepared taking into account the feedback received during the implementation of phase 1 of the TA. The consultants' final report and major activities were delivered within the original schedule, but the TA was completed date on September 2005, 6 months behind the original schedule of 31 March 2005 because of late completion of the study tour.

## 5. Assessment Key Outputs of the Technical Assistance

47. The TA was provided to undertake further consultations with high level decision makers regarding the pros and cons and the overall structure of such an entity. After reaching consensus with the government on the establishment of DHPC, the TA made recommendations on (i) the corporate governance structure and memorandum and articles of association of DHPC; (ii) guidelines on financial management and management information systems between each HPP and DHPC management for corporate oversight; (iii) performance targets and compliance requirements to be met by DHPC; (iv) asset valuation and the opening balance sheet for DHPC; (v) the organizational structure and human resources policy; (vi) the corporate operation and maintenance policy, including an initial assessment of the maintenance needs of Chukka HPP; and (vii) a review of the generation development plan transmission expansion plan.

48. DGPC<sup>8</sup> was formed on 1 January 2008 with the amalgamation of the Basochhu, Chhukha, and Kurichhu Hydropower Corporation. Presently, DGPC is responsible for the operation and maintenance of the four HPPs. Tala HPP, which was commissioned in 2007, was operated by the special agency set up to manage construction of the project and was transferred to DGPC in 2009.

49. The HPPs are being operated and maintained more efficiently with economies of scale. They have a common inventory of spare parts, and human resources have been streamlined with provisions for technical backup for individual plants in the event of technical emergencies. DGPC is establishing centers of excellence to address technical aspects of hydropower (such as preventive maintenance) to mitigate the damage caused by high sediment loading. DGPC is also responsible for debt service and cash management on behalf of all four HPPs. All HPPs are represented on DGPC's steering committee, which provides overall operational guidance. The day-to-day operations of the plants are left to individual plant management.

## 6. Overall Assessment

50. The TA is rated *highly relevant*. There was a clear diagnostic assessment of the problems and opportunities of having HPPs with disconnected operations. The TA was approved at the right time, as a recommendation of an earlier TA, and the sequencing of implementation activities was appropriate.

51. The TA is rated *highly effective*, having delivered all outputs it identified at formulation and the establishment of DGPC as highly professional and competent agency to effectively manage the export-oriented hydropower sector.

52. The TA is assessed as *efficient*. All outputs were achieved within the cost estimate. Despite the six month delay in completing all activities all major activities such as consultant's final report were submitted within the agreed timeframe.

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<sup>8</sup> At the time of its establishment DHPC, was corporatized as Druk Green Power Corporation (DGPC).

53. The outcome of the TA is *likely* to be sustainable, given the institutional performance of DGPC and the likely expansion of its role with the implementation of the 10,000 megawatt (MW) hydropower program.

54. The impact of the TA is *substantial*. The TA made a substantial contribution to the establishment of DGPC. Without the TA, this would have taken a much longer time to achieve.

55. The TA is assessed as *successful*.

## **G. Capacity Building for the Bhutan Power Corporation**

### **1. Basic Project Data**

Date Approved	16 June 2005
Date Effective	12 August 2005
Date Closed	25 July 2007
Approved Amount	\$400,000.00
Amount Disbursed	\$393,359.54
Related Loan	None
Executing Agency	BPC

### **2. Rationale**

56. BPC was corporatized on 1 July 2002 with the mandate of distributing electricity throughout the country and providing transmission access for generating stations for domestic supply as well as export. It is the largest corporation in Bhutan with operations in 19 districts and staffing equal to almost 10% of the entire civil service. In the 3 years after its establishment, BPC had taken significant steps to improve the efficiency of the power sector. However, like other institutions in the sector, BPC still had to develop its institutional self-sufficiency—especially in the areas of investment and operations planning, budgetary controls, cost or profit center accounting, and management information systems. TA for Capacity Building for BPC<sup>9</sup> was provided to improve the quality of business processes, financial management, material management, and management information system of BPC.

### **3. Objectives and Scope**

57. The goal of the TA was to improve the overall efficiency of the energy sector by strengthening BPC's management capability and by assisting in the preparation of plans and designs for the development of its business management systems and procedures to be applied for a commercially oriented entity. The TA had three components:

- (i) development of a strategic management framework to develop benchmarks for monitoring operational efficiency and financial performance, and to assess the impact of accelerated rural electrification on BPC's financial sustainability;
- (ii) development of an enterprise and materials resource planning system to improve the efficiency of the supply chain management; and
- (iii) development of a management information system integrating the outputs of (i) and (ii) with the existing billing and accounting systems.

<sup>9</sup> ADB. 2005. *Technical Assistance to Bhutan for Capacity Building for the Bhutan Power Corporation*. Manila (TA 4599).

#### **4. Implementation Schedule and Financing Arrangements**

58. The TA was approved 3 years after BPC was established as a corporate entity. It was designed to prepare BPC for adapting an enterprise resource planning system. The TA was designed to facilitate close interaction between BPC staff and consultants to maximize knowledge transfer and on-the-job training. The TA agreement was signed on 12 August 2005 and the consultants were fielded in October 2005. The consultants submitted their final report in August 2006 and all TA activities were completed by December 2006. The TA was financially closed on 25 July 2007. The amount disbursed was \$393,359.54 (98.3% of the approved grant amount). Several contract variations were approved to provide additional information technology inputs for installing an inventory control system. The TA completion date will need to be extended to 31 December 2006 from 30 September 2006, a total extension of 7 months from the original TA completion date of 31 May 2006.

#### **5. Assessment Key Outputs of the Technical Assistance**

59. The TA was provided to improve the quality of BPC's business processes, financial management, material management, and management information system. The TA consultants worked closely with BPC staff in developing new business processes, guidelines for allocating material and labor costs to current and capital expenses, introducing management accounting systems including cost or profit centers as a tool for monitoring the performance of functional units of BPC, budget and financial control systems, and accounting standards for depreciating and capitalizing fixed assets.

60. The TA consultants also prepared a corporate planning model to project the required revenue requirements to ensure prudential financial targets for BPC and to use the results to assist in formulating tariff applications and for financial planning services. The TA consultants also trained the BPC staff on the financial and economic analysis of new investment projects.

61. The TA consultants prepared functional specifications for a material and inventory control system, and recommended improvements to BPC's procurement manual. Based on the consultants' recommendation, BPC purchased an integrated inventory control system linking all the BPC warehouses. The TA also reviewed the use of information technology in BPC and identified improvements to the current information technology system. Based on the preparatory work undertaken by the TA consultants, BPC prepared the functional specification for a state-of-the-art enterprise resource planning system. The consultants established guidelines for preparing monthly management information reports and prepared the medium-term information technology strategy for BPC, including the functional requirements of a future information technology system for BPC.

#### **6. Outcomes and Impact of the Technical Assistance**

62. The TA was to strengthen the institutional capacity of BPC and improve its operational and management efficiency. BPC's capacity had been strengthened and operations had become more efficient, partly as a result of the TA and from BPC's own perseverance. The impact of the TA was *substantial* as the TA provided the necessary impetus to BPC to move to a higher level of utility management using state-of-the-art information technology and management practices.

#### **7. Overall Assessment**

63. The TA was provided after BPC was established (3 years after corporatization) and resolved teething problems associated with transition from the DOP to a corporate utility. The

TA scope was defined in close consultation with BPC staff to provide inputs to improve BPC's operational and financial management to introduce modern public utility management procedures. Hence, the TA is rated *relevant*.

64. The TA has been *effective* in achieving its desired outcomes as BPC adopted most of the new business and accounting process developed under the TA, and the TA has laid the groundwork for BPC to adopt an enterprise resource planning package.

65. The TA is *highly efficient* as it effectively leveraged limited TA resources with extensive counterpart staff involvement. The TA also achieved a high degree of knowledge transfer.

66. The TA outcomes are *likely* to be sustainable as BPC took ownership of the TA recommendations and took several initiatives on its own to build on TA outcomes.

67. The TA had a *substantial* impact in terms of improving the managerial efficiencies of BPC and preparing BPC to assume greater responsibilities associated with achieving 100% electrification.

68. The overall rating of the TA is *successful*.

## H. Accelerated Rural Electrification

### 1. Basic Project Data

Date Approved	28 February 2006
Date Effective	29 March 2006
Date Closed	Active
Approved Amount	\$700,000.00
Amount Disbursed	\$694,062.00 (commitments as of 5 April 2010)
Related Loan	None
Executing Agency	DOE

### 2. Rationale

69. The 9th plan, 2002–2007 set an ambitious target of providing 25,000 new household connections and achieving 100% electrification by 2020. A rural electrification master plan was prepared with the assistance of Japan International Cooperation Agency in 2005 for this purpose. The master plan has proposed an increased role for renewable energy and off-grid applications, private sector and community participation in the implementation and operation of both on-grid and off-grid rural electrification schemes, and a more strategic approach to reduce the cost and ensure the overall sustainability of rural electrification schemes in more remote locations yet to be electrified. The TA for Accelerated Rural Electrification<sup>10</sup> was approved on 28 February 2006. It was expected that the recommendation of the TA would be incorporated in rural electrifications projects to be financed by ADB, JICA, and other development partners during the 9<sup>th</sup> (2002–2007) and 10<sup>th</sup> (2008–2013) plan periods.

### 3. Objectives and Scope

70. The TA was designed to facilitate the electrification of more remote parts of Bhutan through innovative approaches consisting of grid expansion as well as off-grid renewable energy applications. The TA scope consisted of (i) recommending new institutional models involving various levels of government, BPC, the private sector, and local communities to

<sup>10</sup> ADB. 2006. *Technical Assistance to Bhutan for the Accelerated Rural Electrification*. Manila (TA 4766).



undertake rural electrification through grid expansion as well as off-grid renewable energy applications; (ii) assessing the feasibility of off-grid renewable energy technologies for rural electrification and proposing policies, incentives, and institutional arrangements to facilitate this; and (iii) undertaking training, capacity building, and awareness building of new approaches proposed under the TA.

#### **4. Implementation Schedule and Financing Arrangements**

71. The TA became effective on 29 March 2006. The consultants submitted their draft final report in May 2009. At the time of the independent evaluation mission, the final report was still to be submitted. Total commitments amounted to \$695,161 (99% of the total approved amount). The DOE was the executing agency, closely coordinating with BPC.

72. A minor change in scope was approved on 20 April 2009 to recruit a national environment specialist using TA savings. The national environment specialist was tasked to develop the project design and comprehensive feasibility studies for rural electrification subprojects. The TA completion was extended to 31 December 2009.

#### **5. Assessment Key Outputs of the Technical Assistance**

73. The TA reviewed the existing institutional arrangements for grid-connected rural electrification projects from the planning stage, to design, construction, and maintenance. It made recommendations to enable the rapid acceleration of project implementation, and recommended the DOE to assume greater responsibility for planning and coordination of the rural electrification program, with BPC acting as the main implementing agency. This involved a more consultative approach for updating the rural electrification master plan prepared in 2005, with an enhanced role for local government bodies in the selection process of villages to be included in rural electrification projects; and streamlined approval procedures for village selection, environment clearances, and procurement. The TA also pilot tested new construction approaches (i.e., a single phase 33 kilovolt [kV] substation and telescopic poles) to meet the technical challenges, as well as community-based meter readers and line maintenance technicians for reducing the cost of electrifying and maintaining the network of remote parts of the country.

74. The TA made recommendations with regard to scaling up the use of off-grid renewable technologies such as solar photovoltaic and micro hydro for electrifying remote parts of Bhutan. Both of these technologies had been deployed in Bhutan in an ad hoc manner through donor-funded initiatives, and there were significant issues regarding the sustainability of the existing off-grid systems in Bhutan as a result of poor operating cost recovery and maintenance issues. During the TA implementation, it was decided to focus on scaling up of solar photovoltaic systems as the government was not keen on promoting off-grid micro HPPs. As a result, the TA scope was substantially revised, with increased focus on solar photovoltaic systems. The TA outputs included (i) specifications for solar home system components; (ii) installation practices for solar home systems; (iii) solar home system maintenance guidelines; (iv) maintenance guidelines for solar home system projects; (v) surveys of existing solar home systems; and (vi) database specification for recording the details of solar home systems.

#### **6. Overall Assessment**

75. The TA is rated *relevant* as it was designed to address the challenges of accelerating the rural electrification program in an efficient and sustainable manner.

76. The TA is rated *efficient* as it has produced useful outputs within budget and pilot tested some of the new approaches.

77. Although the TA recommendations could not be incorporated in the ongoing ADB- and JICA-financed rural electrification project, the IEM has been informed that the TA recommendations will be incorporated in the proposed rural electrification projects to be financed by ADB and JICA to electrify the remaining 40,000 households. Hence, the TA is *likely* to be effective.

78. It is too early to assess the impact and sustainability of this TA as its recommendations have not yet been implemented.

79. The TA is rated *successful*.

## I. **Promotion of Clean Power Export Development** (under implementation)

### 1. **Basic Project Data**

Date Approved	29 October 2008
Date Effective	20 November 2008
Date Closed	Active (completion expected 16 March 2011)
Approved Amount	\$1,488,00.00
Amount Disbursed	\$1,340,192.00 (commitments as of 5 April 2010)
Related Loan	None
Executing Agency	DOE

### 2. **Rationale**

80. Given the critical role of export-oriented hydropower projects to Bhutan's economic growth, there is an urgent need to build the capacity of Bhutan's government agencies to develop, mobilize financing, and then manage the construction of large-scale hydropower projects. The main rationale for the Promotion of Clean Power Export Development TA<sup>11</sup> is to diversify the financing options for Bhutan in developing its hydropower resources and to increase the understanding of project finance concepts among Bhutan's government officials to enable them to negotiate commercial arrangements and agreements effectively with joint venture partners, financiers, and off-takers. Because of the dependency on concessionary bilateral financing for developing the hydropower sector in the past, government offices were not exposed to the intricacies of project finance and commercial negotiations associated with the complex PPP modality.

### 3. **Objectives and Scope**

81. The objective of the TA was to prepare (i) a strategy and action plan to broaden financing avenues for future large hydropower projects, (ii) internal capacity development within DGPC to manage development of commercial hydropower projects on its own or as joint ventures with foreign partners, and (iii) internal capacity building of the DOE for monitoring the performance of export-oriented hydropower sector.

82. The TA consists of three components:

- (i) **Facilitating financing for hydropower projects.** The TA is required to explore innovative financing options for potential hydropower projects through an

<sup>11</sup> ADB. 2008. *Technical Assistance to Bhutan for the Promotion of Clean Power Export Development*. Manila (TA 7157).

- analysis of domestic and regional financial markets and applicable regulations, and will make recommendations to remove barriers to mobilizing financing.
- (ii) **Capacity building of DGPC to manage large hydropower projects.** The TA will provide capacity building to DGPC for structuring financing for PPP transactions by preparing financial plans for two medium-scale hydropower projects and developing an integrated management information system for DGPC to improve its internal managerial efficiencies.
  - (iii) **Capacity building of DOE for accelerating hydropower development.** The DOE exercises the state management function in hydropower development. The TA is designed to provide capacity building to the DOE in promoting new hydropower projects, negotiating commercial agreements on behalf of the government, and ensuring consistency with the provisions of sustainable hydropower development policy of proposed HPPs. The TA also included the preparation of a captive power policy and renewable energy policy for Bhutan to reduce the dependency on hydropower and to address the projected peak load shortages during the winter.

#### 4. Implementation Schedule and Financing Arrangements

83. The TA became effective on 20 November 2008 and consultant services commenced on 17 March 2009. Total commitments as of 5 April 2010 had reached a total of \$1,340,192 (90% of the approved amount). The inception workshop was conducted in April 2009. Workshops have also been conducted on the Clean Development Mechanism and renewable energy. The DOE is the executing agency and the Regional Cooperation and Integration Fund is funding \$888,000 of TA requirements.

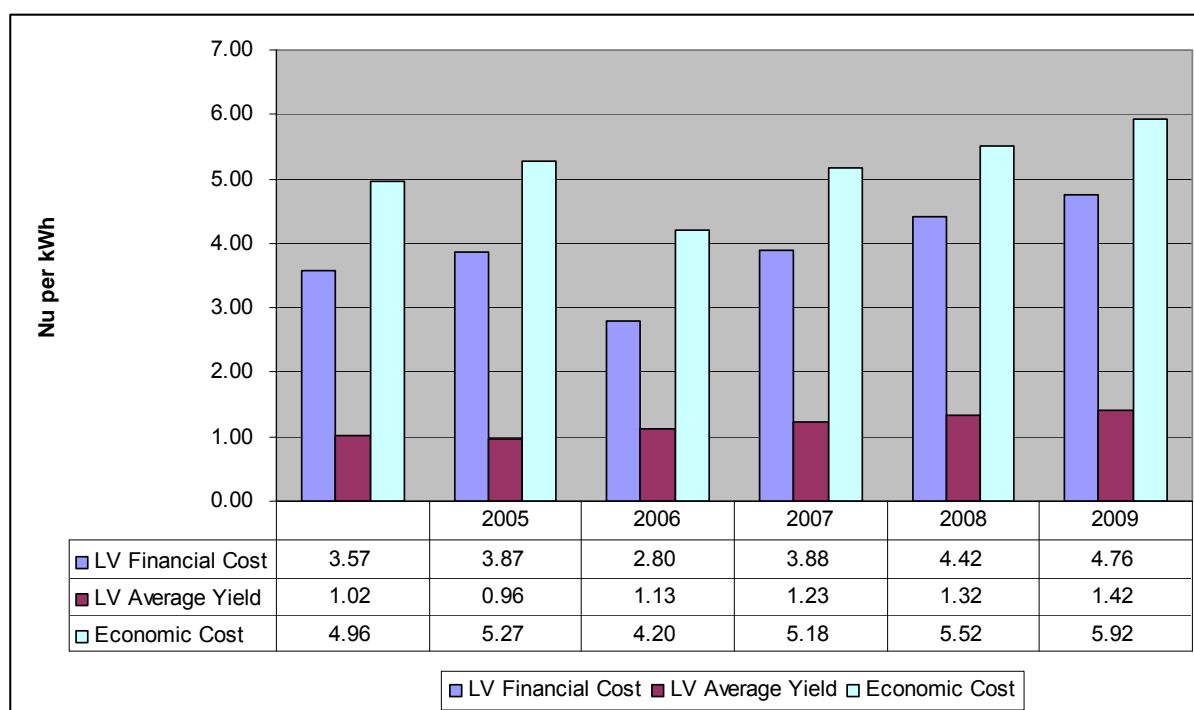
#### 5. Preliminary Assessment of Expected Key Outputs of the Technical Assistance

84. Although the TA is designed to fulfill the critical capacity building needs of government agencies involved in hydropower development, the timeliness of the TA is questionable. As both DGPC and the DOE are heavily involved in finalizing three large hydropower projects, financed with bilateral assistance from the Government of India, the implementation of component 1 of the TA is deferred and the TA resources allocated for preparing two medium-scale hydropower projects under component 2 have been reallocated to internal capacity building of DGPC. Although it is too early to assess the effectiveness and sustainability of the TA recommendations, the close involvement of ADB staff in reallocating the TA resources to urgently needed capacity building requirements of government counterparts to implement the 10,000 MW hydropower program supported by Government of India could make the TA highly useful and effective. In this regard, the TA resources can be utilized to structure PPPs between DGPC and designated Indian public sector agencies for developing hydropower projects included in the 10,000 MW program.

## ECONOMIC EFFICIENCY ANALYSIS OF BHUTAN'S RURAL ELECTRIFICATION PROGRAM

1. Bhutan undertook an ambitious rural electrification program during 1995–2009, which has achieved a rate of electrification of 57% by 2009 compared to 16% in 1995, and the government has set a target of 100% electrification by 2013. The rural electrification program has been financed by concessionary loans from the Asian Development Bank (ADB) and the Japan International Cooperation Agency (JICA); grant financing from bilateral donors such as Austria, India, and the Netherlands; contributions from the Government of Bhutan; and retained earnings of Bhutan Power Corporation (BPC). The financial cost of supplying residential households exceeds the average tariff applicable to the residential sector (Figure A5.1). The cost of supplying rural households is even higher than the overall residential sector as a result of the high capital cost of extending the electricity grid to remote locations. The yield from rural households is even lower than the average residential tariff because of the lower than average consumption of rural households, as most of the consumption of the rural sector is priced at Nu0.75 per kilowatt-hour (kWh).

**Figure A5.1: Financial Cost of Supplying Residential Households**



Source: IED Staff Estimates.

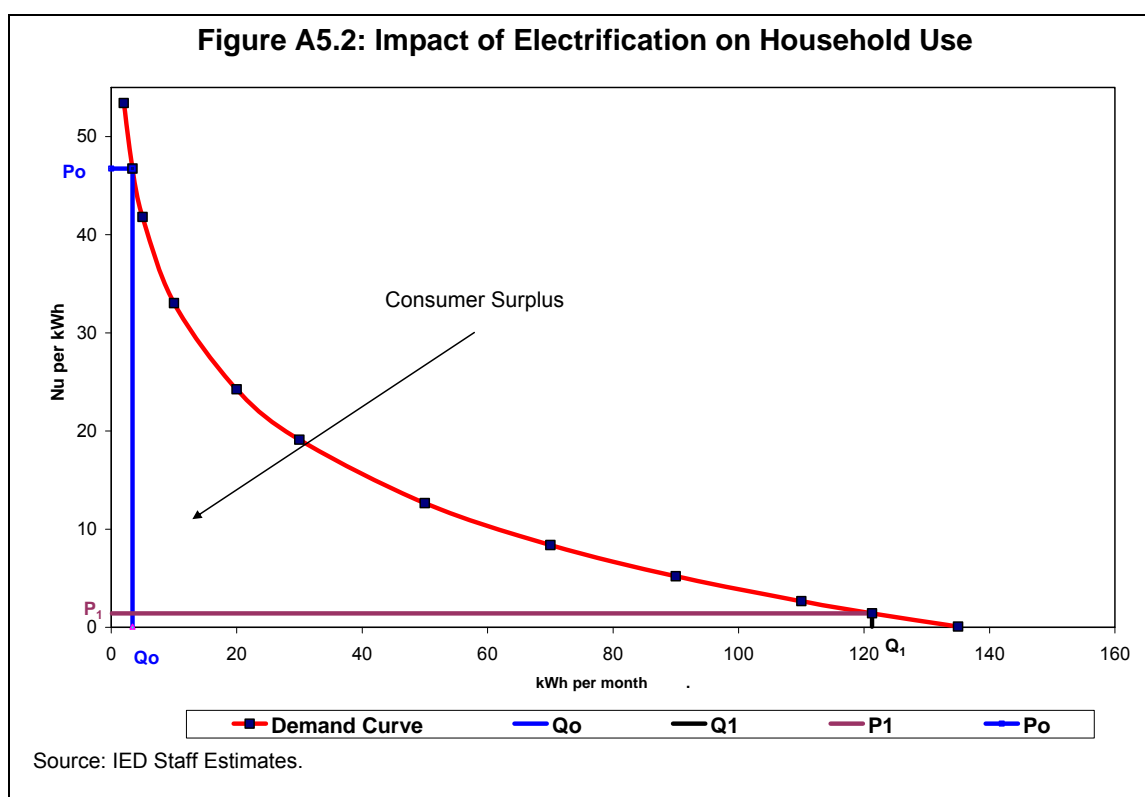
2. From a financial point of view, the rural electrification projects result in negative cash flows to the power utility. The financial cost of supplying rural areas after taking into account the subsidy provided to BPC in power purchase (i.e., Nu0.3/kWh for the royalty energy compared to the cost of generation of about Nu1.2/kWh) is less than the average tariff paid by rural consumers. This result is a negative financial internal rate of return. The extension of the electricity grid to remote areas has been justified on the grounds of social equity as well as economic costs savings in terms of avoidance of use of other sources of fuel.

3. The household survey undertaken by JICA in its master plan study shows that the potential benefits of electrification are constrained by householders' continued use of other forms of energy even after electrification, such as dry cell batteries and candles, albeit at reduced levels. This behavior is consistent with experiences in other developing countries. JICA's survey also indicates that the economic benefits of electrification could be constrained where high-cost electricity is used to displace relatively low value fuel wood, rather than being used for more economically valuable purposes. However, the reduced use of fuel wood has environmental benefits and health benefits as a result of improved indoor air quality.

4. Another difference in the rural electrification project evaluations stems from the definition of the alternative "without-project" scenario against which the net benefits of grid electrification are measured. JICA assumes that grid connections will avoid the need for photovoltaic solar lighting systems from the rural electrification program, whereas another plausible without-project scenario is grid electrification which would displace kerosene consumption of households. The former is consistent with the government policy of providing electricity to all households either through grid extension or off-grid technologies (i.e., solar photovoltaic is the most likely option) while the latter is the prevailing situation where un-electrified households depend on kerosene for lighting.

#### A. Economic Benefits of Electrification

5. Surveys have shown that prior to electrification the average household consumes 3.39 kWh of energy per month (includes kerosene, candles, dry cell batteries; excludes fuel wood) and pays an average of Nu47/kWh in 2009 values. When connected to the grid, the household's energy consumption increases to 80 kWh per month (electricity, kerosene, candles, and batteries) and costs the householder an average Nu0.80/kWh. The demand curve for the average residential household and the impact of electrification on energy demand is shown in Figure A5.2.



6. Based on the survey data, it was assumed that prior to electrification the household derives lighting utility equivalent to electricity consumption of  $Q_0$  (3.39 kWh) by consuming 4 liters of kerosene. Although the market price of kerosene in Bhutan is Nu12/liter, there is an implicit subsidy of about Nu18/liter as Bhutan receives refined petroleum products from India at the same retail prices prevailing in India, as the economic price of kerosene is assumed to be Nu30/liter. The cost of kerosene is equal to Nu120 per month and the price paid to derive a utility value is equivalent to a unit of electricity amounts to  $P_0$  (35.4) Nu/kWh. The non-incremental benefit of electrification is valued at the replacement cost and is equal to the cost of kerosene in the absence of electricity (i.e., Nu120/month)

7. When electrified, the households' electricity consumption increases from kerosene consumption equivalent to  $Q_0$  (3.39 kWh per month) to  $Q_1$  (average electricity consumption per month) at an average tariff of  $P_1$ . The area bounded by the demand curve and the lines  $Q_0$  and  $Q_1$  represent the economic benefits of the incremental benefit, and this can be calculated by integrating to find the area under the demand curve between  $Q_0$  and  $Q_1$ . Assuming a curvature factor of 0.8, the incremental benefit is equal to  $(Q_1 - Q_0) * P_1 + (Q_1 - Q_0) * (P_0 - P_1) * 0.8 * 0.5$ .

## B. Economics of Rural Electrification

8. The economic analysis of ADB-financed rural electrification projects have been undertaken using the revised set of assumptions (Table A5.1).

**Table A5.1: Comparison of Economic Analysis of the Rural Electrification Project (Loan 1375)**

Item	RRP	PCR	PPAR	SAPE
Average monthly consumption $Q_1$ (kWh)	335	521	133	90
Average tariff $P_1$ (Nu/kWh) <sup>1</sup>	1.00	0.80	0.95	0.55
Cost of electricity (Nu/kWh)	0.5	1.21	1.5	1.85
Capital cost per household (\$)	2,716	2,546	3,025	2,578
Incremental benefits (Nu/kWh)	3.03	3.83	11.8	14.5
Non-incremental benefits (Nu/kWh)	0.96	2.07	12.5	35.4
Incremental consumption (kWh/household)	285	...	126	86.5
Non-incremental consumption (kWh/household)	50	...	7	3.5
<b>EIRR</b>	<b>11.9%</b>	<b>11.7%</b>	<b>12.5%</b>	<b>12.9%</b>

... = not available, EIRR = economic internal rate of return, kWh = kilowatt-hour, RRP = report and recommendation of the President to the Board of Directors, PCR = project completion report, PPAR = project performance audit report, SAPE = sector assistance program evaluation.

Source: IED Staff Estimate.

9. The average consumption per household in the report and recommendation of the President (RRP) and the project completion report (PCR) for Loan 1729 were overestimated compared to the average consumption of electrified households indicated by the survey data.

<sup>1</sup> The average tariff and cost of electricity as of the year of full commercial completion of the project is shown here. The tariff and cost of electricity between 1999–2009 are based on actual values in the case of SAPE and there after they are assumed to increase by 3.5% on real terms.

However, the incremental and non-incremental benefits were also underestimated, as a lower value for the economic cost of kerosene is considered in the RRP and PCR. These two anomalies have compensated each other. They have been largely corrected in the project performance audit report (PPAR), but the benefits have been underestimated as the economic cost of kerosene is underestimated (i.e., the effect of a recent oil price increase, which happened after the PPAR was prepared, is not captured in the PPAR). The recalculated economic internal rate of return (EIRR), after adjusting for the recent kerosene price increase, indicates that the project is economically efficient (Table A5.2).

**Table A5.2: Comparison of Economic Analysis of the Sustainable Rural Electrification Project (Loan 1712)**

<b>Item</b>	<b>RRP</b>	<b>PCR</b>	<b>SAPE</b>
Average monthly consumption $Q_1$ (kWh)	318	70	80
Average tariff $P_1$ (Nu/kWh) <sup>a</sup>	...	...	0.65
Cost of electricity (Nu/kWh)	1.37	1.19	1.85
Capital cost per household (\$)	1,644	1,538	1,360
Incremental benefits (Nu/kWh)	4.24	6.42	14.60
Non-incremental benefits (Nu/kWh)	4.24	22.25	35.4
Incremental consumption (kWh/household)	254	42	76.5
Non-incremental consumption (kWh/household)	64	28	3.5
<b>EIRR</b>	<b>13.0%</b>	<b>14.9%</b>	<b>23.0%</b>

... = not available, EIRR = economic internal rate of return, kWh = kilowatt-hour, RRP = report and recommendation of the President to the Board of Directors, PCR = project completion report, SAPE = sector assistance program evaluation.

<sup>a</sup> The average tariff and cost of electricity as of the year of full commercial completion of the project is shown here. The tariff and cost of electricity during 1999–2009 are based on actual values in the case of the SAPE and thereafter they are assumed to increase by 3.5% in real terms.

Source: IED Staff Estimate.

10. The average consumption and the share of non-incremental benefits were overestimated and the economic benefits per unit of electricity consumption were underestimated in the RRP. The PCR adjusted the average consumption and the economic benefits to a certain extent, but the full extent of the recent increase in the kerosene price were not taken into account. Once the economic benefits are adjusted for the kerosene price, the EIRR improves—indicating that the project is *highly efficient* (Table A5.3).

**Table A5.3: Comparison of Economic Analysis of the Rural Electrification and Network Expansion Project Loan 2009**

Item	RRP	PCR	SAPE
Average monthly consumption $Q_1$ (kWh)	110	65	80
Average tariff $P_1$ (Nu/kWh) <sup>a</sup>	0.89	...	0.82
Cost of electricity (Nu/kWh)	1.38	1.19	1.85
Capital cost per household (\$)	1,494	1,603	1,445
Incremental benefits (Nu/kWh)	9.0	13.2	14.7
Non-incremental benefits (Nu/kWh)	9.0	27.5	35.4
Incremental consumption (kWh/household)	93.4	32.5	76.5
Non-incremental consumption (kWh/household)	17.6	32.5	3.5
<b>EIRR</b>	<b>12.7%</b>	<b>24.4%</b>	<b>21.7%</b>

... = not available, EIRR= economic internal rate of return, kWh = kilowatt-hour, RRP =report and recommendation of the President to the Board of Directors, PCR = project completion report, SAPE = sector assistance program evaluation.

<sup>a</sup> The average tariff and cost of electricity as of the year of full commercial completion of the project is shown here. The tariff and cost of electricity during 1999–2009 are based on actual values in the case of the SAPE and thereafter they are assumed to increase by 3.5% in real terms.

Source: IED Staff Estimates.

11. The average monthly consumption is slightly overestimated in the RRP and the benefit estimates are significantly underestimated because of the lower economic price of kerosene assumed in the RRP. These assumptions have been largely corrected in the PCR, but the PCR has not taken into account the recent increase in the export price of electricity and to that extent the economic cost of electricity is underestimated. However, the PCR assumed that larger proportions of the economic benefits are due to non-incremental benefits. Once these anomalies are corrected, there is a slight drop in the EIRR but it still stays above 18%, confirming that the project is *highly efficient*.

**Table A5.4: Assumptions used for Recalculating the EIRR of the Green Power Development Project ( Grant 0119)<sup>b</sup>**

	SAPE
Average monthly consumption $Q_1$ (kWh)	80
Average tariff $P_1$ (Nu/kWh) <sup>a</sup>	1.10
Cost of electricity (Nu/kWh)	1.85
Capital cost per household (\$)	2,600
Incremental benefits (Nu/kWh)	14.9
Non-incremental benefits (Nu/kWh)	35.4
Incremental consumption (kWh/ household )	76.2
Non-incremental consumption (kWh/household )	3.8
<b>EIRR</b>	<b>11.9%</b>

<sup>a</sup> The average tariff and cost of electricity as of the year of full commercial completion of the project is shown here. The tariff and cost of electricity during 1999–2009 are based on actual values in the case of the SAPE and thereafter they are assumed to increase by 3.5% in real terms.

<sup>b</sup> The comparable assumptions used for arriving the EIRR estimate at the project appraisal stage are not presented in the RRP.

Source: IED Staff Estimates.



12. The likely economic efficiency of the rural electrification component of the ongoing Grant 0119 has also been assessed using a set of assumptions consistent with those used for completed loans, based on the consumption data from the surveys undertaken by the Independent Evaluation Department. The recalculated EIRR of the rural electrification component of the Green Power Development Project is 11.9% and is rated *likely* to be efficient assuming that the household electricity consumption will remain at the same level as households electrified under the completed Sustainable Rural Electrification and Rural Electrification Network Expansion projects. The household electrified under Green Power Development Project belongs to more remote villages, there is a possibility of average consumption of these households being less than the consumption of already electrified households. The EIRR is highly sensitive to the household consumption and 11.9% of EIRR is arrived at by assuming average household consumption of 80 kWh/month and if the average consumption is assumed to be 65 kWh/month, EIRR would reduce to 9.3%.

## REVIEW OF FINANCIAL PERFORMANCE OF POWER SECTOR ENTITIES

1. The power sector in Bhutan consists of two state-owned enterprises: Bhutan Power Corporation (BPC) and Druk Green Power Company (DGPC). BPC is responsible for domestic power supply and power transmission, including the operation of export-oriented power transmission lines within Bhutan. DGPC owns and operate the four export-oriented hydropower plants (HPPs) and is responsible for the debt service associated with the export-oriented HPPs.

2. BPC purchases over 98% of the electricity required for supplying domestic consumers from DGPC, and the reset is generated from BPC-owned embedded mini hydro plants. In addition to domestic power sales, BPC receives a wheeling charge from DGPC for providing transmitting power exports.

### A. Bhutan Power Corporation

3. BPC's financial performance is summarized in Table A6.

**Table A6: Bhutan Power Corporation's Financial Performance**

<i>Item</i>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>
Energy Purchased from DGPC (GWh)	618	637	714	950	1,128
Energy Sales (GWh)	589	619	661	902	1,072
Energy Wheeled (GWh)	1,759	1,777	2,027	4,533	5,922
Average Price of Energy Purchased (Nu/GWh)	0.36	0.36	0.33	0.47	0.42
Average Price of Energy Sales (Nu/GWh)	0.94	0.97	1.12	1.23	1.47
Wheeling Charge (Nu/kWh)	0.125	0.125	0.125	0.125	0.125
Domestic Energy Sales Revenue (Nu million)	555	600	741	1,108	1,572
Wheeling Revenue (Nu million)	220	222	253	567	740
Cost of Energy Purchase (Nu million)	225	225	218	422	457
Interest Cost (Nu million)	3	7	19	24	121
Profit after Tax	(28)	(130)	269	456	670
Cash from Operations (Nu million)	391	69	585	1,032	1,310
Investments (Nu million)	1,270	594	703	4,099	976
Loans Taken (Nu million)	43	310	103	1,303	(156)
Government Equity Investments in BPC				1,563	533
Dividends and Taxes paid by BPC				227	408
<b>Return on Assets (%)</b>	<b>-0.7%</b>	<b>-3.0%</b>	<b>6.4%</b>	<b>8.5%</b>	<b>11.4%</b>

( ) = negative number, BPC = Bhutan Power Corporation, DGPC = Druk Green Power Corporation, GWh = gigawatt-hour, kWh = kilowatt-hour.

Source: Bhutan Power Corporation.

4. The rural electrification program has helped boost the growth rate of customer numbers by an average 12.5% per year, while growth in the amount of electricity sold has been driven by industrial demands and averaged 17.5% per year. The increased in sales to industrial consumers and the regular tariff increases for all consumer categories have combined to increase the average electricity price to Nu1.47 per kilowatt-hour (kWh) in 2008 compared to Nu0.94/kWh in 2004. With the increase in domestic power consumption, mainly from the industrial sector, BPC's power purchase requirement exceeded the royalty energy in 2009,

compelling BPC to purchase electricity at a higher cost from DGPC. This resulted in the purchase price of electricity from DGPC increasing to Nu0.42/kWh by 2008. The results for 2006–2008 indicate that BPC's tariffs were realistic as they enabled BPC to earn satisfactory profits with achievable improvements in operational efficiency and improved return on assets each year up to and including 2008. BPC has been consistently profitable since 2006, only 3 years after its establishment.

5. With the commissioning of Tala HPP in 2007, the transmission lines associated with Tala HPP were transferred to BPC at a cost of Nu 2,278 million; 40% of the cost of Tala HPP has been transferred to BPC as a loan and the remainder as capital reserve as 60% of the cost of Tala HPP was provided as a grant by government of India. This resulted in a substantial increase in BPC's balance sheet. The government continues to inject additional equity into BPC in 2008 to finance some of the transmission lines for domestic power supply.

6. In the medium term (2009–2014), BPC's financial performance is likely to be affected as the government's ambitious rural electrification program is rolled out. Investment in the rural distribution network during 2009–2014 is expected to be Nu5,800 million and further investments amounting to Nu 3,500 million are earmarked for 2010–2015 in the power transmission sector to cater to increasing domestic demand. These investments are likely to be financed with debt financing and BPC's debt service burden is likely to increase from present levels. However, if the government maintains the current policy of providing royalty energy to BPC at a deep discount to the export price, and increases the industrial tariffs to a level of cost recovery, BPC should remain profitable. The 2010 tariff review will be critical and will require difficult decisions, as the power sector does not have the same potential to substantially lift exports before 2014. BPC is under pressure to deliver on government promises of 100% electrification by 2013, and mechanisms will be needed to cover the growing losses that are the inevitable consequence of rural electrification.

7. Notwithstanding the doubling of BPC's asset base over the last 5 years, BPC remains conservatively geared, with debt accounting for 25% of long-term funds. However, BPC's liquidity has begun to come under pressure for a variety of reasons: (i) BPC started to pay income tax in 2007, (ii) the grace period on Asian Development Bank loans for rural electrification expired in 2008 and BPC has been facing an increase in debt service payments, (iii) BPC is compelled to maintain investments in rural electrification to achieve the government target of 100% by 2013, and (iv) BPC has begun to pay dividends since 2008.

## FINANCIAL SUSTAINABILITY ASSESSMENT OF BHUTAN'S POWER SECTOR

1. As the power sector has been a major foreign exchange earner through power exports and a source of fiscal revenues through income tax payments and dividend payments by state-owned power sector companies, the government has consistently adopted the policy of using part of the financial surplus generated from power exports to subsidize the domestic power supply. Since 1995, the government attempted to target this subsidy at the rural residential sector and reduce the subsidy accruing to the industrial sector. After corporatization of the power sector in Bhutan in 2003, a more cost-reflective tariff structure was introduced to ensure better targeting of the subsidy to residential consumers consuming less than 80 kilowatt-hours (kWh).

### A. Tariff Setting prior to Corporatization of the Power Sector, 1995–2002

2. The export tariffs were periodically negotiated with India and set at a level to provide an adequate return to the government from power exports after meeting the debt service obligation associated with Chukka hydropower plant (HPP). Because of the high level of grant element (60%) in the financing structure of Chukka HPP, the export tariffs were set at a relatively low level, i.e., Nu0.4/kWh during 1987–1995. There were several increases in export prices since 1995—a 100% increase in 1997 and a further 50% increase in 1999. By 1999, export prices had reached Nu1.5/kWh, resulting in significant cash flow to Bhutan.

3. Domestic prices were set at the same level as export prices, i.e., 0.4 Nu/kWh until 1995. There was no tariff differentiation across different consumer categories to reflect the cost of supply to different types of consumers. The cost of supply in the western grid differs substantially from the cost of supply in the eastern grid, as the western grid is mainly composed of supplies from Chukka HPP with the cost of energy assumed to be Nu0.5/kWh. However, the cost of energy in the eastern grid is substantially higher as a result of sourcing of energy from small hydros and diesel power plants. The tariff structure and the subsidies to different consumer categories as of 1995 are in Table A7.1

**Table A7.1: Subsidy Analysis for the Power Sector in 1995**

Item	Sales (GWh)	Tariff (Nu/kWh)	Cost of Supply (Nu/kWh)	Subsidy (\$ million)
Industrial	136	0.5	0.53	0.1
Residential–Western	24	0.5	1.55	0.8
Residential–Eastern	10	0.5	5.22	1.5
<b>Total</b>	<b>170</b>	<b>0.5</b>	<b>0.95</b>	<b>2.4</b>

GWh = gigawatt-hour, kWh = kilowatt-hour.

Source: IED Staff Estimates.

4. In recognition of the high degree of subsidies from power exports to domestic power supply, the government adopted a policy of gradual tariff increases. The tariff for rural households was kept at a constant rate of Nu0.5/kWh during 1995–2003 but the urban residential and industrial tariffs were increased from Nu0.5/kWh in 1995 to Nu0.8/kWh in 2002. However, the gross amount of subsidies to domestic power supply from power exports increased because of the increase in total power sales to the domestic sector caused by expanded rural electrification and the increase in consumption by industrial consumers.

## B. Domestic Tariff Setting, 2004–2009

5. With the corporatization of the power sector in 2002, a more cost-reflective tariff structure was adopted. An increasing block tariff structure was introduced in 2003 to the residential sector, with the lifeline block of 80 kWh set at 0.6 Nu/kWh, block II (80 kWh–200 kWh) set at Nu0.9/kWh, and block III (over 200 kWh) set at Nu1.00/kWh. The industrial consumers supplied at high voltage were supplied at Nu0.9/kWh and a demand charge (Nu54/kWh) to provide an incentive to reduce peak demand. Since 2003, regular tariff increases have been approved while maintaining the overall structure. During this period, 2004–2009 the average electricity tariff increased by 66% at an annualized rate of 10.6%. Domestic electricity tariffs in Bhutan since 2004 are in Table A7.2.

**Table A7.2: Domestic Electricity Tariffs in Bhutan Since 2004**

Item	2004	2005	2006	2007	2008	2009
<b>Low Voltage Consumers</b>						
(Nu/kWh)						
Block 1 (up to 80 kWh)	0.60	0.60	0.60	0.70	0.75	0.75
Block <sup>1</sup> II (80 kWh–200 kWh)	0.90	0.95	1.10	1.20	1.25	1.35
Block III (above 200 kWh)	1.00	1.20	1.25	1.45	1.55	1.70
<b>Medium Voltage Consumers</b>						
(6.6/11/33 kV)						
Energy Charge (Nu/kWh)	0.95	0.95	1.10	1.25	1.30	1.43
Capacity Charge (Nu/kW)		54	54	54	65	75
<b>High Voltage Consumers (66 kV and above)</b>						
Energy Charge (Nu/kWh)	0.90	0.90	1.05	1.20	1.29	1.40
Capacity Charge (Nu/kW)		54	54	54	65	75
<b>Av. Electricity Tariff (Nu/kWh)</b>	<b>0.94</b>	<b>0.97</b>	<b>1.12</b>	<b>1.23</b>	<b>1.47</b>	<b>1.56</b>

kV = kilovolt, kW = kilowatt, kWh = kilowatt-hour.

Source: Bhutan Power Corporation.

## C. Electricity Subsidy Analysis since 2004

6. Export prices were maintained at an average rate of Nu1.9/kWh during 2004–2009, and it is expected that the export tariff will increase by 5% every 5 years. However, BPC was allowed to purchase the electricity from Chukka HPP and Kuruchuu HPP for domestic supply at Nu0.3/kWh and from Basochuu HPP at Nu0.5/kWh until 2006. The government has introduced the concept of royalty energy at the tariff determination for 2007–2010 undertaken by newly created BEA. It was decided that 15% of the electricity output from DGPC-operated export-oriented hydropower projects would be considered the royalty energy; and it is provided to BPC at a discounted price of Nu0.3/kWh for supplying domestic consumers. Any energy purchase above 15% of the generation output will have to be purchased by BPC at Nu1.2/kWh.

7. The provision of electricity to BPC at a discounted price to the export price results in loss of export revenues (i.e., economic opportunity cost) and can be considered a subsidy from the export sector to the domestic sector. BPC also receives a fee (i.e., wheeling charges) for the use of Bhutan's power transmission grid for power exports. The wheeling charges are expected to cover the return on capital and operation cost of transmission assets dedicated for power

<sup>1</sup> Since 2007 Block II tariff has been applied for 80–300 kWh and block III for consumption above 300 kWh.

exports and the cost of transmission losses incurred within Bhutan. The wheeling charges have been set at 0.125Nu/kWh since 2004. A cash surplus is accruing to BPC as a result of revenues from wheeling, as the costs associated with power transmission are less than the wheeling charges.

8. Bhutan's power demand is characterized by a large increase in the number of low voltage consumers located in remote locations, resulting from implementation of the government's rural electrification program. However, the net contribution to the increase in domestic power consumption by the residential sector is relatively small and contributed only 14% of the incremental power consumption during 2004–2009. The bulk of the increase in power demand was caused by the energy-intensive industrial consumers attracted to Bhutan by the low electricity tariffs. Industrial consumers consumed over 79% of domestic power consumption in 2009 and contributed to 86% of incremental power demand during 2004–2009.

9. The high investment cost of providing access to households located in remote areas and the low consumption per household have resulted in an increasing trend of cost of supply per unit of electricity supplied to the residential sector. The cost of power supply to residential consumers (low voltage consumers) has increased from Nu4.6/kWh in 2005 to Nu5.33/kWh and is expected to increase to Nu7.17/kWh by 2014. The cost of supply to industrial consumers is relatively low, as it does not involve expensive distribution network investments and administrative costs; the cost of supply in 2009 was estimated to be Nu2.23/kWh. The subsidy per unit of electricity consumed amounted to Nu3.91/kWh for residential consumers based on the prevailing average tariff of Nu1.42/kWh in 2009, and Nu0.64/kWh for industrial consumers based on the prevailing average tariff of Nu1.59/kWh. Table A7.3 breaks down subsidies for power exports and wheeling to different consumer categories for 2005–2014.

**Table A7.3: Subsidy Analysis of Bhutan's Power Sector, 2005–2014**

Item	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
(Nu million)										
Opportunity Cost of Power	1,347	1,357	1,801	2,138	2,687	2,917	3,167	3,439	3,734	4,054
Energy Purchase Cost	225	227	422	457	778	888	1,036	1,198	1,375	1,496
Subsidy on Power Purchase	1,122	1,129	1,379	1,681	1,909	2,029	2,131	2,241	2,359	2,558
Surplus from Wheeling	138	164	211	277	222	237	230	223	214	259
Subsidy to LV Consumers	696	741	920	996	1,076	1,228	1,522	1,711	1,868	1,923
Subsidy to HV Consumers	582	512	551	537	682	826	828	799	540	503
BPC Surplus	(18)	41	119	425	373	212	10	(47)	164	391
Cost of Wheeling (Nu/kWh)	0.047	0.044	0.079	0.078	0.084	0.083	0.085	0.086	0.088	0.084
Cost of LV Supply (Nu/kWh)	4.60	4.58	5.21	5.17	5.33	5.65	6.54	6.79	7.10	7.17
Cost of HV Supply (Nu/kWh)	2.41	2.39	2.22	2.19	2.23	2.29	2.34	2.35	2.36	2.38

( ) = negative number, BPC = Bhutan Power Corporation, kWh = kilowatt-hour, LV = Low Voltage, HV = High Voltage  
Source: IED Staff Estimates.

10. The total cross-subsidy to domestic power supply consists of a subsidy on power purchase and the cash surplus from wheeling charges. The total subsidy to domestic power supply increased from Nu1,260 million in 2005 to Nu2,131 million by 2009. In 2009, 50% of the subsidy amounting to Nu1,076 million was allocated to consumers supplied at low voltage (i.e., households and small businesses). Large industries, supplied with high voltage and consuming more than 79% of domestic power consumption, received only 32% of the subsidy. With completion of the rural electrification program expected by 2014, the total subsidy requirement of the household sector will increase to Nu1,923 million and amount to over 68% of the cash subsidy from power exports to domestic power supply. However, the subsidy requirement for domestic power supply will constitute only 22% of the total cash surplus arising from power exports in 2014.

11. The sustainability of the domestic power supply in the context of the high-cost rural electrification program critically depends on the continued availability of cash subsidies in the form of low-cost electricity to domestic power supply at a discounted price to the economic cost of electricity (i.e., opportunity cost in terms of foregone electricity exports). Under the prevailing policy of providing the royalty energy to BPC at Nu0.3/kWh and the domestic energy requirement in excess of royalty energy at Nu1.2/kWh, with modest increases in domestic tariffs (4% per annum), the cross-subsidy from power exports is more than sufficient to cover the cost of supply to both residential and industrial consumers. With the commissioning of large hydropower plants such as Punatsangchhu I HPP in 2016, the cash surplus in the export sector continues to increase and the power export sector will be able to subsidize the domestic sector while providing an increasing contribution to the country's overall fiscal revenues after meeting the debt service obligations of export-oriented hydropower plants.

## MACROECONOMIC IMPACTS OF EXPORT-ORIENTATED HYDROPOWER DEVELOPMENT

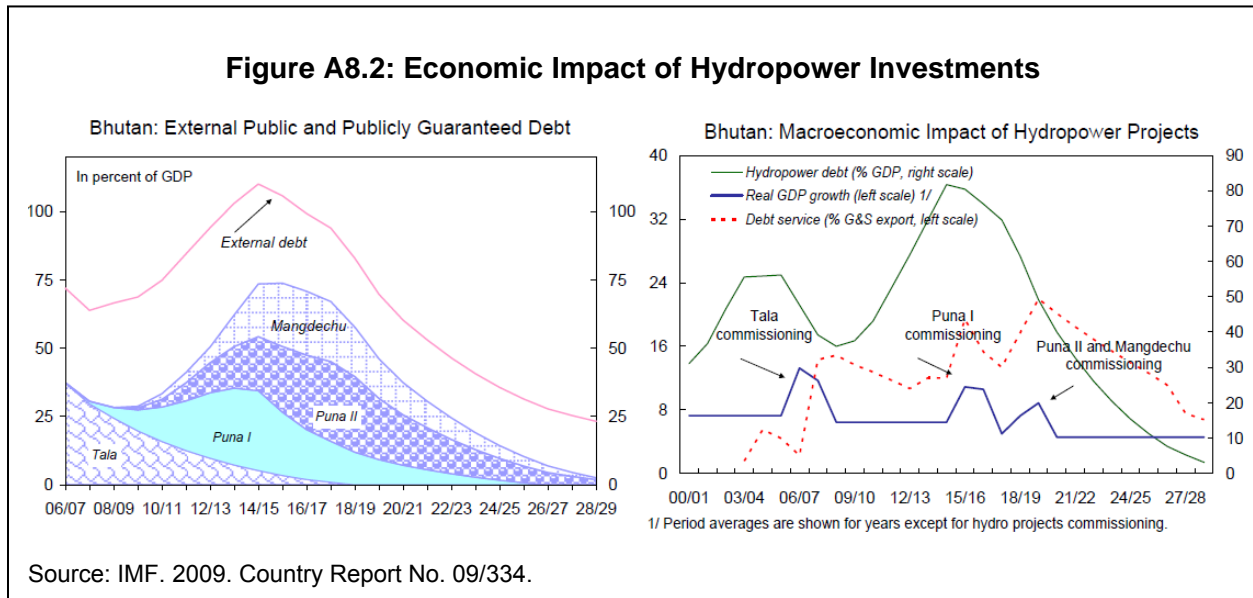
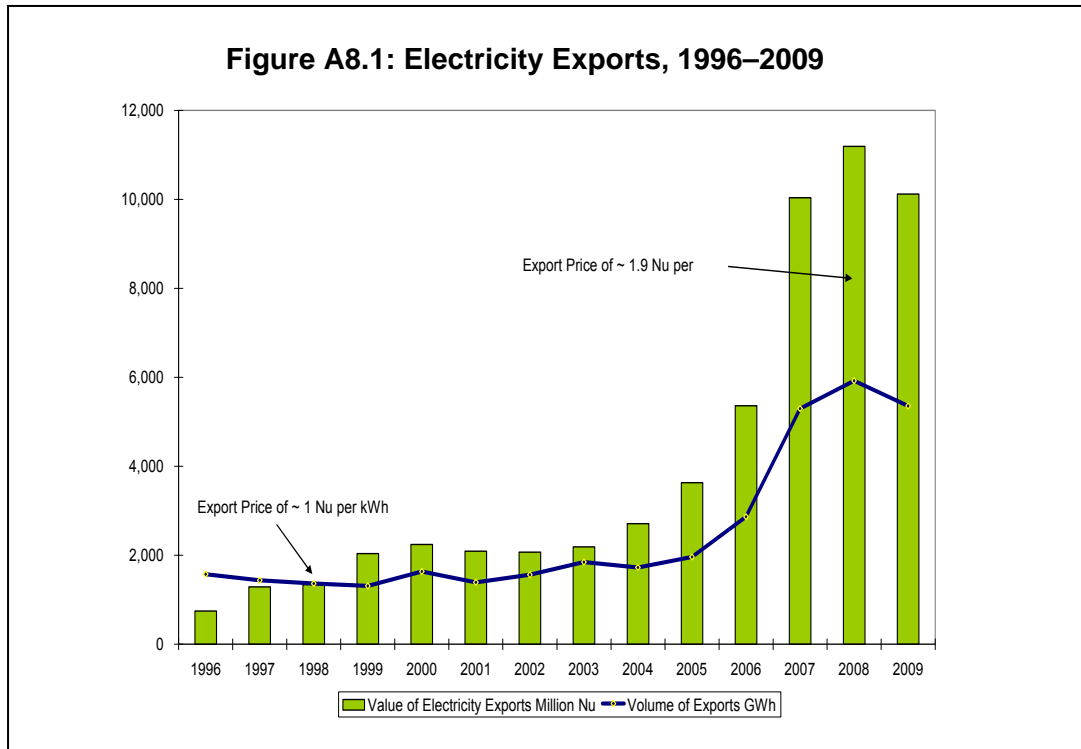
1. Power exports, which accounted for about 21% of total exports in 1996, grew in value in 1997 as India agreed to lift the power purchase price in steps from an average Nu0.5 per kilowatt-hour (kWh) in 1996 to Nu1.5/kWh in 1999. The current export price averages Nu1.9/kWh. The commissioning of Tala hydropower plant (HPP) for 1,020 megawatts (MW) in 2007 had a major impact on both gross domestic product (GDP) and exports, with exports rising to over Nu10 billion. Power exports contributed a significant share to the overall GDP in 2009 as well as the government's fiscal revenues. Power exports in 2008v were 45% of total exports of goods and services, and amounted to 26% of GDP.

2. The export-oriented power generation plants provided an implicit subsidy amounting to Nu1,958 million to the domestic power supply in 2009. After providing for the implicit subsidy (i.e., through power sales to BPC for domestic supply at a deep discount to the export price) for the domestic sector, the operation and maintenance cost, and debt service associated with export-oriented power plants, the cash surplus in the power export sector amounted to about Nu5,100 million or 9% of GDP. This surplus forms part of the government's fiscal revenues as dividend income and tax payments from Druk Green Power Corporation (DGPC). The contribution of power exports to fiscal revenues in 2009 was about 37.5% of total fiscal revenues.

3. In addition to the existing HPPs in operation, two other export-oriented HPPs are under construction. Dagachu HPP (114 MW) is structured as a public-private partnership between DGPC and an Indian private sector company, and it is financed with a debt-equity structure of 70:30. The debt financing of Dagachu HPP is raised in convertible currency from the Asian Development Bank (ADB), i.e., OCR financing, and the Austrian Export Import Bank under commercial terms. As the revenue of Dagachu HPP is in Indian rupees, the project carries exchange rate and interest rate risks. Punatsangchu I HPP (1,200 MW) is financed by the Government of India through a combination of Indian rupee-denominated loans (60%) and grants (40%). Compared to the financing arrangements of Tala HPP, the grant element has been reduced from 60% to 40%, the loan component has been increased to 60% from 40%, and the interest rate has been increased to 10% from 9%. Construction of Dagachu HPP and Punatsangchu I HPP began in 2008; Dagachu HPP is expected to be completed by 2014 and Punatsangchu I HPP by 2016.

4. Two other large export-oriented hydropower projects are at an advanced stage of preparation with Government of India financing. Intergovernmental agreements for Punatsangchu II HPP (990 MW) and Mangdechu HPP (720 MW) are expected to be signed in 2010, and construction is to commence in 2011 with project commissioning expected in 2019. The financing terms for both projects are yet to be finalized, but they are expected to be similar to Punatsangchu I HPP with a 30% grant and 70% loan in Indian rupees at an 11% interest rate. Debt service will begin after commissioning in 2019 and will continue for 12 years. Although the financing terms of Punatsangchu II HPP and Mangdechu HPP are not strictly concessional (i.e., below the 35% grant element according to the International Monetary Fund definition of concessional financing), there is a high degree of concessionality stemming from the grant portion of financing and the exemption of payment of interest during construction. The macroeconomic impacts of electricity exports in terms of value of power exports, increase in public sector debt and debt service as a percentage of GDP, and the overall GDP growth are shown in Figures A8.1 and A8.2.





5. The addition of debt from Tala HPP and the expected addition of further debt from new hydropower projects to be commissioned during 2014–2019 will see a substantial buildup in external debt. While the debt buildup increases Bhutan’s vulnerabilities to the investment and operating risks of the hydropower industry, the external debt service payments are expected to be met with earnings from electricity exports as and when the new projects come on stream. The hydropower related debt will amount to about 80% of GDP by 2017 and the debt service as a percentage of goods and service exports will increase to about 50% by 2020.

6. However, the increase in debt burden will be accompanied by an increase in the contribution of hydropower exports to GDP (i.e., increasing to about 48% by 2020 from 26% in 2009). After the commissioning of Dagachhuu HPP in 2014 and Punatsangchhu I HPP in 2017, electricity exports in 2016 will be over Nu34 billion and will exceed Nu70 billion by 2019 with the commissioning of Punatsangchhu II HPP and Mangedechuu HPPs. Domestic sales by the export-oriented hydropower projects to BPC reached Nu778 million in 2009 and this is expected to increase to Nu1,500 million by 2014. After meeting the debt service obligations, the net cash surplus of the power export sector in 2017 will be Nu24 billion (22.5% of the projected GDP in 2017) and this will increase to Nu45 billion in 2020 (31% of projected GDP in 2020) after Punatsangchhu II HPP and Mangedechuu HPP are commissioned.

7. The financial performance of the export-oriented power sector is summarized in Table A8.

**Table A8: Financial Performance of Export-Oriented Power Sector**

<b>Item</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2014</b>	<b>2017</b>	<b>2020</b>
Export Revenues	3,606	3,953	8,922	11,776	10,857	12,750	34,398	71,706
Domestic Revenues	225	218	423	457	778	1,582	1,391	932
Operation and Maintenance Cost	423	444	1,422	1,422	1,422	1,611	2,433	6,423
Debt Service	715	685	1,091	4,543	4,449	3,820	7,594	18,532
Wheeling Charges	231	253	566	740	676	684	1,231	2,152
Subsidy to Domestic Sector								
Cash Surplus	2,461	2,788	6,265	5,527	5,088	8,217	24,532	45,532

Source: Independent Evaluation Department staff estimates.

8. The Government of India has committed to support the construction of 10 large hydropower projects having a total capacity of 11,620 MW, including Punatsangchu I and II HPPs and Mangedechuu HPP. These projects are presently at the (i) construction stage (Punatsangchu I); (ii) pre-construction stage (Punatsangchu I and Mangedechuu HPPs); and (iii) detail technical design stage. Although construction of the projects belonging to the third category (i.e., under detail technical stage) is expected to commence before 2015, it is unlikely that they will be commissioned before 2020. Hence, these financial projects pertain only to projects that are either operational, under construction, or at the pre-construction stage.

## MANAGEMENT RESPONSE TO THE SECTOR ASSISTANCE PROGRAM EVALUATION FOR BHUTAN ENERGY SECTOR

On 13 September 2010, the Director General, Independent Evaluation Department, received the following response from the Managing Director General on behalf of Management:

### General Comments

1. We appreciate the comprehensive evaluation of ADB's assistance to the Bhutan energy sector from 1999 to 2009 in the Sector Assistance Program Evaluation (SAPE). We commend IED's in-depth analysis and evaluation in identifying the strengths of the ADB energy sector program and the potential areas for our future assistance.

2. We note that the overall assessment of the ADB energy sector program has been rated "successful" with both the top-down and bottom-up approaches. This confirms the contributions of ADB assistance in (i) transforming the power sector into a highly-profitable sector, (ii) improving the sector governance framework through institutional and policy reforms, (iii) expanding access to electricity, and (iv) pioneering new business opportunities for regional power trading through public-private partnerships (PPP) and cross-border clean development mechanisms (CDM). We also note that ADB's assistance has been highly effective in achieving development outcomes and that its strategic positioning has been rated "highly satisfactory".

### II. Comments on Specific Recommendations

3. **Recommendation 1: Consider supporting the grid-connected renewable energy projects, including small hydro-power projects (below 25 MW).** We agree. We support the strategy of developing alternative renewable energy projects to reduce over-dependence on hydropower and improve the country's energy security. The proposed 2010 grant Rural Renewable Energy Development Project focuses on an energy mix of renewable energy resources from solar, wind, and biogas, in addition to hydropower. These demonstration subprojects are being promoted together with the formulation of the renewable energy policy, which has been supported by an ongoing capacity development technical assistance (TA).<sup>1</sup> The proposed country operations business plan includes TA support for preparing potential inventories for renewable energy projects such as solar, wind, biomass, and small and mini- hydropower under a development master plan, and for creating an enabling environment and financial mechanisms to promote both public and private investments. ADB will continue to support these new areas while paying attention to advanced technologies and the financial viability of renewable energy.

4. **Recommendation 2: Increase efforts to develop follow-up PPP transactions to the Dagachhu hydropower project.** We agree. We support leveraging of impacts through follow-up hydropower PPPs based on our experience with innovative transactions for Dagachhu hydropower export

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<sup>1</sup> ADB. 2008. *Technical Assistance to the Kingdom of Bhutan for Promotion of Clean Power Export Development*. Manila.

development under the Green Power Development Project.<sup>2</sup> The successful registration of this project as the world's first cross-border CDM has motivated preparation of similar projects in Bhutan. Under the ongoing capacity development TA referred to in para. 3, we have been assisting Bhutan in enhancing its capacity to carry out its own feasibility studies for a follow-on power export project. To balance various risks related to cross-border hydropower development, ADB will continue its policy dialogue with the government on subsequent development and transaction opportunities.

**5. Recommendation 3: Increase focus on the environmental sustainability of large hydropower development.** We agree. In June 2010, ADB commenced implementation of the TA on Capacity Building for the National Environment Commission in Climate Change.<sup>3</sup> This TA will mainstream climate change risks in the environment assessments of the National Environment Commission (NEC), which is the government's nodal agency for environment protection and climate change. NEC will focus on strengthening environmentally sustainable measures, particularly in utilizing water resources which are the backbone of the country's economy and people's livelihoods. To incorporate effective mitigation measures in the design of hydropower projects, the TA promoting clean power referred to in para. 3 above has been supporting the Druk Green Power Corporation in building its capacity to manage environmental impacts as a project developer. Through these capacity development initiatives, ADB intends to expand its policy dialogue to support future environmental and climate change activities in partnership with other donors.

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<sup>2</sup> ADB. 2008. *Report and Recommendation of the President to the Board of Directors: Proposed Loans, Asian Development Fund Grant, Technical Assistance Grant, and Administration of Grant to the Kingdom of Bhutan for the Green Power Development Project*. Manila.

<sup>3</sup> ADB. 2009. *Technical Assistance to the Kingdom of Bhutan for Capacity Building the National Environment Commission in Climate Change*. Manila.

## **DEVELOPMENT EFFECTIVENESS COMMITTEE OF THE BOARD**

### **Chair's Summary of the Committee's Discussion on 15 September 2010**

#### **Country Assistance Program Evaluation—Bhutan (DOC.IN.180-10)**

1. Director General, IED highlighted that ADB's assistance in Bhutan has been well-focused, consistent with the core areas of Strategy 2020, and aligned with the government's priorities. Although ADB's program has been successful, more attention is required to improve implementation and sustainability, particularly, of transport projects. IED has noted and supports the government's request for ADB's in-country presence.

2. Director General, SARD mentioned that Bhutan is on the right track in achieving most of the targets of the Millennium Development Goals (MDG), as MDG indicators have been generally achieved for malnutrition and hunger, water supply and sanitation, and education including gender parity. The only area that needs more effort to achieve MDG goals relates to maternal mortality. Bhutan is also a model of regional cooperation and integration (RCI) activities, where ADB is actively engaged, particularly in realizing the real economic value of the country's hydropower resources.

#### **Aid coordination**

3. DEC Chair viewed that a comparison of per capita contribution among donors could help in assessing the extent of coordination that could be expected, since in cases where there are several donors providing only small contributions, coordination may turn out to be time-consuming with enormous transactions costs. Staff, IED clarified that there was little ADB coordination with some of the largest donors in Bhutan despite their engagement in assistance activities related to ADB's programs. DEC members noted IED's proposal for better coordination. Director General, IED further suggested that in-country presence of ADB could strengthen donor coordination.

4. DEC members noted ADB's limited use of cofinancing arrangements. Staff, IED clarified that many donors' preferred to engage directly with the government, while some had actually reduced their assistance.

#### **Measuring development effectiveness**

5. DEC expressed disappointment on the non-availability of baseline data that could help in measuring outcomes and impact of ADB's program in Bhutan. Staff, SAEN explained that for rural electrification, surveys on willingness-to-pay and other economic information were conducted prior to the start of the projects. However, the government, which owned the raw data, did not retain the data. ADB has since been in constant dialogue with the government on the importance of maintaining baseline data. Staff, SAOC also mentioned that technical assistance targeting improving data collection and maintenance had also been provided. Director General, IED mentioned that, in the absence of baseline data, IED is adopting other approaches such as measuring impact through rigorous impact evaluations. One such study on Bhutan's rural electrification would present findings that could give a better picture of the outcomes and impact of electrification.

## **Project implementation delays**

6. DEC expressed concern on delays in project start-ups that may have also caused cost overruns. Staff, IED noted that cost-overruns and implementation delays have mainly resulted from project design problems, low capacity of domestic contractors, and land acquisition issues. DEC Chair expressed the view that differences between ADB and national procurement guidelines could have been resolved earlier to help address the problem of implementation delays.

7. Director General, SARD emphasized the feedback from the government that TAs have contributed to capacity building and knowledge transfer to Bhutan. He acknowledged the difficulties in supervising TAs, and mentioned that ADB is taking measures to address these through spring-cleaning, streamlining, and narrowing and sharpening the focus of TAs. He felt that in-country presence of ADB in Bhutan could improve portfolio management and TA implementation performance, including supervision of consultants. Staff, SATC explained that project start-up delays have been below ADB average, and were usually caused by the long period required of about 12 months to select consultants for detailed designs. SARD had requested applying a single-source selection method to a transport project in Bhutan in 2009 that saved 12 months for consultant selection. DEC members noted that single-source selection may be justified in certain cases, but not by the consideration that application of that method could save time.

## **ADB's in-country presence**

8. DEC concurred with IED's recommendation for a resident mission (RM) in Bhutan, but inquired about the general conditions mandating a resident presence/field office in a DMC. DEC emphasized the importance of assessing the costs against the benefits, taking into consideration the size of the portfolio and achieving development effectiveness. Some DEC members suggested exploring similar issues within the context of ADB's RM policy and noted that an update of the RM Policy would be useful. Management believes that some issues mentioned earlier on implementation delays, supervision of consultants, and donor coordination could be addressed by setting up a field office in Bhutan.

## **Sector focus**

9. DEC members noted ADB's limited success in finance and private sector development. Relevant expertise in these sectors would be necessary. One DEC member inquired on how engagement in export-oriented agriculture/horticulture, support to domestic construction industry, and promotion of industrial development could be prioritized as these sectors are not included in the core areas of operations identified under Strategy 2020. Staff, IED explained that the CAPE was referring to the need for coordinating ongoing ADB assistance for SME development with private sector-based employment generation initiatives of the Government. The effectiveness of ongoing ADB assistance to the financial sector is likely to be higher than that of previous assistance due to Government commitment to less state intervention and a more commercial orientation of the sector. Director General, SARD also mentioned capacity and resource issues that need to be addressed within ADB in order to support its assistance to the finance sector.

## **Sustainability**

10. There had been recurring sustainability issues, particularly, operations and maintenance, which Staff, IED noted were not only due to capacity but also financial resource constraints. To

address this issue IED has proposed that ADB should engage in systematic policy dialogue on adequate budget provisions or self-financing mechanisms. Staff, SATC described the policy dialogue for operations and maintenance of transport projects that would ensure that all requirements for proper maintenance are included in the budget. She noted that TAs would also play an important role in effectively implementing road maintenance.

### **Sector Assistance Program Evaluation—Bhutan: Energy Sector (DOC.IN.192-10)**

11. Under the sector assistance program evaluation (SAPE) for the Bhutan's energy sector, IED recommended that for electrification of remote areas, ADB should consider feasible and sustainable life cycle least-cost alternatives to grid extensions, such as off-grid renewable sources.

12. In terms of knowledge transfer, one DEC member suggested that ADB should share the lessons learned from successful energy projects with neighboring countries that have similar natural environment. Another DEC member noted that economic benefits from rural electrification were below expectations, and poor households had not benefited much from network expansion as compared to better-off households. He also inquired about the cost-effectiveness of small hydropower projects and the practicality of developing other renewable energy sources.

13. Director General, IED explained that the SAPE recommends renewable energy in the context of very remote areas, where extending a grid could be prohibitively expensive. The IED staff also mentioned that developing non hydro forms of renewable energy subject to their economic viability can reduce Bhutan's dependency on hydropower for electricity supply.

14. Some DEC members noted certain issues pertaining to resettlement and safeguards, particularly the detailed and cumbersome compliance guidelines. These members observed that guidelines are not customized to suit country conditions and the nature of projects and subprojects.

### **Conclusions**

15. DEC noted that Bhutan's economy had an average annual growth rate of 8.9% for the period 2000-2008, and per capita income increased from \$752 in 2000 to \$1,978 in 2008. Poverty levels came down from 36.3% of total population in 2000 to 23.2% in 2007.

16. DEC also noted that ADB's net resource transfers had financed about 5% of Bhutan's annual investment expenditure of about \$180 million in 2000-2009. Bhutan has been a successful case of development partnership between ADB and a member country.

17. DEC noted that energy has been one of the most dynamic sectors contributing to economic growth in Bhutan. Rural electrification has been a major development agenda of the government, and substantial progress has been made. However, DEC noted that providing connections, including off-grid solutions, to remote households and to isolated households in remote areas was becoming costly. Some rationalization in location of habitations may be considered.

18. DEC emphasized more focus on baseline information and continuous monitoring of data to implement the results framework.

19. Implementation delays should be reduced through better quality of project preparatory technical assistance, firmer alignment and designs, expeditious recruitment of consultants, and application of project readiness filters.

20. Operation and maintenance was a critical issue and ADB was encouraged to engage the authorities on the need to pay greater attention to operation and maintenance.

21. DEC encouraged staff to improve development partner coordination, improve quality of technical assistance through better monitoring of consultants and close coordination by staff, and aligning safeguard policies to national laws and practices.

**Ashok K. Lahiri**  
**Chair, DEC**