



Report and Recommendation of the President to the Board of Directors

Project Number: 37399
October 2008

Proposed Loans, Asian Development Fund Grant,
Technical Assistance Grant, and Administration of
Grant
Bhutan: Green Power Development Project

CURRENCY EQUIVALENTS

(as of 1 September 2008)

Currency Unit – ngultrum (Nu)

Nu1.00 = \$0.023

\$1.00 = Nu43.95

ABBREVIATIONS

ACEF	–	Asian Clean Energy Fund
ADB	–	Asian Development Bank
ADF	–	Asian Development Fund
BEA	–	Bhutan Electricity Authority
BPC	–	Bhutan Power Corporation
CDM	–	clean development mechanism
CDTA	–	capacity development technical assistance
DGPC	–	Druk Green Power Corporation
DHI	–	Druk Holding and Investments
DHPC	–	Dagachhu Hydro Power Corporation
DOE	–	Department of Energy
EIA	–	environmental impact assessment
FIRR	–	financial internal rate of return
FYP	–	five-year plan
GDP	–	gross domestic product
EIA	–	environmental impact assessment
EMP	–	environmental management plan
ICB	–	international competitive bidding
IDA	–	International Development Association
IEE	–	initial environmental examination
IMF	–	International Monetary Fund
NCB	–	national competitive bidding
NEC	–	National Environment Commission
NPPF	–	National Pension and Provident Fund
NPV	–	net present value
OCR	–	ordinary capital resources
OeKB	–	Oesterreichische Kontrollbank Aktiengesellschaft (Austrian export credit agency)
PAVA	–	Property Assessment and Valuation Agency
PPA	–	power purchase agreement
PPP	–	public–private partnership
RED	–	Renewable Energy Division
TA	–	technical assistance
THPA	–	Tala Hydroelectric Project Authority
TPC	–	Tata Power Company
TPTC	–	Tata Power Trading Company
WACC	–	weighted average cost of capital

WEIGHTS AND MEASURES

GWh	–	gigawatt-hour
kV	–	kilovolt, 1,000 volts
kWh	–	kilowatt-hour
MW	–	megawatt

NOTES

- (i) The fiscal year (FY) of the Government ends on 30 June. The fiscal year of its companies ends on 31 December. FY before a calendar year denotes the year in which the fiscal year ends.
- (ii) In this report, "\$" refers to US dollars.

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- A. Detailed Debt Sustainability Assessment
- B. Outline Terms of Reference and Cost Estimates of Technical Assistance
- C. Detailed Financial Performance
- D. Detailed Economic Analysis
- E. Short Resettlement Plan
- F. Poverty and Social Analysis
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- H. Summary Initial Environment Examination and Initial Environment Examinations
- I. Risk Mitigation Analysis
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- K. National Competitive Bidding Annex for Bhutan
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LOAN AND GRANT PROJECT SUMMARY

Borrower	Kingdom of Bhutan
Classification	Targeting classification: General intervention Sector: Energy Subsectors: Renewable energy generation Themes: Sustainable economic growth, private sector development, regional cooperation Subthemes: Fostering physical infrastructure development, public–private partnerships, cross-border infrastructure
Environment Assessment	Category B. An initial environmental examination was completed.
Social Assessment	Category B for involuntary resettlement and category C for indigenous peoples.
Project Description	<p>The Green Power Development Project has two components: (i) regional clean power trade, and (ii) renewable energy access for the poor. Under the first component, the Dagachhu hydropower development (a 114-megawatt [MW] run-of-river type) aims to export power from Bhutan to India through the existing grid to India. The rural electrification component will provide access to electricity sourced from hydropower to 8,767 households and facilities with grid extensions, and electricity sourced from solar energy to 119 remote public facilities (e.g., schools, health clinics, and other community facilities) on an off-grid basis.</p> <p>The Dagachhu hydropower development will be promoted by a joint venture company between Druk Green Power Corporation (DGPC) in Bhutan and Tata Power Company (TPC) in India through a public–private partnership (PPP). The rural electrification component will be mainly served by Bhutan Power Corporation (BPC), a public utility service company.</p>
Rationale	<p>Bhutan has substantial clean and renewable hydropower capacity. Theoretical potential hydropower is 26,760 MW—only about 6% is being used. Of the total 1,500 MW installed, 80% is exported to India after meeting domestic consumption. Power exports account for the largest source of Government revenue in the form of taxes and dividends from hydropower companies. Despite the nation’s net power surplus for export, most rural residents do not have access to electricity. Only 40% of rural households use electricity as their main source of lighting as compared to 96.4% of urban households. Expansion of rural electrification will provide access to more remote rural areas where the costs of investment, operation, and maintenance will be higher due to low population</p>

density and unfavorable terrain.

Since about 70% of the population lives in rural areas, electricity for all is a significant implementation challenge. Operating subsidies are essential to ensure the sustainability of expanding rural electrification. In Bhutan, subsidies are regulated and provided from royalty revenues yielded from power exports to cross-subsidize electricity prices, in particular for rural domestic customers. The Government distributes the remaining power export revenues to support socioeconomic goals, such as health and education, as well as infrastructure development, e.g., rural roads and bridges. Thus, rural electrification and hydropower export are strongly interrelated with inclusive economic growth and poverty reduction. Expanding generation capacity for export and rural access to electricity will enhance energy and social security.

The Government aims for (i) 100% electrification by 2013, and (ii) an additional 10,000 MW of hydropower development and trading by 2020. In rural areas, electricity from hydropower and solar sources will replace kerosene and fuelwood. Given the coal-dominated Indian power market, clean energy development for power export will promote low-carbon energy sources and foster economic cooperation in the South Asia region.

Accelerating the development of hydropower for export is of strategic significance for Bhutan's economy. Given the Government's limited fiscal capacity for large infrastructure projects, the hydropower development strategy is to leverage public and private investments through private participation in development projects. This approach is expected to accelerate hydropower development, and generate income for more socioeconomic development. To promote the country's strategy, the project preparatory technical assistance (TA) supported the Government in establishing a policy and institutional framework for public and private participation in hydropower development. The Dagachhu hydropower development is a demonstration PPP facility in line with the Hydropower Development Policy, which is to promote private and foreign investments for hydropower generation in Bhutan. Further TA support will be provided to develop Government capacity for hydropower export.

Impact and Outcome

The impact of the Project is to sustain the country's inclusive economic growth by promoting cross-border power trade and electricity access. As an outcome, the power sector is to improve the coverage of distribution and expand electricity export through clean power development in a sustainable manner. Investment for Dagachhu hydropower will generate a long-term revenue stream for Bhutan to finance its enormous development needs in social infrastructure, such as health and education, as well as economic infrastructure facilities like roads and electricity supplies. They will

form the basis of rural development and poverty reduction in the country. Investment for rural electrification will improve access to electricity by rural households and small businesses, and replace more expensive and polluting kerosene and fuelwood with renewable hydropower and solar energy. It will make social interventions to the poor and improve the standard of living and quality of life of people living in rural areas. The Dagachhu development will generate export revenues, which will be used for subsidies to maintain low-cost power supplies to rural electrification, while exporting power to India through which cross-border cooperation and regional energy efficiency will be enhanced.

Output

Regional Clean Power Trade. The Dagachhu hydropower development will be a 114 MW run-of-river, with minimal adverse environmental and social impacts. Generated power will be sold to India through the existing grid connected to India. As the first undertaking of a commercial nature in Bhutan, the Dagachhu plant will be developed through PPP to leverage private capital and maximize the impacts of the government investment. DGPC (a Bhutanese state-owned company) and TPC (Indian private power company) agreed to a joint venture arrangement, and Dagachhu Hydro Power Corporation (DHPC) was incorporated as the project special purpose company. The Government envisages that the Dagachhu development will be a pilot case to catalyze private participation and accelerate hydropower development. Since the Dagachhu development has applied for the United Nations Framework Convention on Climate Change under the Clean Development Mechanism (CDM) as defined in the Kyoto Protocol, it will be a showcase cross-border CDM project. These outputs will help create a competitive investment environment in regional power trading and clean energy development.

Renewable Energy Access for the Poor. The rural electrification system will be extended to provide clean and reliable power supply to rural areas mainly in seven districts of Bhutan. It will electrify 8,767 domestic households and facilities in remote central and eastern regions. In addition to the grid extension, 119 solar photovoltaic systems, using an emerging energy-efficient technology, will be installed to support electrification in isolated off-grid rural areas, especially schools, health clinics, monasteries, and other community facilities.

Project Investment Plan

The investment cost of the Project is estimated at \$234.45 million, including contingencies and financing charges, comprising \$201.47 million for regional clean power trade, and \$32.98 million equivalent for renewable energy access for the poor.

Financing Plan

Regional Clean Power Trade. The Dagachhu hydropower development will cost \$201.47 million, including debt of \$121.47 million (60%) and equity of \$80.0 million (40%). ADB will

finance \$80 million as anchor money to take a lead in the financial structuring. The Kingdom of Bhutan will be the borrower of the ADB loans from ordinary capital resources (OCR) and hard-term Asian Development Fund (ADF). Of the \$80 million, ADB will provide \$51 million (OCR) to the debt portion of the Dagachhu development, and \$29 million (hard-term ADF) to the equity portion through lending to the Government. The entire equity will be funded through Bhutan's public sector including the Government, DGPC, and National Pension and Provident Fund (NPPF); and the Indian private company, TPC. The debt balance is expected to be cofinanced by the Austrian Export Credit Agency (ECA) (\$55.46 million) and NPPF (\$15 million).

Renewable Energy Access for the Poor. The ADB grant of \$25.28 million equivalent from the ADF will support the on-grid component for rural electrification. The Government will finance the balance of \$6.64 million equivalent. The Asian Clean Energy Fund (ACEF) established by the Government of Japan and administered by the Clean Energy Financing Partnership Facility (CEFPF) is expected to provide an additional grant cofinancing of \$1.00 million for the off-grid component for rural electrification.

Source	Financing Plan (\$ million)		Total
	Dagachhu Hydropower	Rural Electrification	
ADB			
OCR loan	51.00		51.00
Hard-term ADF loan	29.00		29.00
ADF grant		25.28	25.28
ACEF under CEFPF ^a		1.00	1.00 ^a
Subtotal	80.00	26.28	106.28
Austrian ECA	55.46		55.46
Government^b	45.01	6.70	51.71
Tata Power Company	21.00		21.00
Total	201.47	32.98	234.45

ACEF = Asian Clean Energy Fund, ADB = Asian Development Bank, CEFPF = Clean Energy Financing Partnership Facility, ECA = export credit agency.

^a Subject to approval from the Government of Japan.

^b Includes the Government-owned company (DGPC) and fund (NPPF).

A loan of \$51,000,000 from ADB's OCR will be provided under ADB's London interbank offered rate (LIBOR)-based lending facility. The loan will have a 30-year term including a grace period of 5 years, an interest rate determined in accordance with ADB's LIBOR-based lending facility, a commitment charge of 0.15% per annum, and such other terms and conditions set forth in the draft loan and project agreements.

A loan of \$29,000,000 will be provided under terms for hard-term loans from the ADF. The loan will have a 32-year term including a

grace period of 8 years, a fixed interest rate of 3.15% per annum, and such other terms and conditions set forth in the draft loan and project agreements.

A grant of \$25,280,000 equivalent will be provided from the ADF for the on-grid component of rural electrification.

A grant of \$1,000,000 to be administered by ADB will be provided from the ACEF under the CEFPPF, subject to approval from the Government of Japan.

The proposed ADB financing plan is in accordance with the graduation policy and revised ADF grant framework, which allows nonconcessional term lending (i.e., OCR) on an exceptional basis, hard-term ADF lending, and/or guarantees for grant-eligible ADF countries including Bhutan for projects that earn foreign exchange and are able to fully service their foreign debt from their net foreign exchange earnings.

**Allocation and
Relending Terms**

The Government will relend the ADB loans to DGPC and DHPC, pursuant to subsidiary loan agreements with terms and conditions acceptable to ADB. While the relending terms and conditions will be the same as the ADB loans, DGPC and DHPC will assume the foreign exchange risks.

The Government will relend the ADF grant proceeds to BPC with no interest, pursuant to a subsidiary loan agreement with terms and conditions acceptable to ADB.

Period of Utilization

31 December 2013

**Estimated Project
Completion Date**

30 June 2013

Executing Agencies

DGPC will be the Executing Agency for the Dagachhu hydropower component, and the Department of Energy (DOE) of the Ministry of Economic Affairs will be the Executing Agency for the rural electrification component.

**Implementation
Arrangements**

DGPC will be responsible for overall execution and coordination of the Dagachhu hydropower component, and DHPC, the Implementing Agency, will undertake project implementation and administration. DOE will be responsible for overall execution and coordination of the rural electrification component. The implementing agencies—BPC (for the on-grid component) and DOE (for the off-grid component)—will undertake project implementation and administration for their respective areas.

Procurement

Civil works, materials, and goods to be financed by ADB will be procured in accordance with ADB's *Procurement Guidelines* (2007, as amended from time to time) following international

and/or national competitive bidding. Advanced contracting is endorsed to facilitate timely procurement and implementation.

Consulting Services

The off-grid rural electrification package will include small-scale consultant services to support DOE in implementing procurement and installation of solar panels. Consultants will be selected and engaged in accordance with ADB's *Guidelines on the Use of Consultants* (2007, as amended from time to time) and individual experts will be recruited based on biodata submitted in specific terms of reference for assignments.

Project Benefits and Beneficiaries

The first PPP modality demonstrated by the Dagachhu hydropower development will be catalytic for future public and private investment in Bhutan. Coupled with the Hydropower Development Policy, clean and renewable energy development and trade will be promoted for the country's and region's economic benefits.

In accordance with the Tariff Determination Regulations 2006, the royalty revenue yielded from power export from the Dagachhu development will be used to subsidize electricity for rural domestic customers, in particular under a lifeline tariff. Since the Government estimates that more than 90% of the poor live in rural areas, rural electrification will contribute significantly to socioeconomic development and poverty reduction for about 9,000 households and 55,000 residents, representing almost 10% of the national population. Rural electrification is expected to create opportunities for alternate income-earning avenues and development of rural industries, and improve access to social services such as education and health. After implementation of the component, the national rural electrification ratio is expected to be increased to 84% from the current 60%.

Power exports will increase the Government's revenue base and enable it to allocate more resources to socioeconomic development including health, education, and rural electrification. In 2006/07, revenues from power exports contributed to all the expenditures for the agriculture and social sectors (e.g., health and education). During the next five-year plan, the Government considers that revenues from hydropower development will be the major sources to directly improve social quality of life and reduce poverty. Incremental income from power exports will be used for improving and expanding road and bridge infrastructure to promote rural development for poverty reduction. The enhanced infrastructure will encourage tourism, agribusiness, and communication; and thus contribute to inclusive economic growth. It will also encourage private sector operations and help create new employment opportunities.

In Bhutan, wood is still predominately used for fuel, especially by the poor (with 83% of total consumption); electricity and gas are

widely used for cooking by urban residents (90%). Rural households in nonelectrified villages depend on kerosene for lighting. Therefore, access to electricity sourced from hydropower and solar will have significant positive environmental impacts, such as reduced use of fossil fuels and deforestation due to firewood harvesting. Export of the clean power surplus will lower greenhouse gas emissions (500,000 tons per year) of the coal-dominated Indian power market.

Risks and Assumptions

Dagachhu Hydropower. The main external risks relate to off-take and CDM. The first risk will be mitigated by a 25-year power purchase agreement with Tata Power Trading Company (TPTC). The agreement has a constant escalation, which will make the tariff revision risk minimal. The small size of the 114 MW Dagachhu generation capacity will likely be absorbed by the vast power demand–supply gap in India. Second, the Dagachhu hydropower development is based on the assumption that additional cash flows will be generated from the sale of carbon emission reductions, however, the nature of a post-2012 CDM framework is as yet unknown. To mitigate the risk of this uncertainty, DHPC and TPTC have in principle agreed for the purchase of the emission reductions to be underwritten by TPTC over the 30 year duration at a specific minimum price.

Potential risks for the Dagachhu development include (i) increase in prices of civil works and equipment, and (ii) delays in project implementation and operation. The cost and time overrun risks are to be mitigated by contractual warranties in engineering, procurement, and construction contracts. Sufficient physical and price contingencies have been considered for any increase in the equipment and civil works costs. The implementation capacity of the development sponsors will also be important. The main developer, DGPC, has implemented hydropower projects with various agencies and is operating four hydropower plants in Bhutan. DHPC is adequately staffed with personnel experienced in executing hydropower projects. This will minimize the risk of cost and time overruns, along with a PPP arrangement with TPC, a joint venture partner, with extensive experience in implementing and operating hydropower projects worldwide. The Government of Austria will fund TA to strengthen DHPC's capacity for implementation and supervision during construction.

Rural Electrification. Potential risks include (i) increase in cost of construction materials and transportation due to higher fuel prices, (ii) construction delays due to procurement and contract awards, and (iii) difficult accessibility due to undeveloped access roads. These risks are to be mitigated by (i) adequate physical and price contingencies and cost estimates based on 2008 actual bid prices, (ii) advance procurement action, and (iii) integration of road development plans in rural electrification programs. The Government has firmly committed support for implementation and

counterpart funding.

Technical Assistance

A capacity development technical assistance (CDTA) will be attached to the Project. The Regional Cooperation and Integration Fund under the Regional Cooperation and Integration Financing Partnership Facility will provide a grant of \$888,000 and the ADB TA funding program will provide \$600,000, for a total of \$1,488,000. The CDTA for Promotion of Clean Power Export Development aims to (i) develop capacity (e.g., risk management and project structuring, and public and private participation promotion) for DOE, DGPC, and Druk Holding and Investments; (ii) conduct a financial structuring study for medium-size power export projects; and (iii) prepare project design document(s) accessing CDM funding sources. The CDTA will support DOE in promoting investment solicitation, due diligence, and financing plans for the demonstration projects.

I. THE PROPOSAL

1. I submit for your approval the following report and recommendation on (i) proposed loans, (ii) a proposed grant, and (iii) proposed administration of a grant to be provided by the Government of Japan¹ to the Kingdom of Bhutan for the Green Power Development Project. The report also describes proposed technical assistance (TA) for the Promotion of Clean Power Export Development, and if the Board approves the proposed loans, grant, and administration of grant, I, acting under the authority delegated to me by the Board, will approve the TA. The design and monitoring framework for the Project is in Appendix 1.

II. RATIONALE: SECTOR PERFORMANCE, PROBLEMS, AND OPPORTUNITIES

A. Performance Indicators and Analysis

1. Sector Overview

2. Bhutan is the only South Asian country with a surplus of power for export. Almost 100% of power generated in the country is hydropower—the most productive natural resource in Bhutan. The mountainous terrain and network of perennially flowing rivers and streams provide an abundant source of clean and renewable energy. Bhutan has 27 hydropower stations comprising 4 major hydroelectric power plants, 12 minihydro plants, and 10 microhydro plants, with a total installed capacity of about 1,500 megawatts (MW). Because generation is significantly greater than the 157 MW of domestic demand, Bhutan is a net power exporter.

3. Of total power generated, 80% is exported to India. Power exports account for the largest source of Government revenue in the form of taxes and dividends from hydropower companies. Given the production of an additional 1,020 MW from the Tala hydropower plant commissioned in July 2006, the power sector accounts for more than 40% of national revenue and 25% of gross domestic product (GDP). Hydropower infrastructure development contributes another 25% of GDP through the construction sector.

4. Real GDP grew at an annual average of over 7% during the Government's 9th Five-Year Plan (FYP) (2002–2007). While hydropower is a key driver of economic growth, the Bhutanese economy has strong linkages with the Indian market. Because Bhutan's currency, the ngultrum, is pegged to the Indian rupee at par, local prices in Bhutan generally reflect inflationary movements in India. During the past 5 years, 92% of imports and exports were from and to India. Among all trading commodities, power export is a major foreign exchange earner. During the 10th FYP (2008–2013), the Government intends to expand hydropower development for export. An increasing power shortage in the South Asian region represents a significant power-trading opportunity.

5. Despite the net power surplus for export, most rural residents do not have access to electricity. Only 40% of rural households use electricity as their main source of lighting as compared to 96.4% of urban households.² The Government aimed for 100% electrification by 2020 as outlined in Vision 2020, Electricity for All. The Rural Electrification Master Plan targeted increasing the electrification ratio from 60% to 84% under the 10th FYP.³ It

¹ Asian Clean Energy Fund under the Clean Energy Financing Partnership Facility.

² National Statistics Bureau. 2005. *The Population and Housing Census of Bhutan 2005*. Thimphu. Rural households depend on kerosene (51.3%) for lighting, firewood (2.6%), and solar energy (2.5%).

³ The Government met the target of 52% during the 9th FYP, achieving an overall electrification ratio of 60%.

identified all nonelectrified villages and provided on-grid and off-grid electrification plans based on economic cost–benefit analysis.⁴ Of the 1,716 nonelectrified villages identified, at least 857 will be electrified under 10th FYP. Now the Government has revised the target to achieve 100% electrification during the 10th FYP.⁵

6. Considering that about 70% of the country's population lives in rural areas, providing electricity for all will be a significant implementation challenge. Further expansion of rural electrification will cover more remote areas, where operation and maintenance will be costlier. Experiences with rural electrification indicate that overall electricity consumption will increase as rural households acquire new appliances and increase reliance on electricity use, and rural economies develop. Even now, per capita consumption of all energy (including fuelwood) in Bhutan is the highest in South Asia.⁶ Therefore, continuous generation addition and export will be promoted to (i) meet the increasing demand, (ii) reduce fuelwood consumption and conserve the forest environment, and (iii) provide cross-subsidies to sustain costlier rural electrification supply through export revenues. Energy security will involve expanding generation capacity and providing rural access to electricity.

2. Institutional Overview

7. The Electricity Act, 2001, deals with restructuring the power sector. In 2002, the Government restructured the Department of Power of the Ministry of Trade and Industry into the (i) Department of Energy (DOE) as the Government's policy and planning agency; and (ii) Bhutan Power Corporation (BPC) as the utility service company responsible for transmission, distribution, and supply of electricity within the country. DOE under the renamed Ministry of Economic Affairs continues to be the nodal agency for all planning and coordination activities for the energy sector.

8. The Government is focusing on second-generation reforms to improve the capacity and efficiency of hydropower generation. Bhutan has four major power stations: (i) Chhukha Hydro Power Corporation (336 MW), (ii) Basochhu Hydro Power Corporation (64 MW), (iii) Tala Hydroelectric Project Authority (1,020 MW), and (iv) Kurichhu Hydro Power Corporation (60 MW). Three are located in the western region; the Kurichhu power plant supplies the central and eastern regions. The Tala power plant, established as a joint venture with the Government of India, will be fully owned by the Government of Bhutan in 2009. The other three companies are wholly Government-owned and were amalgamated to form Druk Green Power Corporation (DGPC) in January 2008. To optimize resources and maximize efficiency, the Government established DGPC as a holding company to oversee its interests in hydropower companies and projects, and to accelerate new hydropower development.⁷

9. Under the Electricity Act, Bhutan Electricity Authority (BEA) was set up as the sector regulator in 2002,⁸ and since then has been regularly revising the tariff structure. In 2007,

⁴ Only the villages with an economic internal rate of return of 12% were considered viable for grid-based rural electrification; the rest will be provided with electricity through off-grid options.

⁵ The country's first election resulted in the formation of a new government in April 2008.

⁶ The energy sector encompasses more than the generation of electric power. In Bhutan, consumption of fuelwood is about 1,200 kg per capita per year, which is the highest consumption worldwide (twice as high as in Nepal). Fuelwood accounts for about 77% of total energy consumption. Recent evaluations show that electrification reduces fuelwood consumption by 25%–35%.

⁷ ADB. 2003. *Technical Assistance to the Kingdom of Bhutan for Establishment of Druk Hydro Power Corporation*. Manila. The TA completed the feasibility study.

⁸ ADB. 2003. *Technical Assistance to the Kingdom of Bhutan for Capacity Building of the Bhutan Electricity Authority*. Manila. The TA assisted BEA in establishing the regulatory framework and enabling them.

BEA approved a multiyear tariff revision for 3 years from 1 July 2007 to 30 June 2010. BEA issued separate tariff structures for low-voltage, medium-voltage, and high-voltage consumers, in accordance with the Tariff Determination Regulations, 2006.

B. Analysis of Key Problems and Opportunities

1. Sector Development Strategy

10. **Regional Economic Growth and Cooperation.** In July 2006, the governments of Bhutan and India signed an umbrella agreement with a mutual obligation to develop and trade at least 5,000 MW of hydropower generation by 2020. The two governments further agreed in principle to increase this target to 10,000 MW by 2020. Hydropower development and export have steadfastly underpinned rapid growth of Bhutan's economy and generated valuable resources for social and other investments. Therefore, accelerating the development of hydropower for export will be of strategic significance to the economy. The revenues from power export will provide a cross-subsidy to maintain low-cost power supply to domestic customers, making the power industry environmentally, economically, and financially sustainable.

11. Bhutan's potential hydropower is 26,760 MW, 6% of which is being used to meet domestic consumption and the remainder is for export. On the other hand, the northern and western regions of India are experiencing a large power supply deficit and are shifting electricity from the eastern and northeastern regions within the country. The scenario of a power surplus in Bhutan and supply deficit in India is expected to enhance mutual interest in developing hydropower projects in Bhutan and exporting electricity to India. Clean energy development for power export will improve energy efficiency and foster economic cooperation in the region.

12. Bilateral assistance has supported the development of all hydropower projects in Bhutan. The major hydropower export projects at Chhukha (336 MW) and Tala (1,020 MW) were developed through bilateral assistance from the Government of India. In 2007, the two governments signed an agreement for jointly developing the next project at Punatsangchu (1,095 MW at stage I). A number of large hydropower projects with more than 500 MW are planned for development under the two governments' partnership.

13. **Private Sector Participation.** In addition to bilateral arrangements, the development strategy will require considering various financing mechanisms through public-private partnerships (PPPs) and/or independent power producers. Exploitation of hydropower potential is constrained by high up-front investments and large funding arrangements. Because the Government's fiscal capacity for big infrastructure projects is limited, the hydropower development strategy will leverage public and private investments through private participation in the development, in particular for medium and small size projects. Such an approach is expected to accelerate hydropower development, restrain Government expenditure, and generate income from export revenues.

14. **Inclusive Growth.** Income from power export will increase the Government's revenue base and enable it to allocate more resources for socioeconomic development including health, education, and rural electrification. Additional resources could be used to improve and expand road and bridge infrastructure to promote rural development and reduce poverty. The enhanced infrastructure will encourage tourism, agribusiness,

communication, and urban development; and thus contribute to inclusive economic growth. It will also encourage private sector operations and create new employment opportunities.

15. Supplying rural areas with access to electricity will improve the living standards of the rural population. Since the Government estimates that more than 90% of the poor live in rural areas,⁹ the goal of 100% electrification will contribute significantly to socioeconomic development and poverty reduction by promoting local economic development. Rural electrification is expected to create opportunities for alternate income-earning avenues and development of rural industries. It will also improve access to social services such as education and health. Rural electrification thus provides social interventions and benefits.

16. **Financial and Economic Sustainability.** Rural electrification projects often require operating subsidy inputs to ensure sustainability. Currently the subsidies for rural electrification are provided through (i) sale of power from generation companies to BPC at a rate that is less than the cost of production, and (ii) cross-subsidies from the sale of electricity to large industrial customers. Under the Tariff Regulations, the regulator, BEA, intends to effectively cap the total subsidy available from the sale of power, and require payment at the full cost of power sales to India for all local consumption in excess of 15% of Bhutan's current hydropower generation capability. This means the subsidy will adequately cover low-voltage rural domestic customers below the lifeline tariff, with medium- and high-voltage customers paying the full cost of supply.

17. **Environmental Sustainability.** One-fourth of the national land comprises environmentally protected areas, including four national parks, one natural reserve, and four wildlife sanctuaries. The country's forest, which covers more than 70% of the land, is also protected. Bhutan's strong environmental conservation policies have affected the pace of implementing power projects because of the time required to complete procedures such as environmental impact assessments, public consultations, forestry clearances, and road planning. Nevertheless, the priority concerns for the environment relate to protection of watersheds, forests, and the ecosystem. All the existing hydropower project sites are run-of-river, with less environmental and social impacts compared to economic benefits. In remote and isolated rural areas, solar panel systems have been installed. In spite of the efforts, wood is still predominately used in rural villages (83% of total consumption), while electricity and gas are widely used for cooking by 90% of urban residents. Rural households in nonelectrified villages depend on kerosene for lighting. Therefore, access to electricity sourced from hydropower will have significant positive environmental impacts by reducing fossil fuel use and deforestation due to firewood harvesting. Export of clean power surplus will lower greenhouse gas emissions in the coal-dominated Indian power market. Global warming is critical to Bhutan since a potential environmental hazard is a glacial lake outburst from the Himalaya Mountains, which will influence the long-term viability of hydropower projects that are on rivers fed by glacial lakes.

2. ADB Operations and External Assistance

18. **ADB Sector Strategy.** Power sector development is a major element of the ADB country partnership strategy for Bhutan.¹⁰ During the past decade, ADB has supported the Government in expanding rural electrification and implementing power sector reforms. The

⁹ National Statistical Bureau. 2007. *The Poverty Analysis Report, 2007*. Thimphu. The report estimates that 23.2% of the population is poor. Poverty in rural areas (30.9%) is significantly higher than urban areas (1.7%).

¹⁰ ADB. 2005. *Country Strategy and Program (2006–2010): Bhutan*. Manila.

second generation reforms will focus on efficiency improvement of hydropower generation, while extending rural electrification to more remote areas using hydropower and other renewable sources. ADB will support the Government in achieving the sector targets: 100% rural electrification by 2013, and 10,000 MW hydropower export by 2020. These new initiatives will be aligned with ADB's long-term strategic framework 2008–2020 (Strategy 2020). Strategy 2020 refocuses ADB operations on three development agendas: inclusive economic growth, environmentally sustainable growth, and regional integration.¹¹ ADB's Charter, which would sustain support for cross-border infrastructure development, assigns high priority to regional cooperation. The ADB's Clean Energy Financing Partnership Facility and Carbon Market Initiative are expected to be used to leverage resources to promote energy efficiency, and renewable and clean energy in Bhutan. The assessment of the power sector is in Appendix 2.

19. **Lessons.** ADB has supported Bhutan in expanding rural electrification through three consecutive loans since 1995, covering more than 20,400 households. The first two loan projects were delayed by 1–2 years because of procurement and logistic problems, inexperienced local contractors, and force majeure of heavy rains. Nevertheless, the completed projects are rated successful based on a review of relevance, effectiveness, efficacy, and sustainability. The experience enabled BPC to complete the third loan satisfactorily ahead of the original schedule without any consultancy implementation support. ADB has worked with the power sector, since the early stages of the sector development, to promote reform, improve operating efficiency, and strengthen the capacity of key institutions. Success is most sustainable when the sector development program maintains long-term involvement and combines institutional capacity building with scaling-up investment projects to accelerate development.

20. **External Assistance.** While ADB has supported restructuring of the power sector, institutional development, and rural electrification expansion; bilateral development partners have largely supported developing generation capacity through grants and soft loans. The Government of India funded and assisted in constructing three major power stations: Chhukha, Kurichhu, and Tala for export purposes. The Government of Austria supported development of the Basochhu hydropower plant for domestic supply, and conducted a feasibility study for the proposed Dagachhu hydropower development. The governments of Japan and Norway supported feasibility studies for potential hydropower sites and prepared the Rural Electrification Master Plan and Power System Master Plan, respectively. The Austria, Netherlands, and Japan governments, and ADB have been actively supporting rural electrification. Bhutan still needs to access concessionary sources of external assistance to close the domestic investment gap. The external assistance is summarized in Appendix 3.

3. Policy Dialogue

21. **Hydropower Development Policy for Private Participation.** To accelerate hydropower development on a sustainable basis, the project preparatory technical assistance (PPTA)¹² supported the Government in establishing a policy and institutional framework for private participation, such as PPPs and independent power producers. The Hydropower Development Policy was issued in July 2008 with provisions of (i) an energy

¹¹ ADB. 2008. *Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank 2008–2020*. Manila.

¹² ADB. 2007. *Technical Assistance to the Kingdom of Bhutan for Preparing the Bhutan Power Development Project*. Manila.

royalty requiring a minimum of 12% of the electricity generated to be free to the Government, and (ii) a minimum concession period of 30 years. The key objectives of the policy are to (i) promote public, private, and foreign investments to accelerate development of hydropower generation in a competitive manner; (ii) maximize benefits from hydropower generation for socioeconomic development of the country; (iii) assure energy security for domestic demand and overall development of the sector; (iv) establish the renewable energy fund for the sector development and operational sustainability; and (v) protect and sustain the environment. The policy outlines the various elements including the project structure, fiscal incentives, and bidding process.

22. Institutional Reforms. In line with the policy initiatives, the Government established its sovereign fund, Druk Holding and Investments (DHI), which groups the Government shareholdings of its 11 companies to promote new projects and private sector participation. In January 2008, the Government established Druk Green Power Corporation (DGPC) as a holding company to oversee existing hydropower companies and stations. The amalgamation of the existing corporations enabled DHI and DGPC to have larger assets and better financial strength. Both DHI and DGPC are expected to promote new hydropower projects by leveraging and structuring public and private capital through various approaches including PPPs. Another challenge is to simplify the process of private investment and provide “single-window” clearances to enhance investor confidence in Bhutan. In July 2008, the Government approved DOE to become the Energy Secretariat as the apex agency for accelerating hydropower projects and ensuring good governance through an impartial and balanced investment framework, and use of competitive practices under the Hydropower Development Policy. These new roles will require strengthening of institutional capacities within these organizations.

23. Demonstration Projects for PPP and Clean Development Mechanism. The first few private investment projects coming to Bhutan will be watched and scrutinized by the investor community. Therefore, it is critical for Bhutan to demonstrate its ability to attract and manage private investments. A pilot hydropower project structured through PPP will evince interest and competition from private developers. Financial structuring on commercial principles is expected to achieve more credibility and provide more confidence to potential foreign public and private investors and lenders. To increase the comparative advantage of Bhutan’s hydropower sector in the regional power trading market, some power export projects will need to be promoted on commercial principles, unlike past projects where tariffs have been politically negotiated with bilateral assistance.¹³ Any off-take prices set in a commercial manner will make significant impacts on subsequent project development and investment. Additional benefits from sales of carbon emission reductions are expected to attract private capital once power export substantiates cross-border Clean Development Mechanism (CDM) opportunities.

24. Regulatory Systems. The regulator, BEA, is regulating only two government-owned public entities: BPC and DGPC. It will be required to take proactive initiatives to frame standards and codes to regulate the activities of hydropower development and companies, including private players. Presently, BEA is run by a commission that is functionally and financially autonomous.¹⁴ While BEA remains within DOE managerially, the Government recognizes that the current structure will no longer be appropriate if the private sector

¹³ No specific tariff regulations are in place for cross-border power trading between Bhutan and India. The existing three power plants for export have export tariffs ranging from Rs1.8 to Rs2.0.

¹⁴ One of commissioners was recently appointed to represent the private sector.

becomes involved in hydropower generation. The Government is targeting a complete separation of BEA from DOE in 2009 to prepare for private sector involvement.¹⁵

III. THE PROPOSED PROJECT

A. Impact and Outcome

25. The impact of the Project is to sustain the country's inclusive economic growth in promoting cross-border power trade and electricity access. As an outcome, the coverage of power distribution will be improved, and the export of power expanded through clean power development in a sustainable manner. It will generate a long-term revenue stream for Bhutan to finance its enormous development needs for social infrastructure such as health and education, as well as economic infrastructure facilities like roads and electricity supplies. They will form the very basis of rural development and poverty reduction in the country. Investment for rural electrification will improve access to electricity for rural households and small businesses, and replace more expensive and polluting kerosene and fuelwood with renewable hydropower and solar energy. It will also make social interventions to the poor, and improve the standard of living and quality of life of rural residents. The Dagachhu hydropower development will generate export revenues that will be used for subsidies to maintain low-cost power supplies to rural electrification, while exporting power to India and thus enhancing cross-border cooperation and regional energy efficiency.

B. Outputs

26. The Project will provide separate financing for each of two major physical investments: (i) regional clean power trade, and (ii) renewable energy access for the poor.

1. Loan-Financed Regional Clean Power Trade

27. The 114 MW run-of-river Dagachhu hydropower component will generate 500,000 megawatt hours (MWh) of power annually and export to India through the existing grid connected to India. BPC will separately build a 19 km, 220-kilovolt (kV) transmission line to evacuate power generated from the plant to the grid. The project site will be on the Dagachhu river, a tributary stream of the Punatsangchhu (Sankosh), which drains into the Brahmaputra river in India. Construction of access roads to the site (with Government financing) is progressing well and expected to be completed by January 2009.

28. Clean and renewable power export will be counted as carbon saving in the coal-dominated Indian power market. Under the CDM as defined in the Kyoto Protocol, the clean power generated from the Dagachhu plant will displace power generated by fossil fuel-based thermal power generation in the eastern Indian power grid. The resulting reduction of greenhouse gases equivalent to CO₂ emissions will be quantified as 500,000 tons every year and 15 million tons over 30 years.

¹⁵ ADB and the Norwegian Agency for Development Cooperation (NORAD) supported BEA in establishing a regulatory framework. NORAD has committed to provide continuous technical support to BEA capacity building.

2. Grant-Financed Renewable Energy Access for the Poor

29. The rural electrification component will extend the distribution system to provide clean and reliable power supply to rural households mainly in seven districts of Bhutan.¹⁶ The Rural Electrification Master Plan aims for rural electrification of about 25,000 more rural households during the 10th FYP. In May 2007, the Japan Bank for International Cooperation provided a loan to support rural electrification of 15,322 households in 10 districts. ADB's financing will be provided in parallel to cover the balance of the target, including more remote central and eastern regions. Based on a physical route survey for each of seven subprojects, ADB will help electrify 8,767 consumers including households, facilities, and industries.

30. In addition to grid extension, 119 solar photovoltaic systems will be installed to support off-grid rural electrification in isolated areas, focusing on schools, health clinics, monasteries, and other community facilities to maximize development impact. The solar photovoltaic systems will apply emerging technology of (i) white light-emitting diode for lighting, and (ii) capacitors for electricity charging to replace conventional lamps and batteries. Compared to conventional types of photovoltaic systems, these products will be energy efficient and environment friendly with much longer life and lower electricity consumption. Therefore, they are expected to resolve traditional unsustainable solar energy problems such as unfavorable impacts to the environment from battery disposal, high cost of frequent battery maintenance and replacement, and delivery difficulties for heavy batteries to remote areas.

C. Special Features

31. **Public–Private Partnership.** The Dagachhu hydropower development will be the first undertaking with a commercial nature, unlike projects promoted under bilateral assistance. It was developed through PPPs to leverage private capital and maximize impacts of the government investment. In June 2008, DGPC signed a shareholders agreement to form a joint venture with equity participation from a private company, Tata Power Company (TPC), which has sufficient experience as a private power developer in India. Accordingly, Dagachhu Hydro Power Corporation (DHPC) was incorporated as the special purpose company for the development. The Government envisaged that the Dagachhu development would be a pilot case to catalyze private participation through a concessional agreement and accelerate hydropower development in Bhutan. Tata Power Trading Company (TPTC) signed a power purchase agreement to supply power generated from the Dagachhu plant.¹⁷ The experience gained by Bhutan in terms of negotiating with off-takers for commercial tariffs and developing shareholders agreements with a strategic partnership with the private sector will be of significant importance to implementing more hydropower projects under the Hydropower Development Policy. The Dagachhu development is expected to catalyze and expand investment for clean energy projects in Bhutan.

¹⁶ Target districts include Pemagatshel, Punakha, Samdrup Jongkhar, Sarpang, Trashigang, and Wangduephodrang. Due to the recent changes of district boundary, part of Dagana and Mongar will also be included.

¹⁷ The power generated from the Dagachhu plant is expected to be supplied to North Delhi Power through the transmission line owned by Powerlinks Transmission, a private joint venture with TPC and Power Grid Corporation of India.

32. **Regional Cooperation.** Presently, cross-border power trading is limited in South Asia, where most power exchange is available only between Bhutan and India.¹⁸ During the past decades, all cross-border power trading projects in South Asia have been supported by the Government of India. The Dagachhu hydropower development will be the first to be mainly promoted by the Government of Bhutan and assisted by banks and financial institutions. Since the cross-border power trading market and participants have been limited, TPTC's private sector participation in the market will create a competitive business climate in regional power trading in South Asia.¹⁹ The PPP modality will enhance the investment environment for developing clean hydropower potential in the region through private capital.

33. **Clean Development Mechanism.** The Dagachhu hydropower development posted its application to the United Nations Framework Convention on Climate Change website for public comments in 2007. A validation report is being prepared and DHPC will seek registration with the CDM Board. The Indian electricity grid based on mainly coal-fired power plants has been treated as the baseline against which greenhouse gas emission reductions of the Dagachhu hydropower development are measured. Thus, the Government expects the Dagachhu hydropower development to be a showcase cross-border CDM project. The governments of Bhutan and India have already approved it as a CDM project. Since TPTC has in principle agreed to underwrite the purchase of the emission reductions over 30 years at a specific minimum price, irrespective of whether a post 2012 agreement is reached,²⁰ DHPC expects to have an assured revenue from carbon emission reductions over the duration of its operations.

34. **Energy Efficient Design and Technology.** The Project focuses on energy efficiency and environment-friendly technology. The generation system for the Dagachhu plant will use pelton turbines, which can be operated in an environment-friendly manner with small discharges of river water. The rural electrification will apply the single-phase system where the cost is lower, electricity supply is more efficient, and the delivery is easier because of its smaller transformer size.²¹ The off-grid rural electrification component will apply for emerging technology of white light-emitting diode and capacitors considered to be more environment-friendly and sustainable.²² The technology transfer will need to be demonstrated in terms of design, procurement, and performance before replicating and implementing further applications.

D. ADF IX Grant, Hard-term ADF, and Ordinary Capital Resources

35. **ADF IX Grant Financing.** In 2007, ADB decided to align with the International Development Association 14 framework, to define eligibility for grants to Asian Development Fund (ADF)-only countries. Under the revised ADF grants framework, Bhutan is classified as eligible for 100% grants until the ADF IX replenishment period ends in 2008. ADF grants aim to provide development assistance to help a country tackle development issues in an

¹⁸ The power exchange between India and Nepal is presently only at 50 MW. Since Nepal has an acute power shortage, excess power from Nepal has been limited.

¹⁹ The best off-take price of TPTC was selected on a competitive basis.

²⁰ DHPC and TPTC signed a term sheet in August 2008.

²¹ Most rural electrification in Bhutan was designed with a costly three-phase system. This would make the material head loading transportation more difficult and its associate costs higher since the target project sites extended for rural electrification were remote with difficult terrain away from the existing grid system.

²² The lifetime of a white light-emitting diode is more than 20 years compared to 1 year for conventional compact fluorescent lamps; capacitors have guarantees at least for 10 years (no lifetime theoretically), while conventional chemical batteries have a short lifetime (usually 3 years) and regular replacement and maintenance is required at the expense of consumers.

environment of debt vulnerability, and assist the country in developing the private sector and achieving sustainable economic development.²³ The ADF grant is allocated for the rural electrification component.

36. **Hard-Term ADF and Ordinary Capital Resources Financing.** While ADF grant-eligible countries will generally be restricted from public or public-guaranteed ordinary capital resources (OCR) borrowing until their debt indicators improve, an exception to this restriction is given in individual cases for high-revenue-earning projects that generate more net foreign exchange than the foreign debt service requirement. This is consistent with the approach of the ADB graduation policy for OCR borrowing by ADF countries. In accordance with the graduation policy and the revised ADF grant framework, nonconcessional term lending (i.e., OCR), hard-term ADF lending, and/or guarantees can be considered on an exceptional basis for Bhutan for the Dagachhu hydropower development as it will be earning foreign exchange and will be able to fully service foreign debt from net foreign exchange earnings (para. 61).²⁴

37. **Debt Sustainability.** Bhutan's public debt to GDP ratio peaked in 2006 mainly because of borrowings for the Tala hydropower plant and the purchase of aircraft for the state-owned Druk Air. It declined in 2007 and will continue to drop if no new large projects are accommodated. Even with new projects, such as the Dagachhu hydropower development, the ratio will rise again until 2011 in the short term; it is expected to drop continuously afterward. The PPTA conducted Bhutan's debt sustainability analysis based on the debt sustainability framework for low-income countries as defined by the International Monetary Fund (IMF) and the International Development Association (Appendix 4). Consequently, the cumulative effects arising from the new development's benefits after 2011 will result in a considerable reduction of debt burden with a higher pace. This indicates that the Government's debt burden arising from new projects including the Dagachhu hydropower development will be more than offset by the reduction in debt burden indicators resulting from increases in exports, GDP, and fiscal revenues. The Dagachhu hydropower development will thus help ensure the country's debt position is sustainable. The IMF's 2007 Article IV Consultation on Bhutan clarifies that Bhutan's experience in implementing and operating hydropower projects is one of the biggest mitigation factors in substantially improving the debt dynamics. Consequently, IMF suggests that Bhutan's risk of external debt distress be upgraded, reflecting the authorities' good record of implementation of externally financed hydroelectric projects, high overall foreign exchange reserves, and strong external development partner support for power sector projects.²⁵

E. Project Investment Plan

38. The project investment cost is estimated at \$234.45 million including all relevant costs (Table 1 and Appendix 5). The Dagachhu hydropower component is estimated to cost \$201.47 million including contingencies and financing charges. The rural electrification component is estimated to cost \$32.98 million, including contingencies, which comprise the on-grid component of \$31.92 million, and the off-grid component of \$1.06 million.

²³ ADB. 2007. *Revising the Framework for Asian Development Fund Grants*. Manila.

²⁴ ADB Operations Manual, Section A1/BP, para.10 and A3/BP, para.19.

²⁵ The IMF Article IV Consultation was issued in October 2007 and concludes that Bhutan's risk of external debt distress is upgraded to "moderate." ADB follows the debt-distress classification of the International Monetary Fund and International Development Association, which has a cutoff date of 31 December 2006, to determine future grant eligibility. This is in accordance with the Revised ADF Grant Framework under which Bhutan is categorized as "high" risk (i.e., 100% grant eligibility) based on the 2005 country assessment.

Table 1: Project Investment Plan
(\$ million)

Item	Amount
A. Base Costs^a	
1. Regional Clean Power Trade (Dagachhu Hydropower)	161.92
a. Civil works	80.49
b. Electrical and mechanical equipment	59.22
c. Infrastructure development: road and power lines	13.95
d. Administration, supervision, and preoperative costs	8.26
2. Renewable Energy Access for the Poor (Rural Electrification)	28.45
a. On-grid component	27.46
i. Materials	20.18
ii. Civil works (delivery, erection, and installation)	5.25
iii. Tools, equipment, administrative, and overhead expenses	2.03
b. Off-grid component	0.99
i. Materials	0.71
ii. Administrative and overhead expenses	0.06
iii. Consulting services	0.22
Subtotal of Base Cost (A)	190.37
B. Contingencies^b	24.85
C. Financing Charges^c	19.23
Total Project Cost (A+B+C)	234.45

^a Include local taxes and duties of \$3.31 million which will be financed by the Government and the implementing agencies.

^b Include physical and price contingencies (12.6% of the base costs for the Dagachhu hydropower component and 15.9% for the rural electrification component).

^c Include interest, commitment fees, and guarantee fees; and interest during construction, which is computed at the London interbank offered rate (LIBOR) plus an Asian Development Bank spread and a currency swap market rate.

Source: Asian Development Bank, Bhutan Power Corporation, and Dagachhu Hydro Power Corporation estimates.

F. Financing Plan

39. The project financing plan is summarized in Table 2.

Table 2: Financing Plan
(\$ million)

Source	Dagachhu Hydropower	Rural Electrification	Total	%
Asian Development Bank				
OCR loan	51.00		51.00	
Hard-term ADF Loan	29.00		29.00	
ADF grant		25.28	25.28	
ACEF under CEFPF ^a		1.00	1.00	
Subtotal	80.00	26.28	106.28	45
Austrian Export Credit Agency	55.46		55.46	24
Government and its company and fund^b	45.01	6.70	51.71	22
Tata Power Company, India	21.00		21.00	9
Total	201.47	32.98	234.45	100

ACEF = Asian Clean Energy Fund, ADF = Asian Development Fund, CEFPF = Clean Energy Financing Partnership Facility, OCR = ordinary capital resources.

^a ACEF was established by the Government of Japan, and is administered by ADB.

^b Includes the Government of Bhutan, Druk Green Power Corporation, and National Pension and Provident Fund.

Source: Asian Development Bank, Bhutan Power Corporation, and Dagachhu Hydro Power Corporation estimates.

40. **Dagachhu Hydropower.** The Government has requested a loan of \$51,000,000 from ADB's OCR to help finance the Dagachhu hydropower component. The OCR loan will have a 30-year term including a grace period of 5 years, an interest rate determined in accordance with ADB's London interbank offered rate (LIBOR)-based lending facility, commitment charges of 0.15% per annum during the disbursement period, and such other terms and conditions set forth in the draft loan and project agreements. The Government has provided ADB with (i) the reasons for its decision to borrow under ADB's LIBOR-based lending facility on the basis of these terms and conditions, and (ii) an undertaking that these choices were its own independent decision and not made in reliance on any communication or advice from ADB.

41. The Government also requested a loan of \$29,000,000 equivalent from ADB's Special Funds resources. The hard-term ADF loan will have an interest charge at the rate of 3.15% per annum; a term of 32 years including a grace period of 8 years; and such other terms and conditions as are substantially in accordance with those set forth in the draft loan and project agreements.²⁶

42. The Dagachhu hydropower component will cost \$201.46 million including debt of \$121.5 million (60%) and equity of \$80.0 million (40%). ADB will finance \$80 million as anchor money to take a lead in the financial structuring. The Kingdom of Bhutan will be the borrower of ADB loans from OCR and hard-term ADF. Of the \$80 million, ADB will provide (i) \$51 million (OCR) to DHPC as the debt portion of the Dagachhu development, and (ii) \$29 million (hard-term ADF) to DGPC as the equity portion through lending to the Government. For the total equity requirement of \$80 million, Bhutan's public sector, including the Government, DGPC, and National Pension and Provident Fund (NPPF), will contribute \$59 million (including the \$29 million from the hard-term ADF loan); Tata Power Company will participate as a minority shareholder with equity of \$21 million. The debt balance is expected to be cofinanced by the Austrian export credit agency, OeKB (\$55.5 million) and NPPF (\$15 million). The detailed financial structure and fund flow proposed is provided in Appendix 6.

43. The Government will relend the ADB loans to DGPC and DHPC through subsidiary loan agreements with the same terms and conditions as the ADB loans. Foreign exchange risks will be assumed by the corresponding entities. The Government's equity will be provided to DGPC, which will become the majority shareholder (59% of the total share) of DHPC. The balance of DHPC's shares will be held by minority shareholders: TPC (26%) and NPPF (15%). An Indian commercial bank is expected to help hedge the foreign currency loan(s) through currency swap arrangements or any alternative proposals to minimize the currency mismatching risk between the project's revenue and debt. The currency risk analysis is provided in Supplementary Appendix J.

²⁶ The hard-term ADF loan is more concessional than OCR. The blended use of the hard-term ADF is based on International Monetary Fund guidance that low-income countries (as defined by the fund) should exhaust all avenues of access to concessional resources before considering nonconcessional borrowing, and that borrowing on nonconcessional terms may be justified with high expected rates of return.

44. **Rural Electrification.** ADB will provide a grant of \$25,280,000 equivalent to help finance the on-grid component of the rural electrification. The financing will be provided from ADB's Special Funds resources. The Government will finance the local currency component for civil works by providing \$6,640,000 equivalent. The Government will relend the grant proceeds to BPC with no interest charge. For the off-grid component, the Asian Clean Energy Fund, administered under the Clean Energy Financing Partnership Facility, is expected to provide grant cofinancing equivalent to \$1,000,000, subject to approval by the Government of Japan.²⁷

G. Implementation Arrangements

1. Project Management

45. **Dagachhu Hydropower.** DGPC will be the Executing Agency and have overall responsibility for the component. DHPC will be the Implementing Agency with responsibility for day-to-day coordination, implementation, and administration. DHPC is a special purpose company that has the capacity to undertake all activities required for successful implementation, including (i) procurement of goods and works; (ii) construction supervision; (iii) maintenance of separate project accounts; (iv) monitoring and reporting of project implementation; and (v) provision of supervision, coordination, support, and liaison activities as required.

46. **Rural Electrification.** DOE will be the Executing Agency. BPC will be the Implementing Agency for grid-extended rural electrification and DOE's Renewable Energy Division will be the Implementing Agency for off-grid electrification. BPC has executed the past three ADB-financed rural electrification projects and demonstrated good performance for project management. BPC has established a project implementation unit and assigned the project manager and staff. Under BPC's supervision, local private contractors will carry out the majority of construction works.²⁸ The project implementation unit will coordinate with contractors, district offices, and relevant government departments, in particular the Department of Roads.

2. Implementation Period

47. The Project will be implemented over 5 years to 31 December 2013. The Dagachhu hydropower component has already started developing site infrastructure for access roads, water, and electricity facilities. Construction for the rural electrification component will be completed in a phased manner for each of seven subprojects. The implementation and project readiness schedules are in Appendix 7.

3. Procurement

48. The Dagachhu hydropower component has two contract packages through the engineering, procurement, and construction (EPC) scheme: one for civil works to be financed by ADB and one for electromechanical works to be financed by the Austrian Export Credit Agency, OeKB. The civil works will be procured by using international competitive

²⁷ Asian Clean Energy Fund (ACEF) was established by the Government of Japan. If the Government of Japan does not approve the financing from ACEF, either (i) alternative financing will be obtained, or (ii) the off-grid component will not form part of the Project.

²⁸ This approach of outsourcing construction work to local private contractors is based on experience gained during ADB's previous rural electrification projects, which proved very successful.

bidding procedures in accordance with ADB's *Procurement Guidelines* (2007, as amended from time to time), and the electromechanical works will be procured in accordance with OeKB requirements.²⁹ For the rural electrification component, the ADB grant will mainly be used for the hard costs of material procurement using international competitive bidding. All construction works and material transportation are to be outsourced through national competitive bidding procedures acceptable to ADB.³⁰ DHPC and BPC will include environmental mitigation measures and costs identified in environmental assessments approved for each component in civil work contracts to comply with Bhutanese and ADB environment requirements. The procurement plan is in Appendix 8.

4. Advanced Contracting

49. To expedite implementation, the Government, DHPC, DGPC, and BPC asked ADB to approve advance actions for procurement of works, goods, and services. ADB granted approval of advanced contracting on 1 July 2008. DHPC floated a tender for civil works on 15 July 2008, and electromechanical works on 1 August 2008. BPC will begin this process within 2008.

5. Consulting Services

50. ADB assessed BPC's capacity to implement the rural electrification component and determined that consulting services are not required. Off-grid rural electrification packages will include small-scale consultant services to support DOE in implementing procurement and installing solar panels. Consultants for this component will be selected and engaged in accordance with ADB's *Guidelines on the Use of Consultants* (2007, as amended from time to time) and individual experts will be recruited based on biodata submitted in specific terms of reference for assignments. To support the Dagachhu hydropower component in preparing bidding documents and conducting bidding, bid evaluation, and negotiations for civil works and electromechanical contracts, the Austrian Government also provided DHPC with TA for consulting services. The Austrian Government has committed to provide subsequent TA to support construction and supervision work during construction.

6. Stakeholder Participation and Consultation

51. All relevant stakeholders, including affected communities and affected people, were fully consulted during project preparation.³¹ Development of the Dagachhu hydropower component considered affected peoples' concerns and preferences during finalization of the design, particularly the alignment of access roads to minimize negative impacts, while maximizing benefits. They were consulted to define appropriate compensation rates and a course of actions including scheduling, and were requested to select cash compensation or the alternative land to be awarded as replacement for the land acquired by the Dagachhu facility. Public consultation with all stakeholders will continue throughout implementation of the Dagachhu hydropower component.

²⁹ To coordinate these two procurement processes, the bidding documents for both packages were prepared based on ADB's Standard Bidding Documents for Plant and FIDIC Conditions of Contract for EPC/Turnkey Projects.

³⁰ The national competitive bidding procedure is applied as (i) the contract values are small, (ii) works are scattered across the country, and (iii) works are labor intensive.

³¹ The consultation included the awareness and prevention campaign for HIV/AIDS during construction in spite of a small infection rate in Bhutan.

7. Disbursement Arrangements

52. Disbursement procedures will be in accordance with ADB's *Loan Disbursement Handbook* (2007, as amended from time to time), and detailed arrangements agreed upon by the Government and ADB. Since the disbursements under the Dagachhu hydropower component will mainly be for procurement of works, goods, and services, ADB's commitment letter, reimbursement, and direct payment procedures will be utilized.³² The hard-term ADF loan will be disbursed through the Government to DGPC for its equity contribution. The rural electrification component will also use statement of expenditure procedures to liquidate advances for each payment not exceeding \$100,000. Under these procedures, ADB will advance 6 months of estimated expenditures, or 10% of the grant amount, whichever is lower, to the imprest account, and the Government will use the account to pay eligible expenditures.

8. Accounting, Auditing, and Reporting

53. The accounting, auditing, and reporting systems and procedures for the project loans and grants will be established in accordance with accounting principles and practices satisfactory to ADB. The executing and implementing agencies will maintain separate accounts for the components. Within 6 months of the close of the financial year, they will submit to ADB (i) annual project accounts, with detailed descriptions of the sources of receipts and expenditures; and (ii) annual financial statements comprising an income statement, balance sheet, statement of cash flow, and related notes to the financial statements and consolidated for all operations. Independent auditors acceptable to ADB will (i) audit the project accounts and financial statements, (ii) provide an opinion on the ADB-financed imprest fund and statement of expenditures, and (iii) confirm compliance with ADB's financial covenants, in conformity with the definitions contained in the loan, grant, and project agreements.

9. Anticorruption Policy and Governance

54. ADB's *Anticorruption Policy* (1998, as amended to date) was explained to and discussed with the Government, DGPC, DHPC, and BPC. Consistent with its commitment to good governance, accountability, and transparency, ADB reserves the right to investigate, directly or through its agents, any alleged corrupt, fraudulent, collusive, or coercive practices relating to the Project. To support these efforts, relevant provisions of the *Anticorruption Policy* are included in the loan and grant regulations and the bidding documents for the Project. In particular, all contracts financed by ADB in connection with the loan and grant projects shall include provisions specifying the right of ADB to audit and examine the records and accounts of the executing and implementing agencies and all contractors, suppliers, and other service providers as they relate to Project.

55. DHPC will operate within a corporate and power sector governance framework. Through the PPP structure of the Dagachhu hydropower component, DHPC has public and private shareholder representatives on its board of directors. The shareholders agreement defines board composition, transparent financial reporting and auditing, professional management of the company at an arms-length basis from shareholders, and full transparency of day-to-day administration. The Government ensures that the corporate governance procedures in the Companies Act of the Kingdom of Bhutan will supplement the

³² The Dagachhu hydropower component will not require an imprest fund.

governance arrangements for any potential conflicts of interest among the board of directors. Table 3 summarizes major governance measures under the Project.

Table 3: Governance Measures

Area	Measure
Procurement	<ul style="list-style-type: none"> • Use of ADB guidelines on procurement and consulting services • Use of ADB's standard bidding documents and standard request for proposal documents for procurement and recruitment of consultants • Bid specifications and packaging to be prepared to ensure maximum competition under international competitive bidding procedures
Financial Management and Audit	<ul style="list-style-type: none"> • Financial statements of DGPC, DHPC, and BPC to be audited by external auditors acceptable to ADB, and regularly published and reported to shareholders • Regular monitoring of expenditures, other financial transactions, and safe custody of project-financed assets by the accounting policy and control systems of DGPC, DHPC, and BPC • Use of integrated information management system of DGPC, DHPC, and BPC to ensure efficient and accountable management systems
Sector Corporate Governance	<ul style="list-style-type: none"> • Regulations framed by the Bhutan Electricity Authority • Hydropower Development Policy issued by the Government for promoting public and private sector participation in hydropower development • DHPC's shareholder agreements and charters to define corporate governance • Corporate governance procedures of the Companies Act of the Kingdom of Bhutan, 2000 • Performance-based incentive system to cascade the corporate governance to department and staff of DGPC, DHPC, and BPC

ADB = Asian Development Bank, BPC = Bhutan Power Corporation, DGPC = Druk Green Power Corporation, DHPC = Dagachhu Hydro Power Corporation.

Source: Asian Development Bank assessment.

10. Project Performance Management System

56. Each of the executing and implementing agencies will prepare progress reports for its respective component and submit these to ADB on a quarterly basis within 30 days from the end of each quarter. Each report will provide (i) a narrative description of progress made during the period, (ii) changes in the implementation schedule, (iii) problems or difficulties encountered, (iv) work to be carried out in the next period, and (v) progress on social and environmental compliance. The progress report will include a summary financial account for the project loan and grant components, consisting of project expenditures for the year to date and total expenditure to date, and a contract financing plan. In particular, DHPC and BPC will submit a consolidated report that integrates the Dagachhu development with its associated transmission component financed by BPC. Performance will be evaluated based on indicators and targets stipulated in the design and monitoring framework. BPC will identify and maintain profiles of new customers connected by the rural electrification component as baseline data for the postproject analysis. DHPC will monitor the baseline information as per the resettlement plan (para. 69) and the environmental management plan (EMP) (paras. 74 and 75).

57. ADB will field an inception mission within 3 months of project approval to prepare the project administration memorandum. ADB will review the implementation and operation of the investment project based on the quarterly progress reports and meet with the Government, and executing and implementing agencies semiannually to discuss progress of individual subprojects and any changes to implementation arrangements or remedial measures required to achieve the project objectives. A midterm review will be carried out

during the third year of project implementation, and a project completion report will be submitted to ADB within 3 months following completion of the individual component.

IV. TECHNICAL ASSISTANCE

58. A capacity development technical assistance (CDTA) will be attached to the Project. The Regional Cooperation and Integration Fund³³ will provide a grant of \$888,000 and the ADB TA funding program will provide \$600,000, for a total of \$1,488,000. The CDTA for Promotion of Clean Power Export Development aims to (i) develop capacity (e.g., risk management and project structuring function, and private participation promotion) for DOE, DGPC, and DHI; (ii) provide a financial structuring study for medium-size power export projects,³⁴ and (iii) prepare project design document(s) for accessing CDM funding sources. The CDTA will also support DOE in promoting investment solicitation, due diligence, and financing plans for the demonstration projects. The Government asked ADB for advance contracting to facilitate CDTA implementation. The proposed CDTA scope is presented in Appendix 9.

V. PROJECT BENEFITS, IMPACTS, ASSUMPTIONS, AND RISKS

A. Financial Justification

59. **Financial Viability and Sustainability.** The financial analysis for each of the two project components: Dagachhu hydropower and rural electrification was conducted in accordance with ADB's *Financial Management and Analysis of Projects* (2005). All financial costs and benefits are expressed in constant 2008 prices. To determine the financial internal rate of return (FIRR), cost streams such as capital investment, and operation and maintenance reflect costs of delivering the estimated benefits. Revenue streams are based on the tariff for sale of energy generated by each of the components. The weighted average cost of capital was calculated and compared with the project FIRRs to ascertain the financial viability of each project component. The sensitivity of the FIRR to adverse movements in the underlying assumptions was also assessed.

60. The FIRR after taxes is 10.44% for the Dagachhu hydropower component. The FIRR compares favorably with the estimated value of weighted average cost of capital at 5.63%, substantiating the component's financial viability. However, the rural electrification component will not be financially viable without any capital or operating subsidies. A summary of the project financial analysis is presented in Appendix 10.

61. DHPC's debt to equity ratio is 60 to 40. Its projected financial performance is expected to maintain adequate debt service coverage ratios, with the minimum of 1.5 times and average of 2.2 times. This clearly indicates that the Dagachhu hydropower development will generate cash surplus to fully service debt obligations. The profitability is represented by an internal rate of return on equity of 15.6% on a before-tax basis and 12.0% on an after-tax basis.³⁵ These results demonstrate that the Dagachhu development is bankable. DHPC is expected to contribute to Government revenue through taxes, dividends, and royalties. The major sponsor of DHPC is DGPC, which also contributes to the financial robustness. The

³³ Established under the Regional Cooperation and Integration Financing Partnership Facility.

³⁴ The sample projects will include the Nikachhu (210 MW) and Khomachhu hydropower (326 MW) projects.

³⁵ The return was calculated after deducting the royalty revenue to the Government. The provision for the energy royalty is that a minimum of 12% of the electricity generated for the first 12 years and 18% for the balance of 18 years will be made available at no charge to the Government.

opening financial position for DGPC as of 1 January 2008 is based on the accounts of three subsidiary hydropower companies including Chhukha Hydro Power Corporation, Basochhu Hydro Power Corporation, and Kurichhu Hydro Power Corporation. DGPC's profitability is very high, with 29% return of net fixed assets primarily due to Chhukha Hydro Power Corporation, which is a debt-free hydropower company. Overall DGPC's return of net fixed assets is likely to increase and contribute to Bhutan's economy as it merges Tala Hydroelectric Project Authority³⁶ and promotes more hydropower development projects.

62. BPC substantially improved its profitability in 2006 through a combination of tariff increases and improved operating efficiency after making losses since 2002. Tariff increases were implemented in a timely manner and BPC introduced a performance-based incentive scheme for all operations staff in 2006.³⁷ These initiatives enabled BPC to generate net profits and resulted in a 4.9% return on net fixed assets as of 31 December 2007. The transmission wheeling revenues from the Tala plant will enable it to improve its profitability. BPC's debt service coverage and self-financing ratios have been maintained well above the previous loan covenant's targets of 1.5 times and 20%, respectively. It has also maintained its overall system loss at 9%–10%. However, BPC's future financial performance will be influenced by the very high proportion of rural electrification within its network and the need to work within tariff policies that incorporate high cross-subsidization. The financial performance and management is summarized in Appendix 11.

63. **Financial Management.** Financial management assessment was undertaken to determine the current ability of DHPC, DGPC, and BPC to fulfill ADB's fiduciary requirements; and identify areas for improvement. The assessment was in accordance with ADB guidelines using the financial management assessment questionnaire and field interviews.

64. DHPC was formed as an authority in April 2007 and incorporated in May 2008. As the project company is in its inception stage, its financial accounting is relatively simple, and is used by one of the other hydropower companies under DGPC. DHPC presently uses spreadsheet-based software for accounting purposes. The PPTA supported DGPC's integration of the accounting system among its subsidiaries and DGPC plans to install the accounting software in its own offices and each of its subsidiaries to record financial transactions in a common format. Then, DHPC is expected to strengthen its accounting management and move from manual accounting procedures to an integrated computerized financial management and accounting system. The joint venture project sponsors, DGPC and TPC, agreed to have the seconded or professional financial staff from TPC assist DHPC in conducting its financial management. DHPC and DGPC have no prior experience with managing foreign currency debt and will require capacity building for foreign exchange mitigation, fund raising, and concomitant risk management. This will be supported by a new CDTA (para. 58).

³⁶ The Tala Hydroelectric Project Authority will become a corporation after finalizing its 2008 accounts, and be amalgamated into DGPC at a later date.

³⁷ The performance-based incentive scheme gave all staff an opportunity to earn a bonus of up to 25% of their basic annual salary, depending on the extent to which the corporation and its component department and divisions met objectively measurable performance targets. This scheme has resulted in a significant improvement in BPC's operating efficiency.

65. BPC has 53 accounting units within 29 branch offices; all the units are computerized. BPC developed procedures and guidelines for this reporting under ADB TA.³⁸ BPC has well-defined charts of accounts for recording financial transactions. It now plans to raise commercial financing from local banks to construct a transmission line to evacuate power generated from DHPC. In the future, it may need to raise commercial financing outside Bhutan for some of its investment requirements. Then, BPC will need to develop capacity building for raising and managing external funds.

B. Economic Justification

66. Economic analysis for each of the two project components was carried out in accordance with *ADB's Guidelines for the Economic Analysis of Projects*. A summary of the project economic analysis is presented in Appendix 12.

67. The economic analysis shows that the Dagachhu hydropower component, inclusive of the transmission link, has an estimated economic internal rate of return (EIRR) of 13.8%, which is above the ADB traditional threshold. In addition to the normal revenue stream from export of generated power to India, the Dagachhu hydropower component is expected to generate additional revenue from emission reductions under CDM. In addition it supplies power to address India's energy deficit, in particular to its northern region. Therefore, the overall benefits to the Bhutan–India subregion will be significantly higher than the estimated EIRR, considering that it will eventually supply unserved demand in the subregion. As a result, the EIRR for the subregion is estimated to be 22.0%.

68. The economic benefits and costs were quantified with and without the rural electrification component. Each of the component's subprojects exhibits EIRR values ranging from 13% to 26%. The overall component is estimated to have an EIRR of 20%.

C. Social and Poverty Assessment

69. **Social Aspects.** The summary poverty reduction and social strategy and the summary resettlement plan are in Appendix 13 and Appendix 14 respectively. No indigenous peoples will be affected. No resettlement of houses is required for either of the two project components. The land acquisition for the Dagachhu hydropower component will be mainly necessary due to the construction of access roads, not covered by ADB financing. A total of 25 households will be affected by losing part of their land. Each of the affected households and communities was given the opportunity to choose between cash or land-for-land compensation. Through the public consultation, they have selected alternative plots of land. In addition to the land plots, DHPC is providing compensation for affected crops. Due to the lack of recent market rates for trees and crops, DHPC agreed to top-up the amounts already compensated with additional funds at the end of the cropping season. Affected people agreed to this two-stage compensation approach that will ensure compensation at market value for crops and trees. To guide the land acquisition and compensation, a short resettlement plan was disclosed to all those affected in accordance with ADB's *Involuntary Resettlement Policy* (1995) and the relevant laws and policies of the Government.

70. No negative social impacts are anticipated during implementation of the rural electrification component. No land acquisition will be required and no damage to crops and

³⁸ ADB. 2004. *Technical Assistance to the Kingdom of Bhutan for Capacity Building of Bhutan Power Corporation*. Manila.

private trees is expected as distribution lines and poles can be designed and aligned to avoid any disruptions. No resettlement plan is therefore included, although an in-depth survey was carried out under the PPTA to assess poverty impacts. Access to electricity will make positive social impacts on health, in particular for women who are more active at housework such as cooking.

71. **Poverty Aspects.** The poverty impact analysis is in Supplementary Appendix G. Rural electrification schemes have proved beneficial for poverty reduction and income generation. As rural areas usually fall behind in access to both social services and income opportunities, the grid expansion along with development of other infrastructure such as roads and public utilities will boost the local economy and provide additional health-related benefits. Access to electricity is also expected to improve education by allowing children to devote longer hours to studying, and schools to avail of additional facilities such as computers. Income generation activities and increased productivity are among the major positive impacts of rural electrification schemes. Income security through its diversification is also a fundamental benefit, as it reduces vulnerability. According to the results from the in-depth survey of project beneficiaries, affordability is not expected to be an issue since their real capacity to pay is greater than the expected demand measured by their willingness to pay. As a result, the poverty impact ratio of the rural electrification subproject is an outstanding 62%.

72. The Dagachhu hydropower component will have direct and indirect positive impacts on poverty. The local economy has already started developing as some of the civil works have been implemented. The development of access roads to the project site will improve accessibility of local communities to main roads. This is expected to stimulate the local economy, while improving quality of life. The Dagachhu development will indirectly support rural domestic customers, in particular under a lifeline tariff. The tariff policy requires the Government to subsidize electricity for lifeline consumers, using 12%–18% of the royalty revenue yielded from power export from the Dagachhu plant. Because alternative sources of energy, in particular kerosene, have become progressively more expensive, use of cheaper electricity will increase savings. Power exports will increase the Government's revenue base and enable the Government to make more resources available for socioeconomic development including health, education, and rural electrification. In 2006/07, revenues from power exports contributed to all the expenditures for agriculture and social sectors (e.g., health and education). During the next FYP, the Government considers that revenues from hydropower development will be the major source for directly improving quality of life and reducing poverty. Incremental income from power exports will be used for improving and expanding road and bridge infrastructure to promote rural development for poverty reduction.

D. Environmental Assessment

73. ADB classifies the Project as environment category B. In accordance with ADB's *Environment Policy* (2002) and *Environmental Assessment Guidelines* (2003), a summary IEE (SIEE) was prepared, and reviewed by ADB, to provide a sound basis for project processing and implementation (Appendix 15 and Supplementary Appendix H). ADB's environmental due diligence covers all project-associated facilities including access roads and a transmission line from the Dagachhu plant.

74. In accordance with the national legislation, an environmental impact assessment was completed for the Dagachhu component in July 2006, and the National Environment

Commission granted the environmental clearance in June 2007. The Dagachhu component uses a run-of-river design and does not encroach on any protected areas. Mitigation measures included in the EMP are designed to assure the avoidance of any damage to the local environment or communities, or disturbance of important habitats. No human settlement relocation is required for project implementation. Some impacts will occur due to construction of an access road, but the road does not cross any protected areas or disturb local habitats in the 51 hectares of broadleaf and conifer forest and scrub for the whole development area. This is a small amount in relation to the very large areas of similar habitat present nearby. Impacts on biodiversity will be minimal.³⁹

75. The National Environment Commission and Department of Forests provided national environmental and forestry clearances for the rural electrification component, and initial environmental examinations (IEEs) were issued for each district of the project area. While construction of the distribution infrastructure is not expected to have major adverse impacts,⁴⁰ some negative environmental impacts will occur as most of the villages targeted for electrification are located in forested areas. These impacts will be mitigated through the EMP, which requires a set of measures including the reduction of clearance areas for the rights-of-way, installation of covered conductors in areas close to protected areas and sensitive habitats, and alignment of distribution lines along public roads (on curbs) that are excluded from the protected status according to the Road Act of Bhutan 2004. In addition, all civil works will be performed by manual labor, and cutting of trees will be monitored by staff from Department of Forests local offices. After implementation, the schemes will operate without major negative environmental impacts.⁴¹

E. Risks and Assumptions

76. **Dagachhu Hydropower.** Two external risks relate to off-take and CDM. While the off-take tariff was agreed with an Indian private power trader (i.e., TPTC, para. 31) on commercial terms, the regulatory or tariff revision risk is considered minimal as the power purchase agreement defines the base-year tariff with 2% constant escalation per annum over 25 years. Due to the large power demand–supply gap in India, the small 114 MW Dagachhu generation capacity is likely to be absorbed in the power trading market. Second, the Dagachhu hydropower development is based on the assumption that additional cash flows will be generated from the sale of carbon emission reductions, however, the nature of a post-2012 CDM framework is as yet unknown. To mitigate the risk of this uncertainty, DHPC and TPTC have in principle agreed for the purchase of the emission reductions to be underwritten by TPTC over the 30 year duration at a specific minimum price. Therefore, the overall project risk to the financial sustainability due to external factors is deemed minimal.

³⁹ As per the EMP, DHPC will continue to monitor the air, soil, water quality baseline, and aquatic life and migratory fish species to determine the minimum ecological water flow and an optimal design for the civil works.

⁴⁰ This is because (i) distribution line routes were chosen to minimize the need for forest clearance; (ii) 30% of distribution lines will be in unforested areas where a right-of-way will not be necessary; (iii) lines will be located on road curbs, which are not subject to environmental protection status; (iv) all other construction work is small in scale and will be conducted by manual labor without the use of heavy vehicles and machinery; (v) most affected areas outside the villages are uninhabited, and work in villages can be conducted without causing major disruption to residents; and (vi) construction work is relatively straightforward and can be completed in a fairly short time.

⁴¹ Rural electrification schemes normally operate with routine maintenance and only occasional repair; any repairs should be small in scale and infrequent.

77. Potential risks for the component include (i) increase in cost of civil works and equipment, and (ii) delays in project implementation. The cost and time overrun risks are to be mitigated by contractual warranties in the engineering, procurement, and construction contracts. Sufficient physical and price contingencies have been considered for any increase in the equipment and civil works costs. The component's main sponsor, DGPC, has already implemented hydropower projects with various agencies and is operating four hydropower plants in Bhutan. DHPC staff have experience executing hydropower projects. This will minimize the risk of cost and time overruns, along with PPP arrangements with TPC—a joint venture partner in the component with extensive experience in implementing and operating hydropower projects worldwide. TA funded by the Government of Austria will support DHPC in implementation and supervision during construction. The risk and mitigation analysis is presented in Supplementary Appendix I.

78. **Rural Electrification.** The overarching objective of rural electrification is to reduce poverty by promoting local economic development through provision of electricity supply. However, investment and operations in rural electrification will be not financially viable because of the rural customer's low paying capacity, associated risks, and high staffing cost for utility services in remote areas. Therefore, the Government's financial assistance in the form of an up-front capital subsidy is inevitable. Since failure to mobilize the necessary counterpart funds is critical to the component, the Government has assured timely provision of counterpart funding.

79. Potential risks for the component include (i) increase in cost of construction materials and transportation due to higher fuel prices, (ii) delays in construction due to procurement and contract awards, and (iii) difficult accessibility due to undeveloped access roads. These risks are to be mitigated by (i) adequate physical and price contingencies, and cost estimates based on recent actual bid prices; (ii) advance procurement action; and (iii) integration of road development plans in rural electrification programs.

VI. ASSURANCES AND CONDITIONS

A. Specific Assurances

80. In addition to the standard assurances, the Government, and executing and implementing agencies have given the following assurances, which are incorporated in the legal documents.

1. Financial Aspects

81. **Counterpart Funding.** The Government, and executing and implementing agencies will ensure adequate counterpart funding to complete the Project.

82. **Cofinancing.** The Government and DHPC will keep ADB informed of any discussions on any proposed financing arrangements and provide ADB with the opportunity to comment on any resulting proposals.

83. **Corporate Governance.** The Government will cause DGPC and DHPC to ensure that (i) DGPC retains majority shareholding and majority representation on the board of directors of DHPC and a majority representation of DGPC is required for a quorum for any meeting of DHPC's board of directors; and (ii) no material changes are made to the shareholders agreement without consulting with ADB.

84. **Financial Indicators.** DGPC and DHPC will maintain a debt service coverage ratio of a minimum of 1.2 from the date commercial operations commence. BPC will maintain the following annual financial ratios: (i) a debt service coverage ratio of a minimum 1.5; (ii) a debt to equity ratio of 70:30, and (iii) an accounts receivable collection of less than 2 months. DGPC, DHPC, and BPC will incorporate measures to achieve these financial ratios in the corporate capital expenditure plans.

85. **Hedging.** DGPC will cause DHPC to (i) deliver a proposal to ADB for currency hedging or an alternative proposal that serves the purpose of hedging the OCR loan; and (ii) arrange currency hedging or the alternative measures in a form satisfactory to ADB.

2. Commercial Aspects

86. **Commercial Agreement.** The Government, DGPC, and DHPC will consult with ADB before making any changes to the power purchase agreement, the shareholders agreement, or to authorize new capital for DHPC.

87. **Emission Reduction Underwriting.** No later than 28 February 2009, the emission reduction underwriting agreement with TPTC will have been executed and delivered. All the conditions precedent to its effectiveness will be fulfilled except for the registration with the CDM executive board.

88. **Licensing.** The Government will cause DHPC to, and DHPC will, obtain all necessary construction licenses from BEA within 60 days of the effective date.

3. Institutional Aspects.

89. **Financial Management.** The Government will cause DGPC and DHPC to, and DGPC and DHPC will, apply a new corporate accounting policy by 2009.

90. **Management Information System.** The Government will cause DGPC and DHPC to, and DGPC and DHPC will, prepare the design for an integrated management information system by 2010, and install the integrated system by 2011.

4. Environmental Safeguards

91. **Environment.** The Government, and the executing and implementing agencies will ensure (i) implementation of the Project in accordance with all environmental safeguard measures; (ii) adequate supervision of construction works carried out by private contractors to ensure compliance with these safeguard measures; (iii) assessment, operation, and maintenance of all project facilities and associated equipment under applicable laws and regulations of the Government, ADB's *Environment Policy (2002)*, and internal environmental policies and safeguard operating rules of the executing and implementing agencies; and (iv) compliance with the environmental impact assessment, SIEE, and IEE outcomes and mitigation measures identified in the EMP approved by ADB and relevant government agencies during the design, construction, and operation of the Project.

92. **EMP Monitoring.** The Government will cause the executing and implementing agencies to monitor and audit implementation of the EMP, and report to ADB twice a year on EMP implementation. The Government and the executing and implementing agencies

will ensure that the Project (i) does not take place within national parks, wild and planted forests, and wildlife sanctuaries without prior environmental clearances obtained from all relevant government agencies; and (ii) avoids monuments of cultural or historical importance. The Government will cause DGPC and DHPC to monitor the air, soil, and water quality baselines and the minimum ecological water flow for a minimum of 2 years, and update the EMP in consultation with and to the satisfaction of ADB if any of these baselines suggest that changes to the existing EMP are required, and if any unanticipated environmental impacts arise.

5. Social Safeguards

93. **Land Acquisition and Resettlement.** The Government, and the executing and implementing agencies will ensure that (i) all land and rights-of-way required by the Project are made available in a timely manner; (ii) any involuntary resettlement will be avoided or minimized. The Government, and the executing and implementing will also ensure that (i) in collaboration with the competent authorities, title deeds for the new plots of land will be made available to all affected persons by 31 December 2008, (ii) the provisions of the resettlement plan, including compensation and entitlements for affected households and persons, will be implemented, and (iii) the Project is in compliance with all applicable laws and regulations of the Government, including those amended from time to time, and the entitlement benefits as listed in the Government's applicable laws, and ADB's *Involuntary Resettlement Policy* (1995).

94. **Resettlement Plan Disclosure.** If any changes are made to the design of the Project that affects the land to be acquired or used for the Project in any way, or if new land acquisition and/or involuntary resettlement is required for the Project, the Government, and the executing and implementing agencies will prepare or update the resettlement plan for ADB review and approval, prior to any land acquisition being initiated and no later than the award of civil works, and disclose the resettlement plan to affected people in accordance with ADB's applicable information disclosure requirements. The Government will ensure that essential public infrastructure that may be affected under land acquisition and resettlement is replaced as appropriate in an expeditious manner in accordance with the resettlement plan.

95. **Compensation.** The Government, DGPC, and DHPC will ensure that (i) sufficient budgetary resources are made available to cover all compensation and associated costs; (ii) all compensation will be paid at the applicable rates for project implementation as per the resettlement plan; (iii) rates will be revised by September 2008 to ensure application of the actual market price, and the entitlement matrix in the resettlement plan should be used in determining the suitable compensation; (iv) payments are made in a timely manner, in any case before dispossession and beginning of civil works; (v) all project-affected persons are compensated fairly, such that their living standards are not adversely affected; and (vi) any relocation, resettlement, and compensation of any project-affected persons will be promptly and efficiently carried out in accordance with the resettlement plan, and ADB's *Involuntary Resettlement Policy* (1995), such that project-affected persons will at least maintain their standard of living at the same level as before project implementation. The Government, DOE, and BPC will ensure that any damage to crops or trees or any other asset occur during implementation of the rural electrification component will be compensated at market rates to the eligible affected person or community.

96. **Resettlement Plan Monitoring.** The Government, through DHPC, will conduct monitoring of implementation of the resettlement plan. The Government and DGPC will ensure that DHPC will submit progress and completion reports on land acquisition and resettlement under the quarterly progress reports; and each of the Government, DGPC, and DHPC will ensure that the compensation completion report is submitted to ADB within 3 months of completion of implementation of the resettlement plan.

97. **Construction Contracts.** The executing and implementing agencies will ensure that construction contracts contain binding requirements for construction contractors to (i) fully reinstate pathways, other local infrastructure, and agricultural land to at least their preproject condition upon completion of construction; and (ii) adequately record the condition of roads, agricultural land, and other infrastructure prior to transport of material and construction commencement.

98. **Labor Standards.** The Government, and the executing and implementing agencies will (i) ensure that all civil works contracts require contractors employed under the Project to incorporate minimum workplace occupational safety norms, including the core labor standards as identified by the fundamental International Labor Organization conventions; (ii) provide timely payment of wages to all workers including male and female workers (with such requirements being included in civil works contract and monitored by construction supervision consultants); (iii) provide women's employment, where appropriate, and pay equal wages to women employees for equivalent work; (iv) not employ child labor in project activities, in compliance with the relevant laws and regulations of the Government; and (v) monitor implementation of these provisions including, the effects of the Project on women through collection and compilation of gender-disaggregated data, where relevant, including in the relevant resettlement plan, social development action plan, and project performance monitoring and system; and provide monitoring reports of these activities to ADB.

99. **Health Requirement.** The Government, through DGPC, and DHPC will cause the contractors to disseminate information on the risks of socially and sexually transmitted diseases, including HIV/AIDS and malaria, to their employees during project implementation.

B. Conditions for Loan and Grant Effectiveness

100. Effectiveness of the OCR loan will be subject to (i) signed subsidiary loan agreements (between the Government and DGPC and between the Government and DHPC) satisfactory to ADB; and (ii) signed commercial agreements, including the power purchase agreement and shareholders agreement (among DGPC, NPPF, and TPC), satisfactory to ADB.

101. Effectiveness of the hard-term ADF loan will be subject to (i) a signed subsidiary loan agreement (between the Government and DGPC) satisfactory to ADB; and (ii) the power purchase agreement satisfactory to ADB.

102. Effectiveness of the ADF grant will be subject to a signed subsidiary loan agreement (between the Government and BPC).

103. Effectiveness of the ACEF grant will be subject to approval from the Government of Japan.

C. Conditions for Disbursement

104. Disbursement of the OCR loan will be subject to the execution and delivery of cofinancing agreements for the OeKB Loan Agreement and NPPF Loan Agreement.

105. Disbursement of the ADF loan will be subject to the execution and delivery of shareholders agreement satisfactory to ADB.

VII. RECOMMENDATION

106. I am satisfied that the proposed loans, grant and administration of grant would comply with the Articles of Agreement of the Asian Development Bank (ADB) and recommend that the Board approve

- (i) the loan of \$51,000,000 to the Kingdom of Bhutan for the Green Power Development Project from ADB's ordinary capital resources, with interest to be determined in accordance with ADB's London interbank offered rate (LIBOR)-based lending facility; a term of 30 years, including a grace period of 5 years; and such other terms and conditions as are substantially in accordance with those set forth in the draft Loan and Project Agreements presented to the Board;
- (ii) the loan in various currencies equivalent to Special Drawing Rights 18,832,000 to the Kingdom of Bhutan for the Green Power Development Project from ADB's Special Funds resources with an interest charge at the rate of 3.15% per annum; a term of 32 years, including a grace period of 8 years; and such other terms and conditions as are substantially in accordance with those set forth in the draft Loan and Project Agreements presented to the Board;
- (iii) the grant not exceeding the equivalent of \$25,280,000 to the Kingdom of Bhutan, from ADB's Special Funds resources for the Green Power Development Project, with terms and conditions as are substantially in accordance with those set forth in the draft Grant and Project Agreement presented to the Board; and
- (iv) the administration by ADB of a grant not exceeding the equivalent of \$1,000,000 to the Kingdom of Bhutan for the Green Power Development Project to be provided by the Asian Clean Energy Fund under the Clean Energy Financing Partnership Facility.

Haruhiko Kuroda
President

7 October 2008

DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets/Indicators	Data Sources/ Reporting Mechanisms	Assumptions and Risks
<p>Impact Sustained inclusive economic growth through promoting cross-border power trade and electricity access.</p>	<p>Increase in the energy sector share of GDP from 25% to 40% (2017) with annual GDP growth increased at least 2%–3% from 2012 to 2017</p> <p>Increase in the energy sector share of the government revenue from 45% to 75% (2020), through clean energy export to India with an additional 10,000 MW electricity (2020)</p> <p>Increase in use of electric lighting (to replace kerosene lamps or firewood), from 40% to 100% (2013) of rural households¹</p>	<p>Government statistical and census reports</p> <p>UNDP human development report</p> <p>Economic reports of Government, ADB, IMF, and World Bank</p>	<p>Assumptions</p> <ul style="list-style-type: none"> • Political stability • Government's high policy priority to rural development and hydropower export • Stable economic growth in South Asia • Bilateral and multilateral assistance for rural electrification expansion <p>Risks</p> <ul style="list-style-type: none"> • Exogenous economic and political shocks
<p>Outcome Expanded coverage of clean power development</p>	<p>Increase in access to electricity by rural and urban households, achieving a cumulative national electrification ratio from 60% to 84% (2012)</p> <p>Increase in hydropower export revenue of the total national account from 40% to 45% (2013)</p> <p>Increase in investment size from the public and private sectors to hydropower development projects with minimum additional 1,314 MW (2014)</p> <p>Annual reduction of emission gas equivalent</p>	<p>Quarterly project progress reports and completion report</p> <p>Audit financial accounts and reports</p> <p>National statistics</p> <p>Government's fiscal statements</p> <p>Economic reports of Government, ADB, IMF, and World Bank</p>	<p>Assumptions</p> <ul style="list-style-type: none"> • Government's commitment to promote development for hydropower and rural electrification • Continuation of the existing investment program and regulatory framework • Promotion of a new policy for private participation • Strong demand and supply shortage in the Indian power market • Government's sustainable public debt management • Bilateral assistance from the Government of India for hydropower developments

¹ The Government has revised the target year to achieve 100% electrification from 2020 to 2013.

Design Summary	Performance Targets/Indicators	Data Sources/ Reporting Mechanisms	Assumptions and Risks
	<p>CO₂ by 250,000 tons by 2012 and by 500,000 tons in a cross-country basis after 2012 on onward</p> <p>Continued overall power system loss below 10% and power sector's financial health including sufficient debt service coverage (minimum 1.2) and net profit generation</p>		<ul style="list-style-type: none"> • Bilateral assistance from JBIC for rural electrification <p>Risks</p> <ul style="list-style-type: none"> • Off-taker's serious default • Prolonged significant hydrological shortage because of natural disaster and climate change
<p>Outputs</p> <p>1. Dagachhu Hydropower Development</p> <p>2. Rural Electrification</p> <p>3. Attached CDTA: Promotion of Clean Power Export Development</p> <ul style="list-style-type: none"> - Capacity Building for hydropower - Financial structuring study for medium-size hydropower projects - Preparation of documents for carbon 	<p>Construction of a 114 MW run-of-river Dagachhu hydropower plant by 2012</p> <p>Construction of a 19 km transmission line to evacuate to the grid system by 2012</p> <p>Clean and renewable energy export of additional 250 GWh to India by 2012 and 500 GWh after 2012</p> <p>Provision of reliable power supply and service to 8,767 rural households and 119 off-grid public institutions (schools, health clinics, and other community facilities) in seven subprojects by 2012</p> <p>Full operation of the Druk Green Power Corporation, through the corporate accounting policy (2009) and integrated management information system (2011)</p> <p>Implementation of the Hydropower</p>	<p>ADB review missions' aide memoires</p> <p>Quarterly project progress reports</p> <p>Project completion report</p> <p>Withdrawal applications, and disbursement and contract award records</p> <p>Audit of financial accounts and reports</p> <p>Government's fiscal statement</p> <p>CDM monitoring report</p>	<p>Assumptions</p> <ul style="list-style-type: none"> • Government's commitment to carry out the Green Power Development Project • Timely mobilization of counterpart funds, equities, and cofinancing • Firm commercial agreement (i.e., power purchase agreement, emission reduction underwriting contract) • High quality of construction contractors and equipment • Accessibility to the development sites <p>Risks</p> <ul style="list-style-type: none"> • Unexpected cost increases in commodities and raw materials beyond contingencies • Construction delays due to slow procurement, natural disaster, or design changes • Lack of sufficient and appropriate human resources and expertise

Design Summary	Performance Targets/Indicators	Data Sources/ Reporting Mechanisms	Assumptions and Risks
finance	<p>Development Policy, through two sample projects with public and/or private investments</p> <p>Financial structuring proposals of Nikachhu (210 MW) and Khomachhu (326 MW) development before 2011</p>		
<p>Activities with Milestones</p> <p>1. Dagachhu Hydropower Component</p> <p>1.1 Endorsement and disclosure of the resettlement plan to affected people by June 2008</p> <p>1.2 Advance procurement by July 2008</p> <p>1.3 Endorsement and disclosure of the summary initial environmental examination by September 2008</p> <p>1.4 Completion of physical land acquisition and compensation with revised rates by the fourth quarter 2008</p> <p>1.5 Contract award by the first quarter 2009</p> <p>1.6 Physical construction by 2012</p> <p>1.7 Operation by the second quarter 2012</p> <p>2. Rural Electrification Component</p> <p>2.1 Advance procurement by the fourth quarter 2008</p> <p>2.2 Contract award by the first quarter 2009</p> <p>2.3 Physical construction by 2012</p> <p>3. Promotion of Clean Power Export Development (CDTA)</p> <p>3.1 Consultant selection process by the fourth quarter 2008</p> <p>3.2 Contract award by the first quarter 2009</p> <p>3.3 Consultant fielding by the first quarter 2009</p> <p>3.4 Completion of CDTA by the fourth quarter of 2010</p>			<p>Inputs</p> <p>Dagachhu Hydropower Financing (\$ million)</p> <ul style="list-style-type: none"> • ADB 80.0 • Bhutan Public Sector 45.0 • Cofinancing 55.5 • Private sector 21.0 <p>Rural Electrification Financing (\$ million)</p> <ul style="list-style-type: none"> • ADB 25.28 • Government 6.70 • ACEF 1.00 <p>Attached CDTA (\$ '000)</p> <ul style="list-style-type: none"> • ADB 1,488 • Government 24

ACEF = Asian Clean Energy Fund, ADB = Asian Development Bank, CDM = Clean Development Mechanism, CDTA = capacity development technical assistance, GDP = gross domestic product, GWh = gigawatt-hour, IMF = International Monetary Fund, JBIC = Japan Bank for International Cooperation, MW = megawatt, TA = technical assistance, UNDP = United Nations Development Programme.

POWER SECTOR ASSESSMENT

A. Key Challenges Facing Hydropower Development

1. **Domestic Financial Resources.** The most critical challenge facing hydropower development in Bhutan is the lack of available domestic financial resources to fund large investments. The country's Power System Master Plan identifies 15 projects for implementation, and the Government considers more than 10 hydropower projects with aggregate generation capacity of over 10,000 megawatts (MW) for implementation between 2008 and 2018 during the 10th and 11th five-year plan periods (Table A2).¹ The total investment requirement will be more than \$10 billion. Such a capital expenditure is significant compared to aggregate capital figures for the rest of the country's economy. In Bhutan, limited public funds invariably need to be allocated to socioeconomic development for health, education, and rural development. Under the circumstances, the Government will need to develop a domestic capital market and diversify operations in the financial sector to raise domestic capital and intermediate with external funds.

Table A2: Hydropower Projects Proposed during the 10th and 11th Five-Year Plans

Project Name	Installed Capacity (MW)	Type
Punatsangchhu-I	1,170	Run-of-river
Punatsangchhu-II	1,000	Run-of-river
Mangdechu	720	Run-of-river
Chamkachu-I	670	Run-of-river
Kholongchu	485	Run-of-river
Amochu	500	Run-of-river
Kuri Gobgri	1,800	Reservoir
Sunkosh	4,060	Reservoir
Dagachhu	114	Run-of-river
Chamkachu-II	570	Run-of-river
Khomachhu	326	Run-of-river
Nikachhu	210	Run-of-river

MW = megawatt.

Source(s): Gross National Happiness Commission. 2008. Draft 10th Five Year Plan (2008-2013); and Department of Energy, 2003, Power System Master Plan

2. **Fiscal Sustainability.** The Government's investment is dependent on international aid. Increasing debt burden from external sources would raise the issue of debt sustainability, and limit access to financial resources for the country. The capital needs of the power sector vastly exceed the availability of resources from traditional multilateral and bilateral agencies, and domestic financial resources. Development finance has become even tighter given the declining worldwide trend in availability of concessionary financing for power development, and the recognition that scarce public resources are needed to develop social sectors. In this context, the strategic use of foreign public and private participation and investment will help accelerate the development of hydropower projects in Bhutan.

¹ A number of large hydropower projects with more than 500 MW are planned for development under the bilateral partnership between the governments of Bhutan and India.

3. **Investment Environment.** Private and foreign direct investment is in its early phases. Even though the underlying economic performance for hydropower development is strong, its concomitant risks keep private investors away. This is most evident in emerging markets where the most unexploited hydropower potential exists. In neighboring countries such as India, private investment in hydropower sector was miniscule until recently. Hence, one of the challenges for Bhutan is to develop a hydropower development policy that can attract private sector participation and create a sustainable and competitive investment climate.

4. **Market Competition.** The recent private sector investment in Indian power is creating alternative and competitive generation sources. To solve the large domestic supply deficit, the Government of India has unveiled the concept of large thermal projects: ultra mega power projects. Some of these projects have offered tariffs in a competitive range of \$0.03–\$0.05/kilowatt-hour. These attractive tariffs are due to generation being available throughout the year, compared to run-of-river type hydropower projects in Bhutan where generation capacity is limited during winter months due to lower water flow. To increase the comparative advantage of Bhutan's hydropower in the regional power trading market, some power export projects must be promoted on commercial principles, unlike past projects where tariffs were politically negotiated on bilateral assistance.² Any off-take prices set on a commercial basis will make significant impacts on subsequent project development and investment.

5. **Transmission Networking.** Bhutan Power Corporation (BPC) will need to work closely with its Indian transmission counterpart to ensure transmission facilities for the export of electricity. BPC is responsible for developing the transmission system within Bhutan for the evacuation of electricity from hydropower stations to the Indian border point of transfer. To supervise and control efficient operation and maintenance of the national system, BPC is developing a national load dispatch center, which is expected to contribute to improving system reliability, shortening power interruption time, and reducing system energy losses.

B. Key Challenges for Rural Electrification

6. **Cost Effectiveness.** The average capital expenditure for household electrification was \$1,535 under the previous Asian Development Bank (ADB) loan project.³ This is expected to reach \$3,640 per household customer in the planned rural electrification component of the Green Power Development Project. The increased electrification cost is mainly due to recent price appreciations of materials and fuels (e.g., steel, copper, and gasoline). In spite of a least-cost engineering design, the new rural electrification subproject will be inherently more costly due to more remote and dispersed project areas where the average distribution line length is 50% longer and access roads are further away.⁴ Any future rural electrification program will have even higher capital expenditure considering tougher and more unapproachable terrain. Achieving 100% electrification is estimated to cost about \$90 million.⁵ To improve project implementation efficiency, least-cost design and

² No specific tariff regulations are in place for cross-border power trading between Bhutan and India. The existing three power plants for export have export tariffs ranging from Rs1.8 to Rs2.0.

³ ADB. 2003. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Kingdom of Bhutan for Rural Electrification and Network Expansion*. Manila.

⁴ While most of the previous projects were near roads, the proposed project sites are a 5-hour walk from the road on average.

⁵ Japan International Cooperation Agency. 2005. *The Rural Electrification Master Plan*. Tokyo.

economic feasibility analysis will be required. The Government set up an off-grid electrification arrangement as an alternate approach in case the economic rates of return for the grid extended options are not feasible.

7. **Sustainability.** Rural electrification projects often require operating subsidy inputs to ensure sustainability. Currently the subsidies for rural electrification are provided through (i) the sale of power from generation companies to BPC at a rate that is less than the cost of production,⁶ and (ii) cross-subsidies from the sale of electricity to large industrial customers. Under the Tariff Regulations, the regulator, Bhutan Electricity Authority, intends to effectively cap the total subsidy available from the sale of power, and require payment at the full cost of power sales to India for all local consumption in excess of 15% of Bhutan's current hydropower generation capability. This means the subsidy will adequately cover low-voltage rural domestic customers below the lifeline tariff,⁷ with medium- and high-voltage customers paying the full cost of supply. Nevertheless, BPC's expenditures for rural distribution system operation and maintenance, combined with customer services result in a loss-making proposition for BPC. It must develop a participative approach where minor repairs, maintenance, and billing and collection work will be outsourced to contracted villagers.⁸ Maintenance responsibilities and ownership for off-grid batteries will be transferred to trained village technicians.⁹

8. **Interregional Transmission Network.** The lack of an interregional transmission link between the western and eastern regions of the country has led to constrained industrial growth in these regions. Due to limited generation availability in the eastern region, the extent of rural electrification has lagged. Hence, the interconnection of the western and eastern grids in Bhutan will increase the reliability of electricity supply in the eastern region and reduce dependence on import from India during the winter when generation from Kurichhu is insufficient to meet domestic demand. The interconnected grid will also provide opportunities for accelerated industrialization in the eastern and central region of the country.

⁶ The average production cost of electricity from hydropower generation in Bhutan is Nu1.19/kilowatt-hours (kWh). Electricity for local consumption is sold to BPC for Nu0.3/kWh. Electricity is sold to India for Nu2.0/kWh, except in eastern Bhutan, where electricity from the Kurichhu hydropower project is sold to India for Nu1.80/kWh.

⁷ In 2007, domestic customer consumption was 14.88% of the total BPC consumption.

⁸ ADB. 2006. *Technical Assistance to the Kingdom of Bhutan for the Accelerated Rural Electrification Project*. Manila. The assistance is ongoing.

⁹ ADB. 2006. *Technical Assistance to the Kingdom of Bhutan for the Rural Electrician Training Program*. Manila. The assistance is ongoing.

EXTERNAL ASSISTANCE TO THE POWER SECTOR

1. Bhutan's power sector has received a major portion of its external assistance from the Asian Development Bank (ADB) and governments of Austria, India, Japan, Netherlands, and Norway and their bilateral agencies.
2. While ADB has supported power sector restructuring, institutional development, and rural electrification expansion; bilateral development partners have supported building generation capacity through grants and soft loans. The Government of India funded and assisted in constructing three major power stations: Chhukha, Kurichhu, and Tala for export purposes. The Government of Austria supported the development of the Basochu hydropower plant for domestic supply, and conducted a feasibility study for the proposed Dagachhu hydropower development. The governments of Japan and Norway supported feasibility studies for potential hydropower sites and prepared the Rural Electrification Master Plan and the Power System Master Plan, respectively. ADB and the governments of Austria, Japan and Netherlands have actively supported rural electrification.
3. ADB has been the lead agency in the power sector providing three loans and 10 technical assistance grants (Tables A3.1 and A3.2).

Table A3.1: Previous ADB Loans to the Power Sector

Loan No.	Project	Amount (\$ million)	Approval Year
Loan 1375-BHU	Rural Electrification Project	7.5	1995
Loan 1712-BHU	Sustainable Rural Electrification Project	10.0	1999
Loan 2009-BHU	Rural Electrification and Network Expansion Project	9.3	2003
Total		26.8	

BHU = Bhutan.

Source: Asian Development Bank.

Table A3.2: Previous ADB Technical Assistance to Power Sector

TA No.	Project	Amount (\$ million)	Approval Year
TA 2400-BHU	Institutional and Financial Strengthening of Department of Power	0.4	1995
TA 2912-BHU	Second Rural Electrification	0.6	1997
TA 3112-BHU	Policy and Legal Framework for Power Sector Development	0.5	1998
TA 3307-BHU	Corporatization of the Department of Power	0.6	1999
TA 3825-BHU	Rural Electrification and Network Expansion	0.7	2002
TA 4188-BHU	Capacity Building of Bhutan Electricity Authority	0.4	2003
TA 4599-BHU	Capacity Building for Bhutan Power Corporation	0.4	2005
TA 4766-BHU	Accelerated Rural Electrification	0.7	2006
TA 9093-BHU	Rural Electrician Training Program	1.0	2006
TA 4916-BHU	Preparing the Bhutan Power Development	1.6	2007
Total		6.9	

BHU = Bhutan.

Source: Asian Development Bank.

DEBT SUSTAINABILITY ASSESSMENT

1. The Department of Public Accounts of the Ministry of Finance is responsible for management of government external borrowings. It has shifted its debt records to a more sophisticated information system—Commonwealth Secretariat's Debt Recording and Management System (CS-DRMS). The system is expected to be actively used for regularly monitoring and analyzing debt.

2. **Current Debt Situation.** Total outstanding debt in Bhutan at the fiscal end of June 2007 is estimated at Nu34,973 million, resulting in a debt to gross domestic product (GDP) ratio of 88%, down from a high of 95% in 2005/06 and 91% in 2004/05. The drop in domestic and external borrowing contributed to the decrease in debt burden.

3. A major portion of the Government's borrowing requirements is met from external sources. At the close of fiscal year 2006, domestic borrowing constituted only about 8% of both the sanctioned amount and the total outstanding debt. The Government of India has been the main source of grant aid and loans, contributing the maximum (53%) of Bhutan Government's total outstanding debt. Convertible currency loans contributed to the remaining debt (i.e., 39%). Of other sources of borrowing in convertible currency, ADB contributed the most, about 17% of the outstanding debt followed by the International Development Association (IDA), which contributed about 10%.

4. On similar lines, Indian rupee denominated loans contributed 53%, while special drawing right (SDR) loans constituted about 30% of total loans outstanding. Euro-denominated loans shared about 9% of the debt. Overall, the Government of India, ADB, IDA, and the Government of Austria were the main sources of external borrowing.

5. **Sector Composition of Government Borrowing.** The largest portion (about 60%) of Government borrowing has been directed to investments in the rapidly expanding power sector. The transport and communications sectors (including telecommunications) contributed to about 14% of the outstanding debt. Among other sectors, agriculture and forestry consumed 7% of borrowing, while education and training, and social infrastructure sectors, each contributed 5%. Thus, the Government has purposefully used external borrowing for power, transport, and communications. Since the power sector provides a comparative advantage to Bhutan, while transport and communications are necessary investments for economic growth, the Government has been prudent in utilizing its borrowing.

A. Methodology

6. **Technical Justification and Selection Criteria.** One of the important considerations for external borrowing for the Dagachhu hydropower development is its impact on the country's economy. This assessment essentially entails a comparison of beneficial impacts in terms of additional growth in GDP, exports, and revenues with the impending fiscal stress resulting from additional debt service obligations for the borrowing.

7. The debt sustainability analysis is in accordance with the debt sustainability framework of the International Monetary Fund (IMF) and IDA for low-income countries. The methodology focuses on five key ratios: (i) net present value (NPV) of external debt to GDP; (ii) NPV of external debt to exports, (iii) debt service to exports, (iv) NPV of external debt to revenue, and (v) debt service to revenue. However, the IDA 14 approach argues that

revenue-based ratios are not reliable indicators of stress because of external debt and recommends three indicators of debt distress: (i) NPV of external debt to GDP, (ii) NPV of external debt to exports, and (iii) debt service to exports. The following analysis is confined to these three indicators.

8. Under the debt sustainability framework, the magnitude of each ratio is compared with respective indicative thresholds defined for the ratio. The thresholds, in turn, depend on the classification of the country as a strong, medium, or weak policy nation. Furthermore, indicative thresholds follow a decreasing order as the countries move from a “strong policy” to “weak policy” classification. Bhutan is classified as a “strong policy” nation and the corresponding thresholds are used for the analysis.

9. To assess the impacts of the Dagachhu hydropower development, a forward-looking approach is used to examine the dynamic behaviour of the key ratios under various scenarios. The dynamic analysis considers the impact of future borrowing and is preferable over static analysis, which is based on a snapshot of a country’s external debt situation.¹

10. In assessing the debt distress of countries, the debt sustainability framework categorizes them into three groups: low-, moderate-, and high-risk countries; countries in serious debt distress breach the thresholds by a significant margin. This classification involves examining the relative distance of the country from the debt distress threshold based on the three indicators. The debt situation in Bhutan was assessed accordingly.

11. Liabilities considered for analysis include the existing budget and off-budget loans, loans in the pipeline, and expected additional liabilities because of the fiscal deficit. The composition of new loans is assumed to follow past trends.

12. The impact of the planned borrowing for standby power projects (namely Dagachhu and Punatsangchu-I) was analyzed by including these projects in stages in different scenarios. In addition, the impact of past power projects was assessed separately by excluding debt service obligations and their beneficial impacts on the economy.

13. Further, additional scenarios were examined by excluding all self-sustaining new and existing power projects from the Government liabilities to measure overall impact of the power sector on the debt sustainability indicators. This is based on the self-sustainability concept of “enclave” or commercially viable projects.

B. Analysis

14. The measurement of debt distress involves the thresholds for the three indicators, (i) NPV of external debt to GDP—50%, (ii) NPV of external debt to exports—200%, and (iii) debt service to exports—25%.

15. The introduction of the Dagachhu hydropower development results will increase Bhutan’s external debt by \$135 million over 3 years. The analysis shows that the ratios of NPV of debt to exports and debt service to exports remain within the thresholds even under a scenario where 30% local currency depreciation is allowed. The NPV of debt to GDP ratio,

¹ ADB uses the analysis from the 2007 IMF–IDA debt distress classification, which has a cutoff date of 31 December 2006. Under the analysis, the static approach was used in the absence of the forward-looking approach.

which is already above the threshold and rises further when new loans are introduced, soon falls steeply below the threshold. The rate of fall of this indicator is significantly higher than in the scenario even when new loans are not considered.

16. Further the analyses show that although some of the key indicators rise in the short term when new projects, Dagachhu and Punatsangchhu-I, are considered, the fall in these ratios is significantly faster in the medium term than when these project loans are not considered. Also these indicators rapidly drop below the levels that would be achieved in the absence of these projects. Thus, Bhutan would be at a disadvantage in the long run if the new power project loans are not utilized.

17. From a different perspective, since the Tala, Dagachhu, and Punatsangchhu-I power projects are self-sustaining with firm long-term sales contracts; they can be excluded from the debt stock for the purpose of debt-sustainability analysis. With this approach, all three ratios would remain within the sustainable limit throughout the period.

18. If the calculations exclude the impact of all the existing power projects such as Tala, Chhukha, Kurichhu, and Basochu, the debt situation would become completely unsustainable and all three ratios would be adversely affected. This is because the benefits from these projects in terms of additional exports, revenues, and GDP growth are significant. This means that although these large power projects may cause additional financial burden in the short term, the benefits in the long term far outweigh the debt burden imposed on the country.

19. The financial analysis shows that the Dagachhu hydropower development is self-financing and sustainable, and is not likely to have any burden on the Government budget. It can be supported given its positive long-term impact on the economy and debt sustainability.

20. When considering the dynamic sustainability and solvency criteria of declining fiscal stress, the overall debt situation in Bhutan appears to be sustainable.

21. In June 2007, based on the prevailing debt situation, the IMF–IDA categorization, and available economic data until 2005, ADB classified Bhutan as a high-risk country.²

22. Since then IMF–IDA issued its staff report on article IV Consultation in October 2007 providing a positive assessment of Bhutan's debt distress. Though the conventional indicators and tests point to Bhutan as having a high risk of debt distress, IMF Article IV Consultation on Bhutan (October 2007) suggests that mitigation factors such as Bhutan's experience in implementing and operating hydropower projects, and its relationship and wider dialogue with India, and its support to annual budget, have substantially improved the debt dynamics. Therefore IMF concludes that Bhutan's risk of external debt distress is moderate, reflecting the authorities' good record of implementation of externally financed hydroelectric projects, high overall foreign exchange reserves, and strong external development agency support for power projects. Detailed debt sustainability assessment is in Supplementary Appendix A.

² In accordance with the ADB. 2007. *Revising the Framework for Asian Development Fund Grants*. Manila; ADB follows the 2007 IMF–IDA debt-distress classification, which has a cutoff date of 31 December 2006, to determine future grant eligibility.

DETAILED COST ESTIMATES
Table A5.1: Detailed Cost Estimate for Dagachhu Hydropower Development
 (By Expenditure Category)

Item	Local Currency (Nu million) ^a		Foreign Currency (\$ million)		% of Total Base Cost
	Foreign Exchange	Local Currency	Foreign Exchange	Local Currency	
A. Investment Costs^b					
1. Civil Works	2,272.46	987.39	56.11	24.38	49.7
2. Electrical & Mechanical Equipment	2,123.01	275.40	52.42	6.80	36.6
3. Road & Power Lines	-	564.98	-	13.95	8.6
Subtotal (A)	4,395.47	1,827.77	108.53	45.13	94.9
B. Recurrent Costs					
1. Administration, Supervision, Pre-operative cost	-	236.93	-	5.85	3.6
2. EMP Cost	-	97.61	-	2.41	1.5
Subtotal (B)	-	334.54	-	8.26	5.1
Total Base Cost	4,395.47	2,162.31	108.53	53.39	100.0
C. Contingencies^c					
1. Physical	213.84	110.97	5.28	2.74	5.0
2. Price	153.09	345.06	3.78	8.52	7.6
Subtotal (C)	366.93	456.03	9.06	11.26	12.5
D. Financing Charges During Implementation^d					
1. Interest and Charges During Implementation	469.80	101.25	11.60	2.50	8.7
2. Guarantee Premium	207.77	-	5.13	-	3.2
Subtotal (D)	677.57	101.25	16.73	2.50	11.9
Total Project Cost (A+B+C+D)	5,439.97	2,719.59	134.32	67.15	201.47

^a The exchange rate used is locked at Nu40.5 against the dollar.

^b Include local taxes and duties of \$3.07 millions which will be financed by the Government and the Implementing Agency.

^c Computed on the manufacturer's unit value index (World Bank, 2008) for foreign exchange component and ADB forecasted inflation rate for Bhutan (ADB, 2008).

^d Interest and charges during construction is computed at LIBOR plus an ADB spread and a currency swap market rate, commitment fees and guarantee fees is computed on OeKB (Austria's) guidance and its formula in its website.

Sources: Dagachhu Hydro Power Corporation and ADB.

Table A5.2: Detailed Cost Estimate for Dagachhu Hydropower Development

Item	Cost			ADB		OeKB		Government/Others	
	OCR	Hard-Term ADF	ADF	Amount	% of Cost Category	Amount	% of Cost Category	Amount	% of Cost Category
A. Investment Costs^a									
1. Civil Works									
(a) Through DGPC equity	80.50	45.50	29.00		93	0	0	6.00	7
(b) Through other sources	29.00	0.00	29.00		100	0	0	0	0
2. Mechanical and Equipment	51.50	45.50	0		88	0	0	6.00	12
3. Roads and power lines	59.21	0	0		0	50.33	85	8.88	15
	13.95	0	0		0	0	0	13.95	100
Subtotal (A)	153.66	45.50	29.00		48	50.33	33	28.83	19
B. Recurrent Costs									
1. Administration, Supervision, Pre-operative cost	5.85	0	0		0	0	0	5.85	100
2. EMP cost	2.41	0	0		0	0	0	2.41	100
Subtotal (B)	8.26	0	0		0	0	0	8.26	100
Total Base Cost	161.92	45.50	29.00		46	50.33	31	37.09	23
C. Contingencies^b	20.32	0.0	0.0		0	0	0	20.32	100
D. Financing Charges During Implementation^c									
1. Interests and Charges During Implementation	14.10	5.50	0.00		39	0	0	8.60	61
2. Guarantee Premium	5.13	0	0		0	5.13	100	0	0
Subtotal (D)	19.23	5.50	0.00		29	5.13	27	8.60	45
Total Project Costs (A+B+C+D)	201.47	51.00	29.00		40	55.46	28	66.01	33
% Total Project Costs	1.00				40		28		33

DGPC = Druk Green Power Corporation, EMP = environment management plan.

^a Include local taxes and duties of \$3.07 millions which will be financed by the Government and the Implementing Agency.

^b Computed on the manufacturer's unit value index (World Bank, 2008) for foreign exchange component and ADB forecasted inflation rate for Bhutan (ADB, 2008).

^c Interest charges during construction is computed at LIBOR plus a ADB spread and a currency swap market rate, commitment fees, and guarantee fees is computed on OeKB (Austria)'s guidance and its formula.

Sources: Dagachhu Hydropower Corporation and ADB

Table A5.3: Detailed Cost Estimate for Rural Electrification
(By Expenditure Category)

Item	Local Currency (Nu million) ^a			Foreign Currency (\$ million)			% of Total Base Cost
	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost	
A. Investment Costs^b							
On-Grid Component:							
1 Materials	807.01	10.46	817.47	19.93	0.26	20.18	71
2 Civil works (delivery, erection and installation)	0	212.45	212.45	0	5.25	5.25	18
3 Tools, Equipment, and Vehicles	13.29	0	13.29	0.33	0	0.33	1
4 Right of way vegetation clearing	0	5.90	5.90	0	0.15	0.15	1
5 Administrative and overhead expenses	0	62.95	62.95	0	1.55	1.55	5
Subtotal (A)	820.31	291.76	1,112.06	20.25	7.20	27.46	97
B. Off-Grid Component:							
1 Materials	26.73	0	26.73	0.66	0	0.66	2
2 Transportation, installation, and administration	2.19	2.43	4.62	0.05	0.06	0.11	0
3 Consulting Services	8.91	0	8.91	0.22	0	0.22	1
Subtotal (B)	37.83	2.43	40.26	0.93	0.06	0.99	3
Total Base Cost (A+B)	858.13	294.19	1,152.32	21.19	7.26	28.45	100
C. Contingencies^c							
1 Physical	55.18	16.78	71.95	1.43	0.41	1.84	6
2 Price	85.06	23.86	108.92	2.10	0.59	2.69	9
Subtotal (C)	140.24	40.64	180.87	3.53	1.00	4.53	16
D. Financing Charges During Implementation	0	0	0	0	0	0	0
Total Project Cost (A+B+C+D)	998.37	334.83	1,333.20	24.72	8.27	32.98	0

^a The exchange rate used is locked at Nu40.5 against the dollar.

^b Include local taxes and duties of \$0.24 millions which will be financed by the Government and the Implementing Agency.

^c Computed based on the ADB forecasted inflation rates of 5%.

Sources: Bhutan Power Corporation and ADB.

Table A5.4: Detailed Cost Estimate for Rural Electrification

Item	Cost	ADB		ADB (ACEF) ^a		Government/BPC	
		Amount	% of Cost Category	Amount	% of Cost Category	Amount	% of Cost Category
A. Investment Costs^b							
On-Grid Component:							
1	Materials	20.18	100	0	0	0	0
2	Civil works (delivery, erection and installation)	5.25	25	0	0	3.94	75
3	Tools, Equipment, and Vehicles	0.33	100	0	0	0.00	0
4	Right of way vegetation clearing	0.15	0	0	0	0.15	100
5	Administrative and overhead expenses	1.55	0	0	0	1.55	100
	Subtotal (A)	27.46	79	0	0	5.64	21
B. Off-Grid Component:							
1	Materials	0.66	0	0.66	100	0	0
2	Transportation, installation, and administration	0.11	0	0.05	47	0.06	53
3	Consulting Services	0.22	0	0.22	100	0	0
	Subtotal (B)	0.99	0	0.93	94	0.06	6
	Total Base Cost (A+B)	28.45	77	0.93	3	5.70	20
C. Contingencies^c							
		4.53	3.46	0.07	1	1.00	22
D. Financing Charges During Implementation							
		0	0	0	0	0	0
	Total Project Costs	32.98	25.28	1.00	3	6.70	20
	% Total Project Costs	100%	77		3	6.70	20
			77		3		20

ACEF = Asian Clean Energy Fund, ADB = Asian Development Bank, BPC = Bhutan Power Corporation

^a Established by the Government of Japan, and administered by ADB.

^b Include local taxes and duties of \$0.24 millions, which will be financed by the Government and the Implementing Agency.

^c Computed based on the ADB forecasted inflation rates of 5%.

Sources: Bhutan Power Corporation and ADB

FINANCING STRUCTURE FOR DAGACHHU HYDROPOWER DEVELOPMENT

1. **Asian Development Bank (ADB) Finance.** The cost of the Dagachhu hydropower development is estimated at \$201.5 million including all related costs and contingencies, assuming debt of \$121.5 million (60%) and equity of \$80.0 million (40%). ADB is expected to finance \$80 million as the development anchor money to take the lead for financial structuring for both debt and equity. ADB loans will consist of (i) \$51 million from the ADB's ordinary capital resources (OCR) and (ii) \$29 million as a hard-term loan from the Asian Development Fund (ADF). Of the \$80 million, \$51 million (OCR) will be used for the debt portion of the Dagachhu development, and \$29 million (hard-term ADF) for the equity portion through lending to the Government. The borrower of the ADB loans will be the Kingdom of Bhutan.

2. **Equity and Debt Structure.** The Government will support the equity through Druk Green Power Corporation (DGPC) with a leverage of ADB finance (\$29 million). The balance of the total equity (\$80 million) will be mobilized from (i) public capital from the Government (\$7 million), DGPC (\$11 million), National Pension and Provident Fund (NPPF) (\$12 million); and (ii) private resources of the Tata Power Company (\$21 million). The debt balance of the total debt (\$121.5 million) is expected to be financed by the Austrian export credit agency, OeKB (\$55.5 million), and NPPF (\$15 million). Table A6.1 outlines the financing sources.

Table A6.1: Financing Sources for Dagachhu Hydropower Development
(\$ million)

Item	Amount
Project Cost	201.5
Debt:Equity	60:40
Equity (Total)	80.0
Government	7.0
Government (through ADB hard-term ADF loan)	29.0
Druk Green Power Corporation	11.0
National Pension and Provident Fund	12.0
Tata Power Company	21.0
Debt (Total)	121.5
ADB (OCR loan)	51.0
National Pension and Provident Fund	15.0
OeKB (Austrian Export Credit Agency)	55.5

ADB = Asian Development Bank, ADF = Asian Development Fund, OCR = ordinary capital resources, OeKB = Oesterreichische Kontrollbank Aktiengesellschaft.

Source: ADB staff estimate.

3. **Shareholders.** The Dagachhu Hydro Power Corporation (DHPC) was incorporated as a project special purpose company in May 2008. The Government's contributions including ADB loans will be provided to DGPC, which will become the majority shareholder (59% of total shares) of DHPC. The balance of the shares will be taken by minority shareholders: Tata Power Company (26%) and NPPF (15%).

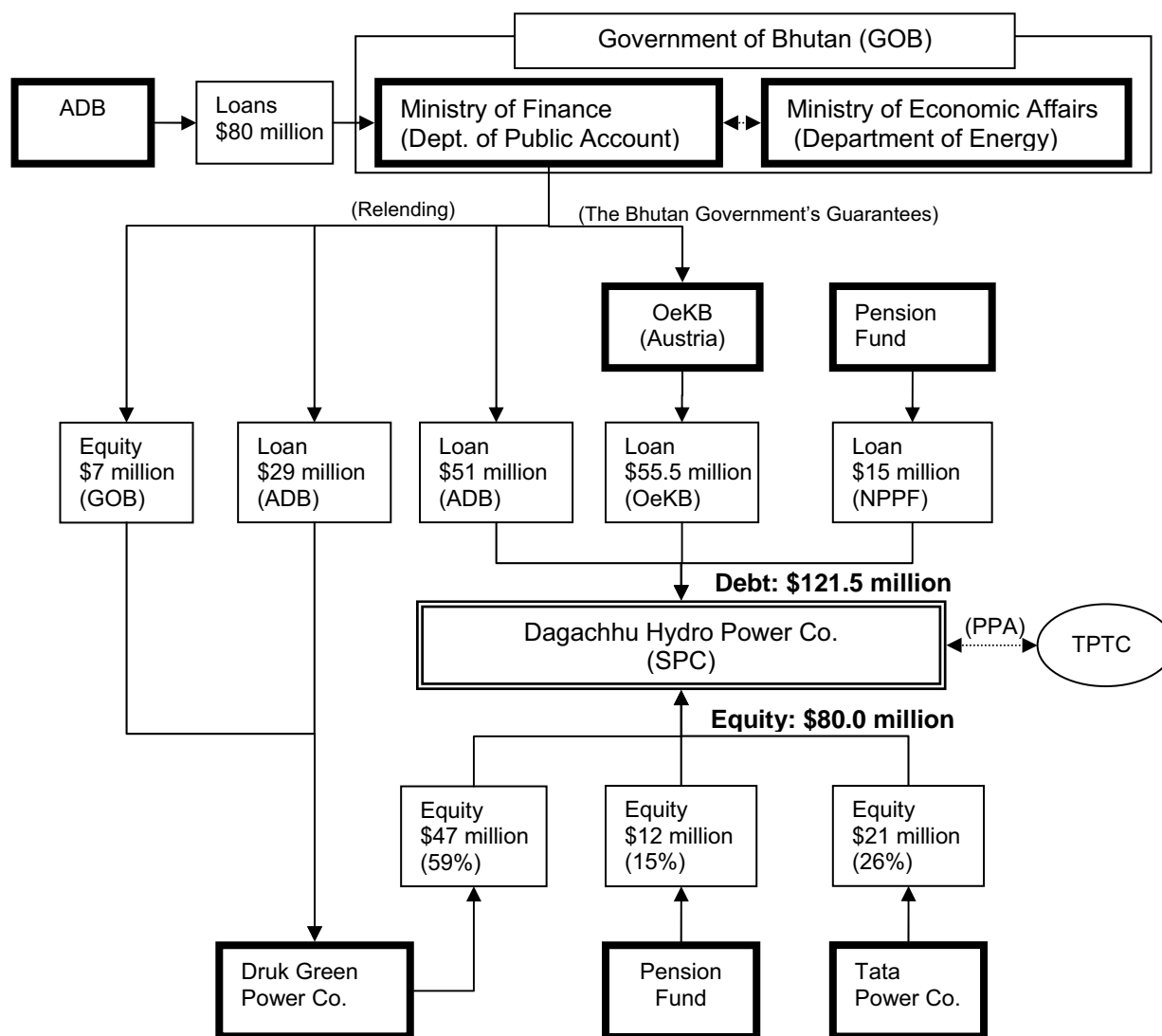
4. **Risk Arrangement.** Indian or international commercial bank(s) will help hedge the foreign currency loan(s) through currency swap arrangements (the currency risk analysis is in Supplementary Appendix J). Table A6.2 indicates the financing plan for DHPC and Figure A6 presents the financial structure and its fund flow for the Dagachhu hydropower development.

Table A6.2: Financing Plan for Dagachhu Hydro Power Corporation
(\$ million)

Items	Amount	Total Financing (%)	Shareholding Ratio (%)
Equity (Total)	80.0	40	100
Druk Green Power Corporation	47.0	23	59
National Pension and Provident Fund	12.0	6	15
Tata Power Company	21.0	10	26
Debt (Total)	121.5	60	
ADB	51.0	25	
National Pension and Provident Fund	15.0	7	
OeKB (Austrian export credit agency)	55.5	28	
Total Financing	201.5	100	

ADB = Asian Development Bank, OeKB = Oesterreichische Kontrollbank Aktiengesellschaft.
Source: ADB staff estimate.

Figure A6: Financing Structure and Fund Flow for Dagachhu Hydropower Development



ADB = Asian Development Bank, NPPF = National Pension and Provident Fund, OeKB = Oesterreichische Kontrollbank Aktiengesellschaft, PPA = power purchase agreement, GOB = Government of Bhutan, SPC = special purpose company, TPTC = Tata Power Trading Company.
Source: ADB staff estimate.

PROJECT IMPLEMENTATION AND READINESS SCHEDULES

Implementation Schedule

	2007				2008				2009				2010				2011				2012			
	Q-3	Q-4	Q-1	Q-2	Q-3	Q-4	Q-1	Q-2	Q-3	Q-4	Q-1	Q-2	Q-3	Q-4	Q-1	Q-2	Q-3	Q-4	Q-1	Q-2	Q-3	Q-4		
Part A: Dagachhu Hydropower Project																								
[Civil Works, ADB Finance]																								
Design and Cost Estimates																								
Preparation of Bidding Documents																								
Bidding (ADB ICB)+ Contract Signing (8M)																								
Construction including Mobilization (34 months)																								
[Electro-Mechanical, Austrian Export Credit]																								
Design and Cost Estimates																								
Preparation of Bidding Documents																								
Bidding (Austrian + Contract Signing (6M)																								
Manufacturing and Installation of Equipment (38M)																								
Testing and Commissioning																								
Part B: Dagachhu Transmission Line [BPC Own Resources]																								
[Dagachhu - Dhajay T/L and Substation Augmentation]																								
Design, Cost Estimates and Bidding Documents																								
Preparation of Bidding Documents																								
Bidding (BPC Own) + Contract Signing (9M)																								
Manufacturing and Installation of Equipment (30M)																								
Part C: Rural Electrification																								
[Materials, ADB Finance]																								
Design and Cost Estimates																								
Preparation of Bidding Documents																								
Bidding (ADB ICB)+ Contract Signing (8M)																								
Manufacturing and Delivery (41M)																								
[Transportation & Erection, Gov't & ADB Finance]																								
Design and Cost Estimates																								
Preparation of Bidding Documents																								
Bidding (BPC NCB) + Contract Signing (8M)																								
Trans. & Installation of Equipment (3 Dry Seasons)																								
Commissioning, Inspection and Charging																								
Part D: Off-grid Rural Electrification																								
[Off-grid, ACEF for Additional Grant]																								
Survey and Design																								
Preparation of BoQ, Procurement and Manufacture																								
Transportation and Installation																								
Monitoring and Reporting																								

ADB = Asian Development Bank, ACEF = Asian Clean Energy Fund established by the Government of Japan and administered by the Clean Energy Financing Partnership Facility, BoQ = bill of quantities, BPC = Bhutan Power Corporation, ICB = international competitive bidding, NCB = national competitive bidding. Sources: Bhutan Power Corporation, Dagachhu Hydro Power Corporation and ADB staff estimate

Project Readiness

Readiness Criteria	Target Date	Status	Responsibility
A. Core:			
1. Government Project Approval		Done	Government
2. Project Management			
• Project management units established		Done	BPC, DHPC
• PMU core staffing		Done	BPC, DHPC
• PMU full staffing		Done	BPC, DHPC
3. Allocation of Counterpart Funding			
• Rural electrification		Done	Government
• Dagachhu hydropower		Done	Government, DGPC
4. Recruitment Plan of Consultants			
i. Rural Electrification (off-grid component)	Mar 2009	Expected	DOE
• Dagachhu hydropower		Done	DHPC
(Austrian government committed TA for implementation support)			
5. Procurement			
• Procurement plan prepared		Done	DHPC, BPC
• Issuance of bidding documents		Done	DHPC, BPC
• Award of contract(s)	Mar 2009	Expected	DHPC, BPC
6. Financial Management and Auditing			
• BPC (Rural electrification)		Done	BPC
• DHPC (Dagachhu hydropower)	Dec 2009	Expected	DHPC
(Attached capacity development TA project will support financial management policy and systems.)			
7. Project Performance Management System and Project Administration Memorandum	Jan 2009	Expected	BPC, DHPC, ADB
B. Project-Specific:			
1. Land Acquisition	Dec 2008	In process	DHPC
2. Resettlement Plan(s)		Done	DHPC
3. Environmental Clearances			
• Rural electrification		Done	BPC
• Dagachhu hydropower		Done	DHPC
4. Cofinancing			
• Austrian ECA (Dagachhu hydropower)	Feb 2009	In process	DGPC
(The governments of Bhutan and Austria including its ECA have had three negotiations, and will finalize a financing agreement once the bidder is selected.)			
▪ Asian Clean Energy Fund (Rural Electrification)	Dec 2008	In process	ADB
(The funding is subject to approval from the Government of Japan.)			

ADB = Asian Development Bank, BPC = Bhutan Power Corporation, DGPC = Druk Green Power Corporation, DHPC = Dagachhu Hydro Power Corporation, ECA = Export Credit Agency, TA = technical assistance
Source: Asian Development Bank assessment.

PROCUREMENT PLAN

Project Information	
Country	Government of Bhutan
Name of Borrower	Government of Bhutan
Project Name	Green Power Development Project
Loan or TA Reference	To be determined (TBD)
Date of Effectiveness	Target: January 2009
Amount US\$ (total from all financiers)	\$201,470,000 (Dagachhu) and \$32,980,000 (RE)
Of which Committed by ADB, \$	\$80,000,000 (Dagachhu) and \$26,280,000 (RE)
Executing Agency	DGPC (Dagachhu), DOE (RE)
Approval Date of Original Procurement Plan	1 July 2008
Approval of Most Recent Procurement Plan	4 September 2008
Publication for Local Advertisement ^a	15 July 2008
Period Covered by this Plan	2008–2013

^a General procurement notice, invitations to prequalify and to bid, calls for expressions of interest.
DGPC= Druk Green Power Corporation, DOE = Department of Energy, RE = Rural Electrification

Procurement Thresholds, Goods and Related Services, Works, and Supply and Install

Procurement Methods	To be used above/below (\$)
International competitive bidding (ICB) works	At least \$1,000,000
ICB goods	At least \$500,000
National competitive bidding (NCB) ^a works	Less than \$1,000,000
NCB ² goods royalty	Less than \$500,000
Shopping works	Less than \$100,000
Shopping goods	Less than \$100,000

^a The summary requirements are given as the NCB Annex in Supplementary Appendix K.

Procurement Thresholds, Consultant Services

Procurement Methods	To be used above/below (\$)
Quality- and cost-based selection (QCBS)	At least \$200,000
Consultants qualifications selection (CQS)	Less than \$200,000
Least-cost selection (LCS)	Less than \$100,000

List of Contract Packages in Excess of \$100,000, Goods, Works, and Consulting Services

Ref No. and Contract Description	Estimated Cost (\$ million)	Procurement Method	Expected Date of Advertisement	Prior Review	Financing Sources
A. Dagachhu Hydropower (loans)					
1. Civil works	80.5	ICB (EPC)	3rd quarter '08	Yes	ADB
2. Electric and mechanical works	59.2	OeKB Own	3rd quarter '08	No	OeKB
3. Transmission line	4.8	BPC Own	4th quarter '08	No	BPC
4. Augmentation of related substation	6.0	BPC Own	4th quarter '08	No	BPC

Ref No. and Contract Description	Estimated Cost (\$ million)	Procurement Method	Expected Date of Advertisement	Prior Review	Financing Sources
B. On-Grid Rural Electrification (grant)					
1. Poles	6.9	ICB (Goods)	4th quarter '08	Yes	ADB
2. Pole filling and accessories	2.2	ICB (Goods)	4th quarter '08	Yes	ADB
3. Conductors	2.0	ICB (Goods)	4th quarter '08	Yes	ADB
4. Insulators	0.9	ICB (Goods)	4th quarter '08	Yes	ADB
5. Cables	3.6	ICB (Goods)	4th quarter '08	Yes	ADB
6. Farthing equipment	0.3	ICB (Goods)	4th quarter '08	Yes	ADB
7. Transformers	2.3	ICB (Goods)	4th quarter '08	Yes	ADB
8. Conductor fittings and accessories	1.0	ICB (Goods)	4th quarter '08	Yes	ADB
9. Switching equipment and accessories	0.6	ICB (Goods)	4th quarter '08	Yes	ADB
10. Energy meters	0.1	ICB (Goods)	4th quarter '08	Yes	ADB
11. Tools and equipment	0.3	ICB (Goods)	4th quarter '08	Yes	ADB
12. 1–3 phase converter	0.1	ICB (Goods)	4th quarter '08	Yes	ADB
13. Vehicle	0.1	NCB (Goods)	4th quarter '08	Yes	Government and ADB
14. Transportation and election works	5.7	NCB (Works)	4th quarter '08	Yes	Government and ADB
C. Off-Grid Rural Electrification (grant)					
1. Capacitor, controller and LED	0.6	ICB (Goods)	4th Quarter '09	Yes	ACEF
2. Photovoltaic module and accessories	0.1	NCB (Goods)	4th Quarter '09	Yes	ACEF
3. Transportation and installation	0.1	NCB (Works)	4th Quarter '09	Yes	ACEF
4. Consulting services	0.2	Individual (Bio-data)	1st Quarter '09	Yes	ACEF

ACEF = Asian Clean Energy Fund established by the Government of Japan, BPC = Bhutan Power Corporation, EPC = engineering-procurement-construction, OeKB = Oesterreichische Kontrollbank Aktiengesellschaft (Austrian Export Credit Agency).

TECHNICAL ASSISTANCE FOR PROMOTION OF CLEAN POWER EXPORT DEVELOPMENT

A. Issues

1. Bhutan generates significantly more electricity than it consumes. With a total installed capacity of about 1,500 megawatts (MW) and a maximum domestic demand of 157 MW, Bhutan is a net power exporter to India. The power sector accounts for a significant proportion of the gross domestic product (GDP) and provides the Government with more than 40% of its total revenue. Given the importance of the power sector, the Government's strategy is to continue to give priority to developing Bhutan's hydropower potential to increase government revenues and provide an important input for economic growth and development with minimal environmental impact. In 2006, the governments of Bhutan and India signed an umbrella agreement to develop and trade an additional 5,000 MW of hydropower by 2020. Now the governments aim to increase this target to 10,000 MW.

2. The Government is looking to accelerate development of hydropower generation by leveraging public and/or private investments. To provide the framework for attracting investments in hydropower, the Hydropower Development Policy was formulated with technical assistance (TA) support from the Asian Development Bank (ADB).¹ To accelerate hydropower development, the Government plans to restructure DOE to form the Energy Secretariat, which will be the nodal agency for soliciting investment proposals and selecting developers through a competitive bidding and/or strategic process.

3. The Government has already consolidated its three government-owned hydropower corporations (Chhukha Hydro Power Corporation, Basochu Hydro Power Corporation, Kurichhu Hydro Power Corporation) by amalgamating them into a single corporation, Druk Green Power Corporation (DGPC) in January 2008. It also plans to merge the Tala Hydroelectric Project Authority with DGPC in 2009. DGPC will be the agency responsible for implementation of hydropower projects to be developed under public–public and public–private partnership routes.²

4. Under a royal charter issued on 11 November 2007, a government holding company, Druk Holding Investment (DHI) was formed to hold the shares of the Government in 11 companies in areas such as hydropower, banking, minerals, and natural resources, where the government has a full or partial stake. DHI is expected to play a major role in accelerating the future development of Bhutan's hydropower resources since Bhutan Power Corporation and DGPC are now fully owned corporations of DHI.

5. As such, three government-owned organizations, DOE (the Energy Secretariat), DHI, and DGPC, will play a critical role in hydropower development in Bhutan.

B. Impact and Outcome

6. The capacity development technical assistance (CDTA) is designed to (i) promote hydropower development, which will contribute to Bhutan's economic growth, and (ii) enhance nationwide energy efficiency and cross-border cooperation. These impacts will be achieved by

¹ ADB. 2007. *Technical Assistance to the Kingdom of Bhutan for Preparing the Bhutan Power Development Project*. Manila.

² Under the Hydropower Development Policy, DOE will mainly promote and execute the bilateral projects.

building capacity to implement the Hydropower Development Policy. The CDTA will result in (i) strategy and an action plan to broaden financing avenues for future large hydropower projects for DGPC and DHI; (ii) internal capacity development within DGPC to manage development of commercial hydropower projects on its own or through partnerships with private and public joint ventures or foreign investment, and (iii) internal capacity building in DOE for promoting more projects in line with bilateral programs and/or the policy. To make the results practical and visible, the CDTA will be implemented through preparation of actual demonstration projects that will focus on a financial structuring study and Clean Development Mechanism (CDM) project design document development.

C. Methodology and Key Activities

7. The CDTA will have three focus areas.

8. **Component 1: Facilitating financing of DHI and DGPC for hydropower projects.** The CDTA will undertake a review of Bhutan's financial market, and associated policies and regulations to assess local financing potential as well as options to attract foreign investments for future hydropower development. The study will look at innovative financing and contractual options including initial public offers, divestment of shares, and issue of bonds. The consultants will share international best practices and experiences from other countries for financing large hydropower projects. The CDTA will formulate a strategy and prioritized action plan for Bhutan. The plan will include changes required in existing legal statutes, policies, and regulations to facilitate greater access to financial markets for DHI and DGPC.

9. **Component 2: Developing internal capacity for DGPC to manage commercial projects.** The CDTA will support DGPC in developing internal capacities for hydropower projects under public–public and public–private partnership routes. This will include building capacities for soliciting investments, evaluating financing proposals, and negotiating for off-take tariffs. To achieve visible and tangible results, the CDTA will prepare and study practical financial structuring options for standby hydropower export projects, namely the Nikachhu (210 MW) and Khomachhu (326 MW) projects. In order for DGPC to become a project management organization to develop public projects allocated to DGPC, the CDTA will support DGPC in developing integrated management information systems to effectively conduct project management. and evaluate existing subsidiary companies and new project investments. To apply emission reductions for CDM and the subsequent framework for climate change, the CDTA will assist DGPC in preparing the project design documents for any sample project(s).

10. **Component 3: Building internal capacity in DOE for accelerating hydropower development in line with the Hydropower Development Policy.** The CDTA will support capacity building of DOE for promoting project structuring, conducting due diligence, and preparing financing plans for these and other selected hydropower projects. The CDTA will assist DOE in acquiring additional capacity required in the areas of promotion, planning, design, power tariff negotiations, contract management, environment, social, economic, and risk management areas to accelerate hydropower development in line with the Hydropower Development Policy. The CDTA will support DOE in restructuring to form the Energy Secretariat along with identifying specific training and skill-building requirements in the newly created department under the secretariat. A study tour will be made to observe the policy and project implementation, practices, and lessons from run-of-river and storage plant developments in another country. The scope of work will include formulation of a captive power generation policy and a renewable energy policy with focus on small and micro hydropower projects, in line with

the Hydropower Development Policy and Electricity Act 2001, which will be reviewed and/or amended under assistance from the Norwegian Agency for Development Cooperation.

11. Based on the training needs assessment, short-term external training programs will be provided to key staff for capacity building.

D. Cost and Financing

12. The CDTA's total cost is estimated at \$1,512,000 equivalent. ADB will provide \$1,488,000. The CDTA will be jointly financed on a grant basis by the Regional Cooperation and Integration Fund under the Regional Cooperation and Integration Financing Partnership Facility (\$888,000) and the ADB technical assistance funding program (\$600,000). The Government of Bhutan will provide \$24,000 equivalent of local currency costs through in-kind contributions, including office accommodation, facilities, data, and other information. The detailed cost estimates and financing plan are given in Supplementary Appendix B.

E. Implementation Arrangements

13. DOE will be the Executing Agency for all CDTA components. DGPC and DHI will be the implementing agencies for components 1 and 2. The DOE director general will be the project director, overseeing day-by-day CDTA implementation. DOE, DGPC, and DHI will help the consultants liaise with other government ministries and agencies, local authorities, and other stakeholders in the project areas, and obtain data and documentation from them. They will assign the counterpart staff for each expertise areas for on-the-job-training and skills transfer. DOE will provide sufficient office space, furniture, and support facilities to the CDTA consultants on time.

14. The CDTA will be implemented over 24 months from January 2008 to December 2010. It will require 55.5 person-months of consulting services (40.5 international and 15 national). The areas of expertise and outline terms of reference are in Supplementary Appendix B. ADB will engage a consulting firm or consortium of firms using its quality- and cost-based selection procedures in accordance with the *Guidelines on the Use of Consultants* (2007, as amended from time to time). Equipment financed by the CDTA will be procured under ADB's *Procurement Guidelines* (2007, as amended from time to time).

FINANCIAL ANALYSIS

A. Dagachhu Hydropower Development

1. **Methodology and Major Assumptions.** The financial analysis of the Dagachhu hydropower development of the Green Power Development Project was carried out in accordance with *Financial Management and Analysis of Projects (2005)* of the Asian Development Bank (ADB). Cost streams used to determine the financial internal rate of return (FIRR) reflect costs of delivering the estimated benefits. The weighted average cost of capital (WACC) of the Dagachhu hydropower development was calculated and compared with the FIRR to ascertain financial viability. The sensitivity of the FIRR to adverse movements in the underlying assumptions was also assessed. Based on this analysis, the Dagachhu hydropower development is determined to be financially viable.

2. The costs of the development include all capital investment including civil works, roads and bridges, electric and mechanical works with physical contingencies, operation and maintenance costs, and resettlement and environmental costs. Additional payments are associated with a 12% royalty power from the development to the Government for the initial 12 years, and then 18% for the remaining 18 years. The hydropower development is assumed to have a 30-year economic life and to revert to the Government at nil value at the end of the concession period.

3. The tariff for the sale of energy generated has been agreed with the Tata Power Trading Company (TPTC), India, and the power purchase agreement (PPA) has been signed with TPTC. The base-year tariff is agreed at Rs2.40/kilowatt hours (kWh) with 2% annual escalation over the 25-year PPA and a rebate of 2% for timely payment. Under the terms of the PPA, TPTC will buy at least 88% of the energy generated from the Dagachhu hydropower facility. For the balance of the power, TPTC will ensure merchant sales on a best effort basis if required by Druk Green Power Corporation (DGPC). The delivery point will be the northern grid of India at the India–Bhutan border. All losses and taxes beyond the Bhutan border will be borne by TPTC. This price includes all transmission costs, and taxes applicable in Bhutan. As payment security, TPTC will establish and maintain an irrevocable letter of credit in favor of Dagachhu Hydro Power Corporation (DHPC); the amount of the letter of credit will be the equivalent of the maximum generating month during non-monsoon (8 months) and maximum generating month during the monsoon (4 months).

4. The Dagachhu development was originally initiated as a Clean Development Mechanism (CDM) case. The development posted its application to the United Nations Framework Convention on Climate Change (UNFCCC) website for public comments in 2007. The governments of Bhutan and India have already approved it as a CDM project. Presently, a validation report is being prepared and DHPC will seek registration with the CDM Board of the UNFCCC. Based on the advanced process, TPTC signed a term sheet to underwrite the purchase of emission reductions over 30 years at the minimum specific price in euros. These revenues are duly considered in the analysis.

5. **Calculation of Weighted Average Cost of Capital.** The financing plan for computing the WACC considers that equity contributions will be provided by the Government, DGPC, National Pension and Provident Fund, and Tata Power Company. The debt component will be a mix of local and foreign loans including the ADB loans. The cost of Dagachhu equity is considered at 14%. The domestic inflation rate is taken at 5.00% and the international inflation

rate at 2.39% for the dollar component and 1.99% for the euro component. The average WACC for the Dagachhu hydropower development is 5.63% (Table A10.1).

Table A10.1: Weighted Average Cost of Capital for Dagachhu Hydropower Development

Source	ADB Loan	OeKB Credit	Local Lender	Equity	Total
A. Amount (\$ million)	51.00	55.46	15.00	80.01	201.47
B. Weighting (%)	25.31	27.54	7.44	39.70	100.00
C. Nominal Cost (%)	7.00	10.60	10.00	14.00	
D. Tax Rate (%)	30.00	30.00	30.00	0.00	
E. Tax Adjusted Nominal Cost (C*[1-D]) (%)	4.90	7.42	7.00	14.00	
F. Inflation Rate (%)	2.39	1.99	5.00	5.00	
G. Real Cost ($[1+E]/[1+F]-1$) (%)	2.45	5.32	1.90	8.57	
H. Weighted WACC (G*B) (%)	0.62	1.47	0.14	3.40	5.63

ADB = Asian Development Bank, OeKB = Oesterreichische Kontrollbank Aktiengesellschaft (Austrian export credit agency), WACC = weighted average cost of capital.

Source: ADB staff estimates.

6. **Calculation of FIRR and Sensitivity Analysis.** The after-tax financial internal rate of return (FIRR) is 10.44 % for the Dagachhu hydropower development, and compares favorably with the estimated WACC at 5.63%, substantiating the financial viability of the Dagachhu development.

7. Separate analyses were carried out to examine the sensitivity of the FIRR to adverse changes in key variables: an increase in construction time by 6 months, a 10% increase in project costs, and a 10% decrease in energy generation (Table A10.2). The results are robust with the sensitivities exceeding the WACC; the development is most sensitive to a reduction in energy generation.

Table A10.2: FIRR Sensitivity Analyses: Dagachhu Hydropower Development

Item	Variable	FIRR	DSCR	
		(%)	Minimum	Average
Base Case		10.44	1.5	2.2
Time Period	+6 months	10.00	1.4	2.1
Project Cost	+10%	9.48	1.3	1.9
Generation	-10%	9.38	1.3	1.9
WACC		5.63		

DSCR = debt service coverage ratio, FIRR = financial rate of return, WACC = weighted average cost of capital.

Source: ADB staff estimates.

B. Rural Electrification

8. **Methodology and Major Assumptions.** The financial analysis of the rural electrification component was carried out in accordance with ADB's *Financial Management and Analysis of Projects*. All financial costs and benefits are expressed in constant 2008 prices. Cost streams used for the FIRR determination reflect costs of delivering the estimated benefits. The WACC for rural electrification was calculated and compared with FIRR for each of seven subprojects to determine the financial viability. The sensitivity of the FIRR to unfavorable movements in the underlying assumptions was also assessed. The off-grid component for rural electrification is analyzed in Supplementary Appendix L.

9. The costs include all capital investment including civil works, material costs, transportation costs, operation and maintenance costs, social and environmental costs, and physical contingencies. The component is expected to have a 30-year economic life after construction. The base tariff for projections is the country's 1 July 2009 electricity tariff with annual escalation of 5%, which the regulator has already given notice under the multiyear tariff scheme.

10. **Calculation Weighted Average Cost of Capital.** To compute the WACC, 79% of the financing source is assumed to be the interest-free Government loan (financed through the ADB grant) and the remaining 21% in the form of Government equity to BPC. The cost of equity is calculated at 6% after upward adjustments for the duration of the rural electrification component and associated risks. The average WACC for the rural electrification component is 0.20% (Table A10.3).

Table A10.3: Weighted Average Cost of Capital for Rural Electrification

Item	Government	BPC	Total
	Loan	Equity	
A. Amount (\$ million)	25.28	6.64	31.92
B. Weighting (%)	79.20	20.80	100.00
C. Nominal Cost (%)	0.00	6.00	
D. Tax Rate (%)	30.00	0.00	
E. Tax Adjusted Nominal Cost (C*[1-D]) (%)	0.00	6.00	
F. Inflation Rate (%)	5.00	5.00	
G. Real Cost ($(1+E)/(1+F)-1$) (%)	0.00	0.95	
H. Weighted WACC (G*B) (%)	0.00	0.20	0.20

BPC = Bhutan Power Corporation, WACC = weighted average cost of capital.

Source: ADB staff estimates.

11. **Calculation FIRR and Sensitivity Analyses.** The FIRR is calculated at a negative 5.99% for the rural electrification component. The rate compares unfavorably with the estimated value of WACC at 0.20%, indicating that the rural electrification component is not financially viable. A sensitivity analysis of the operation and maintenance cost element, capital costs, and time overrun was completed to identify the implications of increase of these costs on component viability. Table A10.4 indicates the sensitivity of FIRRs to an increase in operation and maintenance costs, capital costs, and time period. Any financial loss arising from rural electrification subprojects will be compensated through the cross-subsidy policy mechanism in accordance with the Tariff Determination Regulation of the Bhutan Electricity Authority.

Table A10.4: FIRR Sensitivity Analysis: Rural Electrification

Item	Variable	FIRR %
Base Case		(5.99)
Operation and Maintenance	+10%	(7.08)
Capital Costs	+10%	(7.53)
Time Period	+ 1 year	(6.17)
All of the Above		(9.21)
WACC		0.20

() = negative value, FIRR = financial internal rate of return, WACC = weighted average cost of capital.

Source: ADB staff estimates.

FINANCIAL PERFORMANCE AND MANAGEMENT

A. Dagachhu Hydro Power Corporation

1. The Dagachhu Hydro Power Corporation (DHPC) was formed as an authority in April 2007 and incorporated in May 2008 as a special purpose vehicle created by the Government to promote the Dagachhu hydropower development.

1. Projected Financial Performance

2. **Capital Expansion Program and Funding.** DHPC's current hydro development program consists of 114 MW of power to be commissioned by the beginning of 2012 with a total cost of \$201.5 million, including physical and price contingencies and financing charges.

3. The Government will route \$36 million as equity through Druk Green Power Corporation (DGPC) of which \$29 million will be financed by the Asian Development Bank (ADB) and the remaining \$7 million by the Government's own sources. In addition, DGPC will invest \$11 million as equity. The remaining equity of \$33 million will be provided by the National Pension and Provident Fund (\$12 million) and Tata Power Trading Company (\$21 million). ADB plans to finance another loan of \$51 million from its ordinary capital resources. The Austrian export credit agency, OeKB, plans to provide export credit of \$55.5 million for electromechanical equipment as debt. The National Pension and Provident Fund will also provide \$ 15 million as debt.

4. **Revenues.** As per the power purchase agreement signed by DGPC with Tata Power Trading Company (TPTC), TPTC agrees to buy the generating power of the Dagachhu plant. The tariff is set at Rs2.40/kilowatt-hour (kWh) (Rs2.35/kWh after a discount of timely payments) with annual escalation of 2.0%.

5. **Operation and Maintenance Costs.** DHPC has established its corporate structure and employed staff to fill various posts. Currently, DHPC is constructing the Dagachhu hydropower development with all salary expenses capitalized. The operation and maintenance expenses for DHPC are considered to be 1.00% of the development cost with annual escalation of 3%.

6. **Depreciation Cost.** The average depreciation for the plant is estimated at 3.3% for accounting purposes.

7. **Interest and Financing Charges.** The interest rate is based on the weighted average calculation from three streams of term loans:

- (i) from ADB with tenure of 30 years and an interest rate linked to the London interbank offered rate (LIBOR) in dollars;
- (ii) from OeKB with tenure of 19 years and a floating interest rate of 5.75% for 10% of the loan value and a fixed interest rate at 5.20% in euros for the balance (90%) of the loan value; and
- (iii) from a local lender (i.e., National Pension and Provident Fund) with a tenure of 15 years with annual interest of 10%.

8. Interest during construction is capitalized at the rate of interest during construction. The interest rate on working capital finance is taken at 12.0%. Working capital is taken as 1 month of operation and maintenance expenses and 1 month of receivables from the sale of power.

9. **Transmission Losses.** Transmission losses are calculated at 0.6% of gross generation.

10. **Taxation.** Income tax is calculated as 30% on profits.

11. **Key Financial Performance Indicators.** The key assumptions underlying the profitability projections for Dagachhu hydropower development and the key financial parameters for the first 5 full years of operations are presented in Table A11.1.

**Table A11.1: Summary of Dagachhu Hydro Power Corporation
Financial Projections and Key Financial Ratios**

Year ending 31st December	2012	2013	2014	2015	2016
Revenues (A) (Nu million)	569	1,161	1,185	1,224	1,250
Operating Expenses (B) (Nu million)	41	84	86	89	92
Interests (C) (Nu million)	188	443	426	404	383
Tax (D) (Nu million)	58	110	124	145	160
Repayments (E) (Nu million)	0	122	244	244	244
Cash Surplus (A-B-C-D-E)	282	402	305	342	371
Return on capital employed (%)	4.7	10.3	10.6	11.4	12.1
Fixed assets coverage ratio (times)	1.7	1.7	1.8	1.9	2.0
Profits before depreciation/Sales (times)	1.1	1.1	1.1	1.1	1.1
Profits after tax/Sales (times)	0.3	0.3	0.3	0.3	0.4
Debt service coverage ratio (times)	2.5	1.7	1.5	1.5	1.6

Source: ADB staff estimates.

12. The projected financial performance will maintain adequate debt service coverage ratios, with the minimum of 1.5 times and average of 2.2 times. This clearly indicates that the Dagachhu development will generate cash surplus to fully service debt obligations and that it will be in a position to finance its internal requirements from its own sources. The profitability represented by an internal rate of return on equity is 15.6% on a before-tax basis and 12.0% on an after-tax basis.

2. Financial Management Assessment

13. As DHPC is in its inception stage, its financial accounting system is based on that followed by hydropower subsidiaries under DGPC. DHPC generally uses spreadsheet-based software for accounting purposes. In some cases, DHPC has developed in-house software to record financial transactions. The project preparatory technical assistance supported DGPC's integration of the accounting system among its subsidiaries and the accounting software is to be installed at DGPC and each of its subsidiaries to record financial transactions in a common format. DHPC is expected to strengthen its accounting management and move from manual accounting procedures to an integrated computerized financial management and accounting system.

14. DHPC follows financial accounting on an accrual basis as per provisions of its governing statutes and generally accepted accounting principles. As a company it is subject to audit under the Companies Act of the Kingdom of Bhutan, 2000 and by the Royal Audit Authority. DHPC has a chart of accounts to enable proper recording of financial transactions. Since DHPC was formed on 13 May 2008, it has not prepared its first set of financial statements.

15. **The Future.** DHPC will strengthen its systems and move from manual accounting procedures to use of computerized management information and accounting systems. This will strengthen project construction management, accounting, and reporting procedures; and later hydropower operating procedures. It will improve overall corporate accounting and financial reporting, and provide the basis for accurate and timely accounting and reporting procedures for ADB loan-financed projects. To achieve these goals, the joint venture partners, DGPC and Tata Power Company agree to have the seconded or professional financial staff from Tata Power Company assist DHPC financial management, in line with the shareholders agreement. DHPC and DGPC have no experience managing foreign currency debt and will require capacity building for foreign exchange mitigation, fund raising, and concomitant risk management. These areas will be supported by a new technical assistance project for capacity development.

B. Druk Green Power Corporation

1. Financial Performance

16. DGPC, incorporated in January 2008, was formed by the amalgamation of three hydropower generating companies: Chhukha Hydro Power Corporation, Basochu Hydro Power Corporation, and Kurichhu Hydro Power Corporation. Since the Tala Hydroelectric Project Authority (THPA), commissioned in 2006, will be merged with DGPC in 2009 or later, it is not reflected in the historical financial performance of DGPC. Table A11.2 summarizes generation, export sales, and financial performance of DGPC's subsidiaries.

Table A11.2: Druk Green Power Corporation Generation, Sales and Financial Performance

Year Ended 31 December (Audited)	2004	2005	2006	2007
Generation and Sales				
Energy Production (GWh): Chhukha Plant (336 MW)	2,054	1,885	1,983	2,148
Energy Production (GWh): Basochu Plant (64 MW)	131	231	331	314
Energy Production (GWh): Kurichhu Plant (60 MW)	333	340	365	374
Export Sales for Chhukha/Total (%)	75	71	72	89
Export Sales for Basochu/Total (%)	0	0	0	0
Export Sales for Kurichhu/Total (%)	90	83	82	73
Financial Results				
Chhukha Plant				
Return on Net Fixed Assets (%)	78	103	118	109
Debt/Debt plus Equity (%)	10	6	3	0
Basochu Plant				
Return on Net Fixed Assets (%)	3.5	2.3	3.7	1.3
Debt/Debt plus Equity (%)	48	70	63	62
Kurichhu Plant				
Return on Net Fixed Assets (%)	(0.3)	0.8	1.1	0.8
Debt/Debt plus Equity (%)	48	46	44	42

() = negative value, MW = megawatt.

Source: Druk Green Power Corporation.

17. The Chhukha plant has been making considerable profits and had an impressive reserve of Nu596 million, and cash and cash equivalents of Nu1,274 million (\$32 million equivalent) in

2007. As the plant is old, it has a low book value but continues to give economic benefits reflected by the high return on fixed assets at 109% in 2007. The debt to total assets ratio is low at 3% in 2006 and 0% in 2007.

18. The Basochu plant has been showing an increasing trend in profits with profit after tax reaching Nu119 million in 2006 from Nu32 million in 2004. The debt to total assets ratio is high at around 62% in 2007. As the plant is relatively new, the return on fixed assets in 2007 is low at around 1.3%.

19. The Kurichhu plant had considerable losses until 2004. In 2005, the plant had a Nu39 million profit. However, due to initial years losses carried forward, the amount of profits transferred to the balance sheet is still negative Nu139 million in 2007. This is reflected in the return on net fixed assets, which has been maintained positive over these three years.

2. Projected Financial Performance

20. **Capital Expansion Program and Funding.** DGPC is planning to enter into additional power generation schemes including the Dagachhu hydropower development in 2009. These investments along with the regular capacity expansion and repair and maintenance activities can be sufficiently financed through internal sources of DGPC, as DGPC has significant cash and cash equivalents as indicated in Table A11.3.

Table A11.3: Druk Green Power Corporation Capital Expenditure
(Nu million)

Particulars	2008	2009	2010	2011	2012	2013	2014	2015
Capital investment (A)	442	2,155	342	308	340	281	168	160
Net cash flow before capital investment (B)	3,205	3,382	1,746	1,788	2,026	1,823	1,854	2,197
Free cash flow after capital investment (B-A)	2,762	1,227	1,403	1,479	1,687	1,542	1,686	2,037

Source: ADB and DGPC staff estimates.

21. **Tariff Revenue.** Export sale to the Power Trading Corporation of India from the Chhukha plant is considered at a base rate of Nu2.0/kWh with a 5% escalation every 5 years, and that from Kurichhu plant at Nu1.80/kWh with a similar escalation. Domestic sale to Motanga is at Nu1.29/kWh with a similar escalation. Wheeling charges are unchanged at Nu0.13/kWh. In addition revenues from the sale of royalty power at Nu0.30/KWh and demand charges on a monthly basis follow the same escalation principle. Domestic consumption is assumed to increase at 9% annually.

22. **Staff Costs.** For the projected figures, employee costs are adjusted year-on-year at 6% taking into account the effect of inflation and increase in staff grades.

23. **General Administration Expenses.** General administration expenses are escalated at 6% annually from the base level of 2007.

24. **Depreciation Cost.** Permanent buildings, compound walls, fencing, roads, culverts, and civil works are depreciated at 3% whereas mechanical works, powerhouse generators, plant and machinery, transmission lines, and substation equipment are depreciated at 5%.

Semipermanent and temporary buildings are depreciated at 20% and 50% respectively. All other equipment is depreciated at 15%.

25. **Interest and Financing Charges.** Interest charges on term deposits are considered at 3% and interest for loans taken by Basochu is calculated at 6%.

26. **Taxation and Dividend.** DGPC pays tax at 30%, and is assumed to pay 90% of its profit after tax as a dividend to shareholders.

27. **Key Financial Performance Indicators.** The opening financial position for DGPC as of 1 January 2008 is based on the accounts of Chhukha Hydro Power Corporation, Basochu Hydro Power Corporation, and Kurichhu Hydro Power Corporation for the year ended 31 December 2007. Table A11.4 summarizes the results of the financial analysis for 2008–2015. The debt to asset ratio is progressively declining as principal is being repaid and retained earnings are building up. The return on average net fixed assets is high at 21% in 2008 primarily due to the Chhukha plant. This increase to more than 30% in later years as the plants, though having a low book value, are able to generate significant economic returns. To be conservative, THPA is not included in this projection.

**Table A11.4: Summary of Druk Green Power Corporation
Financial Projections and Key Financial Ratios**

Year Ending 31 December	2008	2009	2010	2011	2012	2013	2014	2015
Total Revenues (Nu million)	4,374	4,473	4,660	4,611	4,568	4,529	4,489	4,657
Total Expenses (Nu million)	1,541	1,508	1,522	1,472	1,464	1,446	1,447	1,450
Profit after Tax (Nu million)	1,983	2,076	2,196	2,198	2,173	2,158	2,129	2,245
Cash and Bank Balances (Nu million)	2,762	2,620	2,082	1,868	1,940	2,132	2,023	2,285
Total Assets (Nu million)	15,154	15,197	15,158	14,942	14,668	14,385	14,061	13,921
Return on Average NFA (%)	21	23	25	26	27	29	29	33
Debt Service Coverage Ratio (times)	4.9	5.1	4.4	4.4	4.4	4.4	4.5	4.7
Debt/ Asset (Debt + Equity) (%)	58	53	46	40	33	27	21	15

GWh = gigawatt-hour, NFA = net fixed assets, Nu = ngultrum.

Source: ADB staff estimates.

28. Once THPA (1,020 MW) is merged with DGPC in 2009 or later, DGPC's financial performance will be much better. DGPC's strong balance sheet and profitability will enable it to make leverage for external borrowing to execute more hydropower projects. This indicates that DGPC is in a position to contribute equity to new development projects from its own revenue generation and/or borrowing and be able to act as a public joint venture partner in public–private partnership programs.

3. Financial Management Assessment

29. Financial management assessment was undertaken to assess the current ability of DGPC to fulfil ADB's fiduciary requirements and identify areas for improvement. DGPC completed a financial management assessment questionnaire to facilitate a review of its financial systems and processes, and to identify issues or constraints.

30. A chart of accounts and accounting manual for DGPC will be developed so that similar accounting and financial processes are followed throughout the organization. This requirement will be significant when THPA is merged with DGPC in 2009. Presently, most of the hydropower

plants and DGPC head office maintain accounting and financial systems using an off-the-shelf accounting package (i.e., Tally).

31. DGPC follows financial accounting on an accrual basis as per provisions of its governing statutes and generally accepted accounting principles. Being a corporate entity and a government company, it is subject to audit under the Companies Act of the Kingdom of Bhutan, 2000 and the Royal Audit Authority. Since DGPC is expected to be the Government agency to undertake the public investment portion of new hydropower projects, it will need to leverage its balance sheet to raise commercial financing including financing from international sources. Thus, DGPC needs to strengthen its systems and processes to become an international financial reporting standards compliant entity so that it is easier to raise funds in international financial markets.

32. Accounting and financial reporting responsibilities are carried out as per a defined set of delegation of powers, which needs strengthening. DGPC has no prior experience of managing foreign currency debt and will require capacity building for foreign exchange fund raising and concomitant risk management. An important challenge for DGPC is management of financial resources for funding large investments in hydropower projects. DGPC will need to significantly enhance its capacity in the areas of financial reporting, financial management, management information systems, and budgeting.

33. **The Future.** The steps undertaken by DGPC to improve financial management will strengthen project construction management, accounting, and reporting procedures; as well as improve DGPC's overall management and operating performance. DGPC plans to implement an integrated computerized financial management and accounting system. Project preparatory technical assistance supported DGPC in preparing its consolidated balance sheet after merger of the three existing hydropower companies and in selecting the information systems to be installed for integrated accounting and financial management across the hydropower plants.

C. Bhutan Power Corporation

1. Financial Performance

34. Bhutan Power Corporation (BPC) was established on 1 July 2002 from the former Department of Power with a mandate to ensure that reliable, adequate, and affordable electricity is available to all citizens of Bhutan. BPC is responsible for transmission, distribution, and rural electrification activities. As of December 2007, it had 77,433 customers. Overall transmission and distribution losses have been maintained at about 9%–10%.

35. After losses from 2003 through to 2005, BPC had profits of Nu269 million in 2006 and Nu456 million in 2007. This is reflected in the return on net fixed assets, which increased from minus 0.6% in 2004 to plus 4.9% in 2007. The company's debt component increased from 13% in 2004 to 31% in 2007 primarily due to increased borrowing from the 2007 transfer of THPA's transmission debts to BPC. Table A11.5 summarizes the BPC's financial performance for the past years.

Table A11.5: Bhutan Power Corporation Financial Performance

Year Ended 31 March	2004	2005	2006	2007
Financial Results				
Profit/Loss After Tax (Nu million)	(28.0)	(130.0)	269.0	456.0
Total Assets (Nu million)	6,295.0	6,878.0	7,338.0	10,934.0
Return on Net Fixed Assets (%)	(0.6)	(2.6)	4.9	4.9
Debt / Asset (Debt+Equity) (%)	13.0	18.0	19.0	31.0
Accounts receivable collection (months)	1.5	0.7	0.4	1.1

() = negative value, Nu = ngultrum.

Source: Bhutan Power Corporation.

2. Projected Financial Performance

36. **Capital Expansion Program and Funding.** As a part of the capital expansion program, BPC identified many areas of transmission, distribution, and rural electrification where expansion is required. Most of these activities are expected to be funded from internal sources of BPC (Table A11.6). A significant contribution is expected in the form of grants.

Table A11.6: Bhutan Power Corporation Project Funding Source 2008–2018
(Nu million)

Project	Loans	Grant	Internal Funding	Total
Transmission	0	3,463	7,897	11,360
Distribution	0	0	336	336
Rural Electrification	3,073	0	320	3,394
Head Office	0	0	659	659
Others	0	0	1,103	1,103
Total	3,073	3,463	10,315	16,851

Source: Bhutan Power Corporation and ADB staff estimates.

37. **Tariff Revenue.** The consumer tariffs for BPC are determined by the Bhutan Electricity Authority, which calculates the average cost of supply for each tariff category. The average cost of supply per kWh for high-voltage, medium-voltage, and low-voltage categories for 2007/08 were computed as Nu1.62, Nu 1.93, and Nu 0.97 respectively. At present, the tariffs are fixed at Nu1.43/kWh for high- and medium-voltage consumers and Nu1.30/kWh for low-voltage consumers. The subsidy obtained from royalty power has been directed at low-voltage tariffs (Nu750 million per annum), so the costs of supply for low voltage are not fully cost reflective. The cost-reflective supply to low-voltage customers, excluding the royalty subsidy, is around Nu3.4/kWh. The low-voltage tariff at Nu1.30/kWh covers 38% of this cost of Nu3.4/kWh. In 2007 high- and medium-voltage consumers subsidized around Nu1,045 million for low voltage customers. For projection purposes, the supply tariffs are taken from the 1 July 2009 electricity tariffs, approved by Bhutan Electricity Authority under the multiyear tariff scheme, with annual escalation of 5% on the base tariff for projections.

38. **Staff Costs.** BPC has around 1,450 staff and an employee cost for 2007 of about Nu323 million. For projection purposes, employee remuneration is increased at 5% for inflation and another 2% for real increase in remuneration.

39. **Operation and Maintenance Expenses.** Operation and maintenance for projection purposes is escalated by 5% annually to take into account the effect of inflation. Proportional increments for capacity expansion are duly considered.

40. **Depreciation Cost.** The depreciation rate for transmission assets and customer service department line assets is set at 3.33%, and at 5.00% for customer service department generation assets. The assets at the head office are depreciated at 6.4% per annum.

41. **Taxation and Dividend.** Income tax is calculated at 30% of profits. BPC will set aside around Nu23 million from its net profit after tax for transfer to the general reserve and pay 20% of the remaining amount to shareholders as dividend.

42. **Key Financial Performance Indicators.** Table A11.7 summarizes the results of financial analysis for 2008–2017. Assuming tariffs subsidized by the royalty, BPC is expected to maintain adequate profitability and debt service capacity. However, the profitability is likely to be gradually declined. BPC's future financial performance will be influenced by the very high proportion of rural electrification within its network and the need to work within tariff policies that incorporate high cross-subsidization.

Table A11.7: Summary of Bhutan Power Corporation Financial Projections and Key Financial Ratios

Year Ending 31 December	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Revenue (Nu million)	3,143	3,807	4,133	4,674	5,095	5,592	5,848	6,118	6,290	6,419
Total Operating Expenses (Nu million)	2,214	2,780	3,183	3,590	3,903	4,376	4,611	4,909	5,174	5,463
Profit after Tax (Nu million)	594	688	637	747	819	874	879	830	742	636
Cash & Cash Equivalents (Nu million)	869	1,116	941	422	392	1,017	1,962	2,834	3,283	2,951
Total Assets (Nu million)	12,476	13,661	14,673	16,486	18,317	20,336	21,085	21,608	21,999	22,346
Return on Net Fixed Assets (%)	5.8	6.2	5.3	5.3	5.2	5.2	5.4	5.2	4.7	3.9
Debt Service Coverage Ratio (times)	4.60	5.10	4.70	5.10	5.20	6.00	6.00	5.00	4.60	4.40
Debt / Asset (Debt + Equity) (%)	19.4	20.6	22.2	25.1	22.8	22.1	21.3	20.2	18.8	17.5

Source: ADB staff estimates.

3. Financial Management Assessment

43. A financial management assessment questionnaire was administered to facilitate a review of BPC's financial systems and processes with the objective to identify issues and constraints. The assessment was in accordance with ADB guidelines using the financial management assessment questionnaire and field interviews.

44. BPC has 53 accounting units under 29 branch offices; all the accounting units are computerized. BPC's Finance and Accounts Department is headed by a general manager with 20 assistant finance officers throughout BPC. In the head office, four assistant finance officers head four divisions: finance and accounts, asset management, management information system, and budgeting. The finance and accounting unit has 53 staff comprising accountants and assistants.

45. The BPC finance and accounts system is an application system built on the Oracle database platform. BPC has a well-defined chart of accounts for recording financial transactions. Accounting and financial reporting responsibilities are carried out as per the delegation of powers defined and approved by the BPC board of directors. BPC's Finance and Accounts Department has developed procedures and guidelines for this reporting.

46. BPC follows financial accounting on an accrual basis as per provisions of its governing statutes and generally accepted accounting principles. Being a corporate and a government company, it is subject to audit under the Companies Act of the Kingdom of Bhutan, 2000 and the Royal Audit Authority.

47. **The Future.** BPC raises commercial financing for its investments from local banks. Going forward, it may be required to raise commercial financing outside Bhutan for some of its investment requirements. BPC needs capacity building for raising and managing external funds. Another area of capacity building is in the field of budgeting. BPC carries out an annual budgeting exercise for its all accounting units that needs to be well-documented in budgeting manuals and procedures.

48. The detailed financial performance for DHPC, DGPC, and BPC is analyzed in Supplementary Appendix C.

ECONOMIC ANALYSIS

A. Dagachhu Hydropower Development

1. The 114 megawatt (MW) run-of-river Dagachhu hydropower development is on the left bank of the Dagachhu River in Dagana district. It is planned to be implemented under the Clean Development Mechanism (CDM) as defined in the Kyoto Protocol. A dedicated transmission line from Dagachhu to Dhajay will evacuate power from the hydropower plant. This transmission line is energized at 220 kilovolts (kV), has a single circuit on a single circuit tower, and is considered as a part of this facility for economic evaluation.

2. **Generation Forecast.** The generation system for the Dagachhu hydropower plant is designed to deliver power at a maximum flow of 50 cubic meters/second. Its mean annual net energy production is estimated to be 500 gigawatt-hours (GWh), while the net energy production with 90% dependability is about 360 GWh. The economic analysis is based on its economic life of 30 years.

3. **Cost.** The Dagachhu plant is expected to be set up at an aggregate cost of \$201.5 million (including soft and hard costs). The total economic cost considered in this current economic assessment is \$173.9 million, excluding price contingencies and financing costs.

4. **Benefits.** The main benefit of the facility to Bhutan comes in the form of export of power to India. The total power generated is expected to be exported at a border price of Nu2.40/kilowatt-hour (kWh) and a 2% discount on timely payment leading to an effective Nu2.35/kWh. When Bhutan–India subregional benefits are considered, they are in the form of avoidance of operation of standby generation units of industrial, commercial, and agricultural consumers as well as serving domestic consumers more hours of electricity at average domestic tariffs.

5. Under the CDM, the development will seek emission reduction certificates that can be sold to provide additional revenues to the facility. These benefits are assumed to continue even after the first commitment period of the Kyoto Protocol, which ends in 2012, the year of expected commissioning of the power plant since Tata Power Trading Company in principle agreed to underwrite the purchase of emission reductions for 30 years beyond the first commitment period at specific minimum price.

6. **Estimation of Economic Internal Rate of Return.** Based on these assumptions, the overall Dagachhu facility has an estimated economic internal rate of return (EIRR) of 13.8% for Bhutan, indicating that it is economically viable. When the benefit to Bhutan–India subregion is considered, power exported to India is assumed to eventually replace diesel standby generating sets in industry, commercial, and agricultural sectors, while domestic consumers are willing to consume at their average electricity price. With these assumptions the EIRR considering the benefits to the subregion rises to 22% (net present value at 12% discount rate is Nu488.3 million).

7. **Sensitivity Analysis.** To test the robustness of the results, a sensitivity analysis was based on a variety of parameters tested separately (Table A12.1).

Table A12.1: Results of Sensitivity Analysis
(%)

Item	Variable	EIRR (country)	EIRR (subregion)
Base Case		13.8	22.0
Operation and Maintenance	+ 10%	13.7	22.0
Capital (Investment) Cost	+ 10%	12.6	20.4
Time Period	+ 1 year	12.8	19.1
Threshold		12.0	12.0

EIRR = economic rate of return.

Source: ADB staff estimates.

B. Rural Electrification

8. The Government has updated the target for household electrification to complete 100% electrification by 2013. The rural electrification component, which is intended to partially fulfil achievement of this target, is expected to be implemented by Bhutan Power Corporation. Most of the required data for the economic analysis was obtained from a comprehensive household socioeconomic survey. The detailed economic analysis is in Supplementary Appendix D and the off-grid subproject is analyzed in Supplementary Appendix L.

9. **Demand Forecast.** Household demand is based on the willingness to pay and the capacity to pay, values determined using the socioeconomic survey. The average monthly household electricity consumption in the seven districts to be electrified is estimated to be about 103 kWh. For other categories of consumers, energy demand projections used for the technical design are used. For medium-voltage consumers, the capacity projections are considered because of the two-part tariff. This forecast was extracted from the technical assumptions.

10. **Cost.** Total economic cost of installation and commissioning of all feeders in the seven districts is estimated to be \$29.27 million inclusive of physical contingencies.

11. **Benefits.** In principle, the estimation of economic benefits will be based on an estimate of the household demand curve for energy. Economic benefits are assumed to be equal to the area under the demand curve, i.e., the sum of consumer surplus, cost savings, and revenue to Bhutan Power Corporation. For other consumers (low-voltage bulk and medium voltage), economic benefits are derived from fuel savings and revenue to Bhutan Power Corporation.

12. **Estimation of the EIRR.** To estimate the economic feasibility of the rural electrification component, EIRR values were determined for feeders and districts in the targeted areas. Each district exhibits EIRR values ranging from 13% to 26%, significantly higher than the threshold 12% EIRR required by ADB for funding a project. The overall EIRR of the rural electrification component is estimated to be 20%.

13. **Poverty Impact Analysis.** Poverty impact analysis is carried out to establish the impact of rural electrification on poor population groups in different stakeholder categories. The share of the poor in net economic benefits is estimated (Table A12.2). The estimated poverty impact ratio is 62%, implying that the poor are estimated to receive 62% of the net economic benefits.

Table A12.2: Poverty Impact Ratio
(Nu million)

Item	Bhutan Power Corporation	Government Economy	Labor	Consumers	Total
Net Benefits (Nu million)	(345)	(88)	20	2,738	2,324
Financial Returns (Nu million)	(1,215)				(1,215)
Proportion of Poor (%)	25	25	50	40	
Benefits to Poor (Nu million)	(390)	(22)	10	1,095	693
Total Economic Returns (Nu million)	1,110				
Poverty Impact Ratio	62%				

() = negative value, Nu = ngultrum.
Source: ADB staff estimates.

SUMMARY POVERTY REDUCTION AND SOCIAL STRATEGY

Country/Project Title: Green Power Development Project

Lending/Financing
Modality:

Project

Department/
Division:

**South Asia Department/
Energy Division**

I. POVERTY ANALYSIS AND STRATEGY

A. Linkages to the National Poverty Reduction Strategy and Country Partnership Strategy

In Bhutan, most of the population (about 70%) lives in rural areas, rural electrification is therefore a key issue in the Government's overall development strategy. For this reason, the Government is highly committed to develop and promote rural electrification projects, from which a larger part of the population is expected to benefit. Under the present 10th five-year plan, at least 25,000 households are expected to have access to electricity, raising the percentage of the population with access to 84%. The Government now aims to increase this target to 100% for the next five years by 2013.

Access to electricity in rural areas is a key element of human development as well as economic growth. Electrification does not only mean longer productive hours, it is also expected to improve health care delivery and education. Most of all, it means a greater range of opportunities for rural people to exploit to improve their quality of life and capacity to generate income. It will also benefit the living conditions of women and children, reducing the incidence of respiratory diseases and increasing their time for more productive activities.

Another immediate tangible benefit is the reduced use of costly energy sources, i.e., of kerosene and wood. Rural electrification provides electricity to public facilities such as health centers, schools, and other local community facilities.

Rural electrification under the Project will provide a stable supply of electricity as well as opportunities for commercial business development and employment in extensive rural areas of Bhutan. Benefits from power export, owing to the increased capacity given by the construction of a new run-of-river generation plant in Dagachhu, will contribute to the country's economic growth, providing low cost supply of electricity to customers including the most vulnerable households of the poor. Regional development and use for clean and renewable energy will specifically benefit the poor beyond the country since they are more adversely affected by pollution and environmental degradation.

B. Poverty Analysis

Targeting Classification: General Intervention

1. Key Issues

The Project has two major components: Dagachhu hydropower development and rural electrification. While the construction of a run-of-river hydro plant generally does not have direct benefits for local poor, rural electrification is expected to improve quality of life and bring new economic opportunities in increasingly remote areas of the country.

The Dagachhu hydropower facility's benefits are related to increased economic activities (particularly in restoration and small retail) around the plant site, increased accessibility due to construction of access roads connected to the main roads, and use of 15% of the revenue generated by the plant to subsidize lifeline customer tariffs.

Concerning the rural electrification component, the socioeconomic impacts of electrification will be very positive in nature and considerable in scale. These include the beneficial impacts accrued from (i) improved lighting; (ii) improved education, as improved lighting permits students to study for longer hours during the evening; (iii) improved health through decrease in smoke emitted from kerosene wick-lamps leading to decreased eye and respiratory ailments; (iv) cleaner living environment as smoke emitted from kerosene lamps for lighting purposes is reduced; (v) promotion of weaving and other income-generating activities during the evening leading to enhanced incomes; (vi) facilitation of undertaking household chores during the evening; (vii) promotion of recreational activities in the evening such as reading, watching television, and listening to the radio; (viii) promotion of social visits and interaction even after dark; (ix) making it easier to prepare for, perform, and conduct religious ceremonies and prayers; (x) making it easier to deal with emergencies such as illnesses and child delivery at night, and (xi) decreased dependence on kerosene for lighting purposes means residents do not have to walk (in many instances for days) to district headquarters to purchase kerosene and saves the cost of kerosene.

The poverty reduction potential of this component is significant since rural electrification is a pro-poor intervention that provides an avenue for supporting social progress by dispersing benefits of electrification widely and equitably. The impact of rural electrification is enormous among smaller, more remote communities, where isolation presents an additional dimension to combating poverty and improving quality of life.

The component will contribute significantly to poverty reduction and promote equitable regional development, particularly rural development. It will also ensure that coverage in terms of electricity provision is equitable, and will support economic growth and sustainable development.

II. SOCIAL ANALYSIS AND STRATEGY

A. Findings of Social Analysis

B. In 2007, Bhutan had a population of 658,888, with 345,298 males (52.4%) and 313,590 females (47.6%); 43.5% is below the age of 20 years, 34% between 20 and 39, 15.5% between 40 and 60, and 7% above 60 years. Sixty-nine percent live in rural areas.

By 2007, Bhutan had 29 hospitals, 179 basic health units, 514 dispensaries and outreach clinics, 1 Indigenous hospital, 21 indigenous dispensaries, and 150 doctors. In 2001, the doctor to person ratio was 1:7,476, by 2006 within a span of 5 years it decreased to 1:4,312, with 90% of the population covered by health care. In 2002, 24% of women were attended to by trained personnel during childbirth; by 2006 this had more than doubled reaching 57.1%. In the 1970s and 1980s life expectancy was 47 years; about two decades later in the 2000s it has increased to 68 years.

Until the late 1950s monastic education was the only form of formal education in Bhutan; formal school-based education was introduced only in the late 1950s. In 1959, the country had only 11 primary schools and enrolled a total of 440 children.^a In 1968 the first 20 Bhutanese completed high school (class X) education within the country.^b By 2007, Bhutan had 1,158 schools and institutions catering to 169,776 students.

In 2004, agriculture contributed 24.7% to the total economy, i.e., as measured by gross domestic product (GDP). It was also the single largest sector, providing livelihoods to 79% of the population.^c The contribution of agriculture to GDP has been gradually decreasing; in 2006 it accounted for 21.4% of GDP. This decline is only natural as the energy (hydropower) sector is experiencing a boom and is set to overtake agriculture as the largest contributor to GDP. Nonetheless, agriculture was still the largest contributor to GDP in 2006. Agricultural practices have changed tremendously. Until a decade ago, agriculture was practiced on a subsistence basis. Now an increasing number of farms are mechanized with sizeable investment in machinery and other inputs that are subsidized by the Government leading to increase in export of agricultural produce.

The major source of energy has traditionally been firewood, and it still represents the major source of energy consumption. With the commissioning of the first two units of the Chhukha Hydropower Project in 1986, and the other two units in 1998, Bhutan increased its electricity generation substantially and became a significant exporter of energy to India. In 2006, the total electricity generated was 3,357.2 million units. The Kurichhu Hydropower Project has a generating capacity of 60 megawatts (MW) and Basochu 64 MW. The number of villages electrified increased from 1,210 in 2004/05 to 1,318 by December 2006.

Bhutan first opened to tourism in 1974 when only a handful of tourists visited. In 2001 Bhutan received a total of 6,393 tourists, within 5 years, by 2006, this number almost tripled with tourist arrivals totaling 17,342.

In 2001, the value of Bhutan's exports was Nu4,994.75 million, by 2006 the value of exports almost quadrupled to Nu18,771.00 million. The value of imports in 2001 totaled Nu8,990.20 million and reached Nu19,011.00 million in 2006.

Boosted by earnings from Tala Hydropower Project, GDP grew at an average of more than 7% during the 9th five-year plan. This growth was derived from the sustained expansion of electricity and construction, which experienced average annual growth of around 25% and 11.8% respectively. Trade and other services sectors grew at an average of 11.5%. Overall, electricity continues to dominate the country's exports accounting for around half of the country's total export during the 9th FYP period. The country's per capita income is estimated to rise to \$1,500 in 2006 from \$835 in 2002.

The rural electrification component is an integral part of the rural electrification program under the 10th FYP (2008-2013) and will help Bhutan achieve its target. Around 9,000 rural households mainly in seven districts,^d including remote central and eastern regions, will be connected to the main grid. In addition, 119 solar panels will be installed to electrify public utilities in extremely remote areas.

Of the beneficiaries, 88% farm as their main activity (mainly rice and maize); 10% raise livestock; and the remaining 2% are employed in some service activity, particularly hospitality (restaurants and small guesthouses). Additional information on poverty and social analysis are in Supplementary Appendix F.

B. Consultation and Participation

1. Provide a summary of the consultation and participation process during the project preparation.
 For the Dagachhu hydropower component, affected people were consulted since September 2007 to define acceptable alignment of the access roads, and the most appropriate compensation package. All 25 affected families have opted for land-for-land and chosen their preferred plot, which is currently being legally transferred to them. In addition, the affected families who are losing land and crops for the construction of access roads have already been compensated for the loss of crops and trees. They all accepted additional compensation for the crops at the end of the cropping season as they expect a sharp increase in prices. The project authorities, along with local authorities, agree that the fairer market price will be available at the end of the cropping season (September) and they are willing to top up the present compensation with the necessary funds, as agreed with the affected people. All affected people have expressed their support for the Dagachhu hydropower component in view of the agreements reached with the authorities. For the rural electrification component, public consultations are mandatory to explain to the beneficiaries' acceptance of electrification, safety awareness of electricity, and the availability of free electrification kits. These activities are completed.

2. What level of consultation and participation (C&P) is envisaged during the project implementation and monitoring?
 Information sharing Consultation Collaborative decision making Empowerment

3. Was a C&P plan prepared? Yes No

If a C&P plan was prepared, describe key features and resources provided to implement the plan (including budget, consultant input, etc.). If no, explain why. Consultations are ongoing in a constant and consistent manner. Given the small number of affected people, the approach of direct involvement in all relevant decisions seemed to be the best option and no specific plan was therefore considered necessary. The consultations will be carried out during implementation as per Bhutanese regulations. No plan is therefore prepared for further consultations and related activities are embedded into the implementation of the Project.

C. Gender and Development

1. **Key Issues.** While the Dagachhu hydropower development is basically neutral to gender issues, rural electrification is expected to make positive interventions on gender development. Women in the rural electrification area will not be constrained by any discrimination in accessing the benefits that accrue from electrification. In fact, females will benefit more than males as they remain indoors and perform household chores. The provision of electricity will not only make their chores easier but will improve their health condition since most of their respiratory and eye ailments are caused by the smoke emitted from firewood stoves and kerosene wick-lamps in poorly ventilated houses. Considering the status of women in the project areas, and considering that the rural electrification component is gender neutral, no specific measures (gender plans) are needed for differential gender requirements as women are not specifically disadvantaged because of economic, political, or sociolegal discrimination and they do not face specific barriers to access and benefits of electrification. A gender-specific analysis for the rural electrification component is in Supplementary Appendix E.

2. **Key Actions.** Measures included in the design to promote gender equality and women's empowerment—access to and use of relevant services, resources, assets, or opportunities and participation in decision-making process:
 Gender plan Other actions/measures No action/measure

III. SOCIAL SAFEGUARD ISSUES AND OTHER SOCIAL RISKS

Issue	Significant/Limited/ No Impact	Strategy to Address Issue	Plan or Other Measures Included in Design
Involuntary Resettlement	A short resettlement plan is required for the Dagachhu component, but no resettlement or damage is expected for the rural electrification component since it will not infringe on any private property or disturb any cultivation (stringing will in fact take place in winter)and therefore no need private land will need to be acquired.	A short resettlement plan was prepared to guide the acquisition of land (the land-for-land option was chose by all affected people who have already identified the land they wish to be awarded) and the compensation for the loss of crops. Involuntary resettlement is categorized as "B".	<input type="checkbox"/> Full Plan <input checked="" type="checkbox"/> Short Plan <input type="checkbox"/> Resettlement Framework <input type="checkbox"/> No Action

Indigenous Peoples	Since the Project will not have any negative impact on the indigenous peoples and since they do not face any barriers to accessing the project benefits, no special provisions, mitigation measures, or indigenous peoples development plan will be required to protect them against any such vulnerabilities.	No indigenous people will be negatively impacted. No specific action has been foreseen. The Project is categorized as "C" for impact on indigenous peoples.	<input type="checkbox"/> Plan <input type="checkbox"/> Other Action <input type="checkbox"/> Indigenous Peoples Framework <input checked="" type="checkbox"/> No Action
Labor <input checked="" type="checkbox"/> Employment opportunities <input type="checkbox"/> Labor retrenchment <input checked="" type="checkbox"/> Core labor standards		Core labor standards are included in the assurances.	<input type="checkbox"/> Plan <input checked="" type="checkbox"/> Other Action <input type="checkbox"/> No Action
Affordability	Affordability is not considered to be an issue as electricity in Bhutan is highly subsidized by the Government, particularly for lifeline customers. All previous schemes of provision of free connection kits have proved to be unrealistic as virtually none of the beneficiaries has decided to avail of the opportunity. Since free kits are still available at Bhutan Power Corporation, they could be provided on the request.		<input type="checkbox"/> Action <input checked="" type="checkbox"/> No Action
Other Risks and/or Vulnerabilities <input checked="" type="checkbox"/> HIV/AIDS <input type="checkbox"/> Human trafficking <input type="checkbox"/> Others(conflict, political instability, etc), please specify	The Government has been successfully carrying out awareness campaigns and free health care to minimize the spread of HIV/AIDS in the country. They have extended the same provisions (and free health care) to all workers, whether local or foreign.		<input type="checkbox"/> Plan <input type="checkbox"/> Other Action <input checked="" type="checkbox"/> No Action
IV. MONITORING AND EVALUATION			
Are social indicators included in the design and monitoring framework to facilitate monitoring of social development activities and/or social impacts during project implementation? x Yes □ No			

^a Planning Commission. 2000. *Bhutan National Human Development Report 2000*. Thimphu.

^b Royal Monetary Authority. 2005. *Bhutan 2020- A Vision for Peace Prosperity and Happiness*. Thimphu.

^c National Statistics Bureau, 2007. *Statistical Yearbook of Bhutan 2007*. Thimphu.

^d Lhuentse, Pema Gatshel, Punakha, Samdrup Jonkhar, Sarpang, Trashigang, and Wangdue Phodrang.

Source: Asian Development Bank

SUMMARY RESETTLEMENT PLAN

1. The Dagachhu hydropower development of the Green Power Development Project will use the water of the Dagachhu River to power the turbines. The run-of-river power plant is located on the left side of the Dagachhu River between river kilometer (km) 10.5 and 20.2, upstream of the Dagachhu–Sunkosh confluence. The river stretch between the intake and tailrace outlet is about 9.7 km. The difference in riverbed elevation between the intake and outlet is about 296 meters (m), and the natural river gradient averages about 3%.

2. The main components of the development are the weir and intake, desilter, headrace channel and tunnel, surge shaft, pressure shaft, powerhouse (cavern) with two pelton turbines, and transformers for 220 kilovolt power transmission. The system is designed to convey a maximum flow of 50 cubic meters/second. The plant will have an installed capacity of 114 megawatts (MW).

3. The development will require land for the construction of these components. Although most of the land required is within government-owned land some land required belongs to private individuals. Since Asian Development Bank (ADB) policy applies to all resettlement effects, irrespective of the scale of land to be acquired and regardless of the number of people affected, a resettlement plan is a mandatory requisite for all ADB-financed projects. This resettlement plan was prepared in keeping with ADB policy and in accordance with ADB's *Handbook on Resettlement: A Guide to Good Practice* (1998).

4. The resettlement plan defines affected persons as those who stand to lose as a consequence of the project, permanently or temporarily, all or part of their physical and nonphysical assets including homes; communities; productive and nonproductive lands; resources such as forests, community lands, or important cultural sites; commercial properties; tenancy; income-earning opportunities; and social and cultural networks and activities.

5. The Dagachhu development is classified as having “nonsignificant” resettlement effects since it does not involve relocation and resettlement of any households and since the number of households affected is only 25, and the total number of affected persons in the 25 households is 145, which is less than 200. Moreover, the development does not affect any structures (house or living quarters, other physical structure, commercial or industrial structure, and rented or occupied commercial premises) or religious, community, or cultural sites. Therefore, following ADB guidelines, a full resettlement plan is not required since the resettlement effects are not severe enough to warrant it, and a short resettlement plan will sufficiently protect the interests of the affected people.

6. To minimize the effects of resettlement, as far as possible vacant government land was identified for the location of project infrastructure, and the acquisition of private land was kept to the essential bare minimum. Other measures to minimize resettlement effects include (i) access road contractors are to avoid affecting homesteads even if this causes some realignment of the access roads design; (ii) efforts were made to avoid affecting larger settlements, resulting in no families being displaced; (iii) during design, extra care will be taken to ensure that religious structures and public property are avoided; and (iv) stone crushing units and other noise-generating activities will be located away from residential areas as far as possible to mitigate the effects of noise pollution. Similarly, air pollution caused by dust, will be alleviated by locating machinery and equipment that cause air pollution away from residential areas.

7. The total amount of land to be acquired from affected people is 27.42 acres. Of this, about 19.99 acres is Kamzhing (dry land including orange orchards) and 7.43 acres is Chhuzhing (wet land or paddy fields). Of the 27.42 acres, 2.61 acres falls under Kana, 16.27 acres falls under Khebisa, and 8.54 acres is under Goshi. Overall, about 2.7% of the total population of the three affected blocks (about 5,363 people) is affected by the DHP.

8. The total amount of standing crops affected is 3.1 acres of paddy and 8.16 acres of maize. The total number of fruit trees affected is 388 orange trees.

A. Policy Framework and Entitlement Matrix

9. This resettlement plan provides a review of Bhutan's policy framework and laws and regulations pertinent to the development and its effects, including the identification of policy gaps in land acquisition, land replacement, and cash compensation. It also provides an overview of ADB's policy on resettlement and recommends measures to make Bhutan's policies compliant with ADB's *Involuntary Resettlement Policy* (1995).

10. The basic principles adopted in the resettlement plan are (i) involuntary resettlement and loss of land, structures and other assets, and incomes will be avoided and minimized by exploring all viable options; (ii) affected people will be provided with compensation for their lost assets, incomes, and businesses; and provided with rehabilitation measures sufficient to assist them to improve or at least maintain their preproject living standards, income levels, and productive capacity; (iii) lack of legal rights to the assets lost will not bar affected persons from entitlement to such compensation and rehabilitation measures; (iv) replacement of affected assets (land, crops, fruits, structures) will be provided at the 2008 rates fixed by the Property Assessment and Valuation Agency (PAVA). However, if the difference between the rates adopted by PAVA is found to be significantly lower than current local market rates, an independent assessment of current local market rates will be undertaken and this will be used as a basis for making compensation; (v) preparation of resettlement plans and their implementation will be carried out with participation and consultation of affected people; (vi) a budget schedule for resettlement planning and implementation must be incorporated into the overall development, and; (vii) payment of compensation or replacement of affected assets must be completed prior to the award of civil works contract, apart from the access roads.

11. To implement these principles, 16 policies were developed in the resettlement plan and will be applied when implementing the plan.

12. A detailed section on entitlements in the plan covers eligibility and entitlements for various categories of losses. The entitlement matrix is provided in the Table A14.1.

13. Compensation for land acquired by the development will be on a land-for-land basis as far as possible. Cash compensation for land acquisition will only be made if the affected person concerned insists even after being advised otherwise. The replacement land must be of equivalent size as the land acquired and of similar productivity standards and potential. The replacement land must, as far as possible, be within the immediate vicinity of the affected land or close to it to avoid causing inconveniences to the already affected person.

Table A14.1: Entitlement Matrix

Type of loss	Application	Definition of entitled persons	Compensation policy	Implementation issues
Temporary loss of arable land	Arable land in the project area	Farmers who cultivate the land Owner of the plot	Cash compensation for loss of net income, damaged assets, crops and trees at rates approved by PAVA in 2008. Restoration of land to former state	Affected people have been compensated for their crop-loss. However, the compensation for crop loss was paid following the 1996 compensation rate guidelines for the time being. Affected people will be paid the 2008 rates retroactively when the new rates are finalized and released. Price of agricultural products in the local market will be checked for comparison with the new compensation rates when released by PAVA to ensure coherence between the two. Affected people will be provided with cash compensation to restore land to its former state.
Permanent loss of arable land	Arable land located in the project area	Farmers who cultivate the land Owner of the plot	Provide equivalent land nearby Provide cash compensation for preparation of replacement farmland	Available vacant government land is required. Assistance is provided to farmers to develop new crops and increase production.
Loss of standing crops	Crops located in the project area	Farmers who cultivate the crop	Compensation in cash for crops based on expected harvest	Price of agricultural products in the local market have to be checked for comparison with the new compensation rates that PAVA is expected to finalize and release in September 2008.
Loss of fruit trees	Fruit trees located in the project area	Farmers who cultivate the trees	Compensation in cash based on type and age of trees	Only private owners will be compensated for trees.

14. If paddy fields are acquired and undeveloped land is provided as replacement land, then the affected person is entitled to “land development costs” for converting the undeveloped land into paddy fields. The market rate for such land development costs is estimated to be Nu60,000 per acre. This rate was arrived at after consulting with officers of district offices, the affected people in the project area, and farmers in other districts.

15. Cash compensation will be paid for loss of standing crops and fruit trees. The compensation rates will be determined by PAVA (PAVA expects to finalize the 2008 compensation rates by September 2008), an agency instituted by the Government to set compensation rates. The 2008 compensation rates are expected to be in line with current local market valuation.

16. Site selection for replacement land will be carried out by the affected persons themselves in consultation with the land records officers of the Dagana district office and the executive officers of the block offices. This has been agreed to by the district authorities. The affected persons will be given the choice of choosing replacement land of their preference from

within the same block (if vacant government land is available) to avoid causing encumbrances to affected people and to minimize complaints and grievances about the replacement land. In fact many affected people have already selected and identified their replacement land.

B. Grievance Redress Mechanism

17. A two-tier grievance redress committee has been set up for the affected people who will have the right to file complaints and/or grievance on any aspect of land acquisition and resettlement such as inventories, valuation, and entitlements. Any affected persons who have had their land, crops, fruit trees, or structure expropriated or altered and believes that they have not been compensated or assisted in compliance with their entitlements will be able to express their grievances through the two-tier grievance redressal mechanism instituted under the resettlement plan. Three grassroots redressal committees, gewog grievance redressal committees (GGRCs) have been set up (one in each of the three affected blocks [gewogs]). The GGRCs comprise members elected by the affected people themselves and selected on the basis of who could best represent and voice their grievances. Over 90% of GGRC members are affected people themselves. The executive officer of the respective block office will chair the GGRC.

18. A higher-level, grievance redressal committee has been set up at for the districts (dzongkhags). The dzongkhag grievance redressal committee (DGRC) is chaired by the chief executive officer of Dagana district. The DGRC comprises the district agricultural officer(s), forest officer(s), land record officer(s), finance officer(s), and engineer(s) as its members.

19. If the grassroots grievance redress committee is unable to resolve the grievance, within 1 week it must pass the unresolved grievance to the DGRC. If the DGRC is unable to resolve the grievance, then the DGRC must, within 2 weeks, refer the complaint or grievance to the National Land Commission, which is the highest body to approve land replacement and compensation allotments in the country. If the National Land Commission is unable to resolve the grievances referred to it, then the affected people have the right to appeal to the courts or to His Majesty, the King of Bhutan who is the ultimate arbitrator in the country. The grievance redress procedures are summarized in Table A14.2.

Table A14.2: Grievance Redress Procedure

<p>Step 1: GGRC deals with grievance within 7 days of receipt of complaint from affected person. If unresolved,</p> <p>Step 2: DGRC deals with grievance within 2 weeks. If unresolved the grievance is forwarded to the National Land Commission,</p> <p>Step 3: The National Land Commission deals with the grievance. If unresolved,</p> <p>Step 4: The affected person has the right to appeal to the courts or to His Majesty, the King of Bhutan.</p>

C. Consultation and Disclosure

20. The resettlement plan was disclosed to the affected people and the public (all stakeholders) for review and comments on the various mechanisms and entitlements for implementation of the plan. The intention of this procedure was to receive comments from affected families in particular so that appropriate suggestions can be incorporated in the resettlement plan and at later stages of implementation. Relevant components of the

resettlement plan were translated into the national language (dzongkhag) and placed at the block office, office of the Dagachhu Hydro Power Corporation (DHPC), and their websites.

21. An institutional framework prepared as a separate section assigns specific roles and responsibilities to relevant agencies and individuals to implement the resettlement plan. Various committees such as the dzongkhag resettlement committee, internal monitoring committee, and the Resettlement Cell within DHPC have been established. Moreover, the resettlement commissioner, chief resettlement officer, and district resettlement officer have been identified and their roles and responsibilities designated. The main report provides details on the functions, role, and responsibilities of individual officials and committees.

D. Budget

22. The budget required to implement the resettlement plan is provided Table A14.3. However, the resettlement cost estimate and budget are subject to revision when PAVA finalizes the compensation rates for 2008, particularly for standing crop loss and loss of fruit trees. The Dagachhu development provisioned the budget as part of the cost estimate.

Table A14.3: Resettlement Cost Estimates and Budget

Category	Cost Item	Cost (Nu)
Land acquisition	Compensation for land acquired will be on a land-for-land basis; therefore no costs are reflected under this category.	0
Resettlement preparation and compensation	1. Compensation for standing crops 2. Compensation for 388 orange trees 3. Compensation for converting undeveloped replacement land into paddy fields (7.43 acres) 4. Cost of information translation, printing, dissemination, and consultation 5. Cost for community education campaign	88,120 270,352 445,800 125,000 50,000
Administrative costs	1. Training and/or workshop 2. Monitoring and evaluation 3. Independent monitoring 4. Travel and miscellaneous expenses for resettlement commissioner, CRO, dzongkhag resettlement officer, GRC's internal monitoring committee, dzongkhag resettlement committee	50,000 200,000 600,000 300,000
	Subtotal	2,129,272
Contingency	10% of total	212,927
	Total	2,342,199

CRO = chief resettlement officer, GRC = grievance redressal committee.

Source: Dagachhu Hydro Power Corporation.

E. Monitoring and Evaluation

23. An implementation plan was prepared to guide resettlement plan implementation (Table A14.4).

Table A14.4: Resettlement Plan Implementation Schedule

Activity	2008					2009									
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Establishment of resettlement cell in DHPC	■														
Conduct of DMS	■	■													
Review of DMS by affected people		■													
Payment of interim compensation			■												
Complete land acquisition				■											
Finalization of compensation rates for crop-loss				■	■	■	■	■	■	■					
Endorsement of resettlement plan				■	■	■	■	■	■	■					
Disclosure of plan to affected people				■	■	■	■	■	■	■					
Training for plan implementation personnel				■	■	■	■	■	■	■	■	■	■	■	■
Preparation and maintenance of plan database				■	■	■	■	■	■	■	■	■	■	■	■
Internal monitoring of plan implementation				■	■	■	■	■	■	■	■	■	■	■	■
External monitoring of plan implementation							■	■	■	■	■	■	■	■	■
Effect revised and final compensation payments							■	■	■	■	■	■	■	■	■
Complete land replacement procedures										■	■	■	■	■	■
Advance notice for clearance from project site										■	■	■	■	■	■
Clearance of encumbrances in project site										■	■	■	■	■	■
Award of civil works contracts for project const.											■	■	■	■	■
Postresettlement impact evaluation															■
Quarterly progress reports							■	■	■	■	■	■	■	■	■

DHPC = Dagachhu Hydro Power Corporation, DMS = detailed measurement survey.

Source: Asian Development Bank and Dagachhu Hydro Power Corporation.

24. Monitoring and evaluation of implementation of the resettlement plan will be done by the Internal Monitoring Committee established within DHPC, and will be by external monitors (e.g., consultants). Training workshops were provided to DHPC and relevant local government officials. The monitoring parameters and indicators are provided in the resettlement plan, including the monitoring methodology. The monitoring time frame and reporting requirements are also detailed.

25. DHPC will evaluate the performance of the progress of the affected people 2 years after all resettlement activities are completed and evaluate them against the indicators listed in the resettlement plan. This will provide a picture of whether the socioeconomic situation of the affected people was better off before the DHP, or after.

26. Certain assurance have been made to the affected people and are incorporated in the resettlement plan, they are (i) the cash compensation made to affected people for loss of crops and fruit trees on 1 May 2008 is an interim measure aimed at alleviating their need for cash until the final 2008 compensation rates are finalized and released by PAVA; all cash compensation for crops and fruit loss will be made by 30 September 2008; and (ii) all land replacement procedures will be completed and ownership titles (thrams) will be delivered to the affected people by 31 December 2008.

ABSTRACT OF SUMMARY INITIAL ENVIRONMENT EXAMINATION

1. The Green Power Development Project is classified as Asian Development Bank (ADB) environment category B. In Bhutan, the National Environment Commission (NEC) is the apex body that oversees environmental protection and issues environmental clearance mandatory for any projects and activities that may have adverse environmental impacts. Bhutan released the National Sustainable Development Strategy of Bhutan in 2006. Other major environmental acts include Environment Assessment Act 2000, the Forest and Nature Conservation Act 1995, and the Biodiversity Act of Bhutan 2003.

A. Dagachhu Hydropower Development

1. Environmental Impacts and Mitigation Measures

2. The Dagachhu development won't encroach on any declared protected areas, or undermine the rich cultural heritage sites of Bhutan. Some localized impacts due to construction activities could be mitigated or minimized by implementing the designed mitigation measures.

3. The physical, biological, and social impacts identified and the scope for mitigation and enhancement measures, provide obvious reasons from an environment perspective why the development should not be implemented. The environmental impact assessment (EIA) report prepared by the Department of Energy of the Ministry of Economic Affairs,¹ and approved by NEC proposes measures to mitigate potential impacts along with measures to enhance positive impacts of construction and operation of the Dagachhu hydropower plant. The enhancement measures should receive equal attention as the proposed mitigation measures.

4. Potential increases in air, water, and noise pollution due to construction activities will be minimized by taking proper mitigation measures and are not expected to exceed the compliance standards provided in the respective 2003 NEC regulations. The river water quality is unlikely to deteriorate because the water circulates relatively quickly.

5. Mitigation measures are included in the environmental management plan (EMP) that constitutes an integral part of the EIA preparation and is subject to implementation by the Dagachhu Hydro Power Corporation (DHPC). The EMP approved by NEC covers all aspects of environmental issues in connection with the plant site and activities. The EMP is arranged for all three phases: preconstruction, construction, and operation. The EMP lists possible impacts and proposes adequate mitigation measures. The expected impacts are similar to those that are characteristic of other medium-size hydropower developments including effects from excavated soil, worker safety, increase in air quality and noise pollution, handling construction and solid waste, electrical fire hazards, and safety aspects of facility operation and management. All identified impacts are ranked as low or medium, and appropriate mitigation measures are proposed for implementation through DHPC. The EMP outlines such mitigation measures as transporting of excess soil and rocks to designated dump sites, and ground leveling; slope stabilization and revegetation to prevent slides and soil erosion along access roads and river banks; appropriate handling of construction waste and hazardous waste (if applicable) to designated disposal sites; setting up barriers and check posts to prevent poaching; implementation of electric shock and fire prevention safety measures; regular water sampling to assure early detection of water-borne diseases; data collection of hydrological flows to assure implementation of the minimum ecological water flow requirements; water reservoir

¹ The document was prepared under the feasibility study funded by the Government of Austria.

management including sampling downstream water quality to detect riverbed sedimentation levels; and proper handling of transformer oil replacement. All recommended mitigation measures reflect industry best practices on environmental mitigation actions for hydropower facilities.

6. Specific issues addressed in the preconstruction phase include (i) environmental clearance, that is mandatory to obtain as per the Environment Assessment Act 2000 before initiation of any project activities (completed); (ii) preparation of a resettlement plan (completed); (iii) incorporation of environmental requirements in project design particularly inclusion into contract clauses; and (iv) monitoring of implementation of the EMP and resettlement plan.

7. EMP-specific issues for the construction phase include the following (i) setting up an environmental management unit within DHPC (completed); (ii) coordination with the project engineering unit to incorporate environmental concerns into civil works contracts; (iii) environmental capacity building including contractor's engineer; (iv) monitoring of civil works execution; (v) monitoring of wildlife indicators; (vi) monitoring of social indicators; and (vii) reporting and mitigation measures rectifications.

8. Particular issues to be addressed during post construction are basically the implementation of monitoring and mitigating activities including downstream flow variations, reservoir management, downstream water quality management, and insect vector disease management.

9. The Government-approved EIA report recommends a minimum flow (ecological flow) release from the dam 1.4 cubic meters per second (roughly in the range of 5%–10% of the mean annual natural flow) to support animal life, in particular fish migration from March to April (to spawning site) and from September to October (return to lower altitude for warm water). However, because only limited data on baseline water quality and aquatic habitat patterns was collected, DHPC will continue to conduct a separate study on collection of baseline water quality indicators (for subsequent monitoring during implementation) and aquatic species migration routes and spawning sites for enhancing mitigation measures through potential installation of a fish ladder (or other means of facilitating fish migration).² DHPC will reflect the results of the study in the design and construction works.

10. The development will result in minimal negative social impacts. It will impact 25 households with part of their landholdings on the plant site or needed for construction of access roads (not financed by ADB). DHPC has compensated affected people as per the Land Act of Bhutan 1979 and Land Compensation Rates 1996. In addition, DHPC agreed to pay for affected crops using market rates at the end of the cropping season.

11. Social impacts from the hydropower plant are expected from the influx of about 1,500 construction workers into the area during the construction, although the number of workers for each site is minimal. Nevertheless, subsistence agriculture has been the norm for centuries, and established social and cultural institutions will shape people's understanding. Thus, special attention will be given to mitigate adverse impacts of the interaction between existing communities and the construction work force.

² The environmental study will be conducted by the technical assistance consultant (the terms of reference are given in Supplementary Appendix B).

2. Institutional Requirements and Environmental Monitoring Plan

12. The Executing Agency, Druk Green Power Corporation (DGPC) will be responsible for overall implementation of the EMP. Specifically, DGPC will be responsible for management, coordination, and execution of all activities funded under the ADB loans. DGPC will bear overall responsibility for providing regular monitoring reports to ADB as specified in the EMP. DHPC as the Implementing Agency, will be responsible for construction and operation of the plant, and implementation of the EMP.

13. DHPC has already set up an environmental unit headed by an environmental manager and support staff. The unit will be responsible for day-to-day monitoring of EMP implementation and preparation of environmental monitoring reports as specified in the EMP. DHPC will assure overall environmental compliance and adherence to the required mitigation measures as specified in the EMP. It will be responsible for reporting any changes in the project scope (e.g., addition of new civil works or changes of access roads alignments and the tunnel layout) to DGPC. DGPC will, in turn, inform ADB about any changes proposed to the agreed scope of works. If ADB finds that the changes will have impacts on environmental safeguard compliance, DGPC will be required to complete either initial environmental examinations (for category B projects) or a full EIA if the changed scope is categorized as an environmental category A.

3. Public Consultations and Disclosure

14. DHPC will acquire land for the construction of the Dagachhu plant. Although most of the land required is government-owned land, some land will be required from private individuals. The land acquisition exclusively concerns the access road construction, but not the reservoir and dam building. No activities take place in environmentally protected areas, and thus the consultations were held with people affected due to access road construction. The EIA approved by NEC indicates that water quality and fish migration will not be affected to the extent that family incomes (from fishery) or dietary habits of the local population will be altered.

4. Conclusion

15. The Dagachhu hydropower plant will generate moderate to low environmental impacts that can be alleviated through a set of mitigation measures proposed in the EMP. None of the identified potential impacts will be of an adverse nature requiring additional studies or complementary mitigation programs (with the exception of a thorough study on baseline water quality and aquatic species seasonal migration to be completed for monitoring purposes). Overall, hydropower generation as a renewable energy source will contribute significantly to the socioeconomic development of the country and the region, and improve the standard of living for the population.

B. Rural Electrification

1. Environmental Impacts and Mitigation Measures

16. During the construction stage, the activities that can cause potential environmental and social impacts generally include (i) clearance of the right-of-way where distribution lines pass through forested areas; and (ii) soil excavation and line stringing during the pole and line installation. The operation phase is not expected to have any major negative impacts because (i) rural electrification schemes normally operate with routine maintenance and only occasional repairs; and rural electrification infrastructure is inspected and maintained by Bhutan Power

Corporation (BPC) regularly, so that repairs should be small in scale. Once the system is operating the main risks will relate to probable occurrence of accidents harming workers during maintenance or repairs to the system.

17. To avoid or reduce environmental impacts, the mitigation designs and actions include
- (i) narrower coverage of right-of-way to avoid branches touching the line compared to the standard requirement;
 - (ii) routing of the lines along existing farm roads and footpaths to reduce the cutting of new trees;
 - (iii) installation of covered conductors for lines near protected areas and biological corridors to ensure that local habitat is not in danger of electroshocks;
 - (iv) terms of reference for all civil works to require employing manual labor under the guidance of field environmental officers to reduce the impacts of (i) heavy machinery tracking through forest areas; and (ii) cutting mature trees that have ecological value;
 - (v) locating poles on field boundaries where the lines cross agricultural areas, to reduce the loss of productive land;
 - (vi) marking the right-of-way boundary and prohibiting workers from trespassing outside;
 - (vii) limiting tree cutting to samples marked as approved for cutting by the Department of Forests;
 - (viii) adequately equipped labor camps including sanitation facilities and serviced accommodation; and
 - (ix) screening of workers for infectious diseases and providing free treatment if necessary.

18. Although some of the distribution line will run close to protected areas and through biological corridors, all lines are aligned along the existing or planned roads and highways, and poles are placed at road curbs. The Road Act of Bhutan (2004) states that for all roads constructed and maintained by the Department of Roads (DOR) that 15 meters on either side of the motor road is DOR property, irrespective of whether such roads are constructed or passing through protected areas. If a distribution line is located within 15 meters of the roadside, it is considered to be located on DOR property and the line installation is not subject to environmental requirements applicable for works performed within protected areas (the Road Act of Bhutan, 2004).

2. Institutional Requirements and Environmental Monitoring Plan

19. Each subproject for each district will be managed and implemented within the institutional framework that already exists in Bhutan for the provision of rural electrification services. The Department of Energy (DOE), as the Executing Agency, is responsible for management, coordination and execution of all activities funded under the loan. BPC as the Implementing Agency is responsible for construction and operation of all subprojects. Implementation will be managed centrally by the BPC's Project Implementation Unit where a project manager and staff have already been appointed.

20. By August 2008 the national environmental clearances for all subprojects were obtained from NEC. Environmental issues have been coordinated by the BPC Environmental Unit, which ensures that all subprojects comply with ADB and national environmental safeguards. Initial environmental examinations and other documents were developed for all subprojects during

project preparation to comply with ADB and the Government requirements. In the unlikely event that further study is required, this will be conducted by the BPC Environmental Unit and/or by the BPC-recruited environment consultants.

3. Public Consultation and Disclosure

21. More than 2,000 people attended 26 public consultation meetings organized by DOE, BPC, and the consultant in each of the districts. Primary stakeholders included residents of target households and owners/users of facilities to be electrified; people who work on farmland that is crossed by the lines; and owners and users of land that is acquired for the erection of poles. Secondary stakeholders are DOE, BPC, Department of Forests as the custodian of protected areas and other forested land through which the lines will pass, NEC as the authority granting environmental clearances, other government institutions; nongovernment organizations working in affected communities, and ADB.

22. Public meetings were organized with the objectives of disseminating information to local government officials and the community about the rural electrification component, to explain potential impacts and mitigation measures; and to solicit the views of the community and clarify any issues or doubts regarding the undertaking. Prior to each meeting, the local government offices were contacted to set the date, time, and venue for the meeting.

4. Conclusion

23. The environmental impacts of the rural electrification infrastructure proposed by the Project were assessed by initial environmental examinations summarized in this section in accordance with ADB's *Environment Policy* (2002) and *Environmental Assessment Guidelines* (2003). The overall conclusion is that through implementation of the mitigation measures, no significant negative impacts will result from the location, design, construction, or operation. The analysis does not include any uncertainties, and no additional studies are required to address further concerns or to comply with ADB procedures or national laws.