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3 Asia
3.3 South Asia

3.3 Bhutan
Tandin Jamtsho, Druk Green, Bhutan; Ugranath Chakarvarty, International Center on Small Hydro Power

Key Facts

| Population | 716,896 |
| Area       | 38,394 km² |
| Climate    | Varied climate; tropical in southern plains; cool winters and hot summers in central valleys; severe winters and cool summers in Himalayas |
| Topography | Mostly mountainous with some fertile valleys and savannah |
| Rain pattern | Average annual rainfall: 1,793 mm. Rainy season: April to October (monsoon season) |

Electricity sector overview
The rich hydropower resource has spurred hydropower development along with proving its prominence in Bhutan’s economic development. The country has not been fully electrified and the electrification rate remains 60 per cent. This is primarily due to lack of transmission and distribution facilities. Bhutan generates more electricity than it actually needs and therefore exports power, primarily to India.

According to Druk Green Power Corporation, the total installed capacity of all power plants is 1,504 MW. Hydropower is the main source of electricity in Bhutan with an installed capacity of 1,488.8 MW, generating annually 7,304 GWh according to the World Bank statistics on 2010 (table 1).

Table 1
Installed hydropower capacity in Bhutan
(Megawatts)

<table>
<thead>
<tr>
<th>Project name</th>
<th>Installed capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chukha</td>
<td>336.0</td>
</tr>
<tr>
<td>Kurichhu</td>
<td>60.0</td>
</tr>
<tr>
<td>Basochhu Upper Stage</td>
<td>24.0</td>
</tr>
<tr>
<td>Basochhu Lower Stage</td>
<td>40.0</td>
</tr>
<tr>
<td>Tala</td>
<td>1020.0</td>
</tr>
<tr>
<td>Small/Mini/Micro plants</td>
<td>8.8</td>
</tr>
<tr>
<td>Total</td>
<td>1488.8</td>
</tr>
</tbody>
</table>

Source: World Bank²
Note: Only operational plants listed.

Diesel generator constitutes the remaining installed capacity. Hydropower provides more than 99 per cent of electricity needs of the country (figure 1).

Harnessing hydropower in Bhutan offers sustainable socio-economic development potential; in fact it is widely accepted as a backbone of the Bhutanese economy. Being located on the Southern slope of Eastern Himalayas, its rugged terrain and well conserved dense forests, covering 72.5 per cent of total territory, provide swift water flow offering immense opportunity for hydropower development. However, Bhutan is prone to earthquakes and landslides; therefore planning of hydropower development and other infrastructure must involve essential consideration in this regard.

Small hydropower sector overview and potential
Bhutan has set its small hydropower standard as 25 MW. There are 21 operational small/mini hydropower plants (up to 10 MW) at the moment (figure 2). These small hydropower plants, totalling an installed capacity of 8.8 MW, generated 25.58 GWh of electricity in 2010. All small hydropower plants are under the public sector and there is no private sector participation, although it is encouraged.

Table 2
Operational small hydropower plants in Bhutan

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Number of plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 1 MW</td>
<td>3</td>
</tr>
<tr>
<td>&gt; 100 kW &lt;= 1 MW</td>
<td>9</td>
</tr>
<tr>
<td>&lt;= 100 kW</td>
<td>9</td>
</tr>
<tr>
<td>Total plants</td>
<td>21</td>
</tr>
</tbody>
</table>

Figure 1 Electric power generation in Bhutan
Source: Druk Green Power Corporation Limited³
Two proposed small hydropower plants, Begana (12 MW) and Druk Bindu (13 MW), can be identified as per Power Transmission Infrastructure Map, prepared by Engineering, Design and Contracts Department, Bhutan Power Corporation in July 2008.

Renewable energy policy
The Renewable Energy Policy draft was submitted to Gross National Happiness Commission (The Planning Commission of Royal Government of Bhutan) in April 2011. Gross National Happiness (GNH) has been the country’s development philosophy. It affects the country’s Renewable Energy Policy that is also, based on the promotion of sustainable development, preservation of cultural values, conservation of natural environment and establishment of good governance. This policy would cover solar power, wind power, bio-energy, geothermal, micro/mini/small hydropower and waste-to-energy renewable energy sources. Objectives of this policy are to:

- Initiate exploration and development of renewable energy sources;
- Institutionalize development of national and local capabilities for enhanced use of RE sources;
- Promote efficient and cost effective based commercial application by providing fiscal and non-fiscal incentives;
- Mobilize funds and attract private investment;
- Contribute to socio-economic development;
- Enhance energy security;
- Establish institutional framework to promote renewable energy (includes setting up a Department of New and Renewable Energy under the Ministry of Economic Affairs, as a nodal agency).

However, the date of implementation of Renewable Energy Policy 2011 depends on its time of approval, after which all projects awarded in the renewable energy category will be governed by this policy.

As hydropower development is a major driver of economic growth, it finds a prime focus in the government’s 5 year plan. Bhutan has no specific small hydropower policy but it’s Economic and Hydropower related policies well complement its development. The policy initiatives supporting hydropower development in Bhutan include Bhutan Sustainable Hydropower Development Policy 2008 and Economic Development Policy 2010.

The Sustainable Hydropower Development Policy 2008 has been introduced to attract public, private and foreign investment, to ensure development of hydropower resources in accordance with sustainable development policy of the Government, to contribute towards development of clean energy, to contribute to socio-economic development and thereby to enhance revenue contribution to the Government.

According to Economic Development Policy 2010, energy is the main driver of Bhutan’s economy. It puts strong focus on hydropower’s ability to boost sustainable and equitable socio-economic development, and on environmental conservation. It aims to support the government to achieve 10,000 MW target by 2020 by promoting construction of projects and interlinking transmission grids to ensure energy security and reliability.

Another policy under formulation in support of hydropower includes Captive Power Generation Policy under which industries shall be permitted to develop hydropower plants for industrial consumption. Bhutan truly has several forms of policy in support of hydropower, and pays strict adherence to environment conservation making hydropower as a long term sustainable development strategy.

Barriers to small hydropower development
Several barriers exist to small hydropower development. Market related barriers include the power system that is not yet competitive and the lack of private sector participation. Due to terrain and topographic conditions, providing electricity to remote rural household and institutions through grid extensions is not always economically possible. Furthermore conservative environmental laws apply. In addition to its challenging terrain, Bhutan is located in Himalayan Hindu-Kush region widely considered a region of unmatched biodiversity with Bhutan having several bird areas and protected areas. Attentive measures are therefore required to develop hydropower sites.

For mini hydro, difficulties are exacerbated by the costs of developing suitable sites, the absence of technical support and assistance for operation and maintenance, the large variations in water flows between the dry and wet seasons, and the very low electricity demand by households.

References