SUSTAINABLE
ENERGY FOR ALL

Rapid Assessment Gap Analysis
Bhutan

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Bhutan:
Rapid Assessment and Gap Analysis

[Final Report]

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Section I: Introduction

1.1 COUNTRY OVERVIEW

Bhutan is a democratic country with a constitutional monarchy form of government. The government has promoted the Gross National Happiness (GNH) in the country whose four pillars are (a) Equitable socio-economic development, (b) Preservation and promotion of cultural and spiritual heritage, (c) Conservation of the environment and (d) Good governance . The country has introduced decentralization and local governance to empower people and ensuring equitable and sustainable socio-economic development.

Geography and Population[1]

The Kingdom of Bhutan is a land locked country in the eastern Himalayas strategically bordered between the Republic of India and the People's Republic of China. The country has a total land area of about 38,394 km^2, and the population of country is estimated to be about 716,896. The birth rate in Bhutan is relatively low compared to most countries and the population growth rate is estimated to be about 1.175%. The capital of the country, Thimphu, has a population of about 89,000 (2009 estimates). The life expectancy of its population is 67.88 years and the country spends about 5.5% of its GDP on health. The literacy rate is about 47% and the country spends 4.8% of its GDP on education. Bhutan is a mostly mountainous country and has extreme elevations ranging from 97m in some valleys to about 7,570m in the high mountain ranges. Due to the mountainous terrain, only about 2.3% of the land area is arable of which less than 1% of the land is used for crop growing.

Bhutan's Economy

Bhutan has a GDP of $1.488 billion (and PPP GDP of $4.342 billion, 2011), and its economy grew by about 5.9% in 2011, which was lower than the over 10% growth in 2010[2]. The average annual growth rate over the period 2008-2010 was 6.1%. The country's economy is based largely on agriculture and forestry, and now increasingly on hydropower exports to India. Agriculture accounts for nearly 17% of the GDP and sustains 60% of the workforce, industry accounts for some 45% of the GDP, and the services sector accounts for the remaining 38% of the country's GDP[3]. The unemployment rate in the country has been steadily decreasing from an estimated 4% in 2009[4] to 3.1% in 2011 and 2.1% in 2012, and youth unemployment has also reduced from 9.2% in 2011 to 7.3% in 2012[5]. The government budget runs a deficit (2.19% in 2010-11)[6], and the country depends on India to finance part of its expenditures, and its currency, the Ngultrum, is pegged to the Indian Rupee. The country's debt has also been rising and was about 64% of the GDP in 2010-11, and the inflation rate is estimated to be about 7%[7].

Despite the progress made to improve human development and the relatively low unemployment rate, the UNDP has estimated that about 23% of the population is below the poverty line. The government targets to reduce poverty to 15% by the Five-Year Plan ending 2013[8].

Several new hydropower projects are planned and four large projects are under construction to generate 10,000 MW by 2020. The revenues from power exports are expected to sustain economic growth in the coming years. The economy is closely aligned with India's through strong trade and monetary links. Bhutan strongly protects its national heritage, culture and environment, and the government closely controls

[1] The data quoted in this paragraph is from the CIA Fact book for Bhutan. https://www.cia.gov/library/publications/the-world-factbook/geos/bt.html
[2] ibid
[3] ibid
[4] ibid
[5] Ministry Of Labour And Human Resources, Annual Report (Fiscal Year 2011-12)
[6] Annual Financial Statements Of The Royal Government Of Bhutan For The Year Ended 30 June 2011, Department Of Public Accounts Ministry Of Finance
[7] ibid
[8] 10th Five Year Plan 2008-13, Gross National Happiness Commission, RGoB

foreign direct investments in the economy including in the fast growing hydropower sector. Besides electricity, Bhutan exports several other commodities including ferrosilicon, cement, calcium carbide, copper wire, manganese, and vegetable oil. Commodities imported into the country include fuel and lubricants, passenger cars, machinery and parts, fabrics, and rice.

1.2 ENERGY SITUATION

Energy Supply and Demand

Bhutan meets its energy needs primarily from renewable energy sources with firewood and hydropower accounting for the largest share of energy use in the economy. The potential for hydropower in Bhutan is estimated to be around 30,000 MW of which around 23,760 MW is estimated to be techno-economically feasible for development[9]. Bhutan also has good potential for other renewable energy sources, primarily solar energy, wind energy and municipal solid waste, these have not yet been tapped with the exception of some solar installations.

The most recent Bhutan Energy Data Directory provides data for the year 2005 and indicates that total primary energy use was 402,102 toe, and per capita energy consumption was 0.63 toe[10]. More recent estimates indicate that primary energy use in 2009 may have tripled to about 1.3 million toe[11] with a proportionate increase in the per capita consumption, which is a very significant increase. According to the Energy Data Directory, in 2005, firewood accounted for 57.7% of total primary energy and electricity accounted for 15.9%. Diesel at 11.5% and coal at 6.8% were the next most used primary fuels, and other energy forms such as petrol, LPG, and kerosene, aviation fuel, etc., make up the rest. The Bhutan Energy Data Directory has not been updated since its last publication and more recent studies of the proportional mix of primary fuels use in the economy are not readily available. The fuel use mix however is unlikely to have changed much since Bhutan continues to be dependent on firewood and hydropower, though diesel use for transport has been steadily increasing.

Again, based on 2005 data, the residential sector is the highest energy-consuming sector in Bhutan, accounting for 48.7% of the total energy consumption, and about 91% of household energy demand is met by biomass with electricity, LPG and kerosene making up the rest. The industrial sector accounts for 25% of the total energy and is the largest consumer of electricity in the country, and the commercial and institutional sector (shops, hotels, monasteries, government offices, schools, hospitals, etc.) accounted for 10.2% of total energy consumption. The transport sector accounts for 14.3% of the total energy consumption[12].

Bhutan's power sector is predominantly dependent on hydropower plants, and the country has a total installed capacity of 1,488.12 MW[13]. The electric utilities also have installed diesel generator sets with a total capacity of 10.73 MVA[14]. The two major power utility companies in Bhutan are the Druk Green Power Corporation Limited (DGPC), and the Bhutan Power Corporation (BPC). DGPC owns and operates the large hydro power plants in the country, and the BPC owns and operated plants below 5 MW, which include the mini and micro-hydro and diesel power plants. BPC also manages the transmission and distribution system and the retails electricity to customers in the country.

In 2011 BPC generated 21.30 GWh from mini and micro hydro and diesel plants, purchased 1,689.22 GWh of electricity from DGPC, and imported 3.41 GWh from India[15]. BPC also wheeled 5,273.1 GWh of electricity export to India on behalf of DGPC. Domestic demand for electricity has been steadily growing over the years and is presently about 276 MW. The customer base has been growing steadily as additional

[9] DGPC Annual Report 2010
[10] Bhutan Energy Data Directory, 2005, Department of Energy, Ministry of Trade and Industry, Bhutan, TERI, New Delhi
[11] United States Energy Information Agency, http://www.eia.gov/countries/country-data.cfm?fips=BT, accessed on July 4, 2012
[12] ibid, 15
[13] DGPC and BPC data
[14] ibid
[15] Power Data Book, 2001, Bhutan Power Corporation Limited

rural customers are connected to the grid, and in 2011, BPC served 116,354 customers. Total electricity sales in the country to various customer categories was 1,619.95 GWh, which was 3.6% higher than the previous year. Electricity sales and number of customers by customer category and their proportion to the total is provided in Tables 1 and 2 below[16].

Table 1: Electricity Sales by Customer Category, 2011

Customer Category	GWh	%
Domestic, Rural	65.04	22.94
Domestic, Urban	95.09	33.54
Commercial	43.44	15.32
Industrial	10.18	3.59
Agricultural	1.55	0.55
Institutions	46.44	16.38
Street Lighting	2.59	0.91
Powerhouse auxiliaries	1.06	0.37
Temporary connections	18.16	6.40
Sub-Total, LV, non-bulk	**283.55**	**100%**
LV Bulk	56.21	4.21
MV Industries	109.54	8.20
HV Industries	1,170.64	87.60
Sub-Total bulk LV, MV, HV	**1,336.39**	**100%**
Total Electricity Sales	**1,619.95**	

Table 2: Electricity Customers by Category, 2011

Customer Category	Customers, #	%
Domestic, Rural	61,372	53.05
Domestic, Urban	31,492	27.22
Commercial	8,428	7.29
Industrial	1,701	1.47
Agricultural	664	0.57
Institutions	8,343	7.21
Street Lighting	254	0.22
Powerhouse auxiliaries	22	0.02
Temporary connections	3,413	2.95
Sub-Total, LV	**115,689**	**100%**
LV Bulk	604	90.83
MV Industries	46	6.82
HV Industries	15	2.26
Total Customers	**116,354**	

Energy & Economic Development

Hydropower is a major resource, which contributes significantly to Bhutan's economy contributing about 17.6%[17] of the country's GDP and about 45% of the national revenue in 2010[18]. And given the vast

[16] ibid

[17] The contribution of the electricity sector was higher at 19.3% of GDP in 2009.

[18] Climate Summit for a Living Himalaya, Bhutan 2011, National Road Map for Energy Security, 2012-2021

potential for further development of hydropower, Bhutan's economy could significantly benefit by exploiting this potential and exporting power to India. But developing the energy sector to its full potential requires vast expenditures, which is beyond the capacity of the government and requires private sector participation. Government allocated expenditures on energy in financial year 2012-13 is Nu. 733.97 m, which is just 2 percent of overall planned government expenditures[19]. The planned expenditure is primarily towards expanding rural electrification to meet the government's target of providing energy access to all by 2013 and for conducting studies on various hydropower projects totalling 10,000 MW planned for completion by 2020. The country also subsidises electricity for low and medium voltage customers and other fuels. Electricity supplies are heavily subsidized and subsidies totalling Nu. 1066 m will be required in 2012/13[20]. Diesel and petrol constitute the largest imports for the country, which impacts the already poor balance of payment situation, which is about 21% of GDP[21].

Energy Security

Bhutan has vast hydropower resources and will continue to depend on it to meet the country electricity needs and earn revenues from export of power. Given that the country has no other major energy resource, barring some coal, the country will also continue to import fuels such as petrol, diesel, LPG, kerosene and aviation turbine fuel for transport and other sectors of the economy. However, given the possible long-term impacts of climate change on water flows, vegetation, and forestry, the country needs to develop mitigation and adaptation programs to diversify its fuel mix and improve energy security. Use of energy resources such as solar, wind, waste-to-energy, and biomass and biogas systems could help diversify the fuel mix and also help Bhutan in its quest to become a net zero carbon emissions economy.

Energy Sector Strategy

Bhutan's energy development strategy is to tap its vast hydropower resources and develop additional renewable energy resources. Bhutan's techno-economically feasible hydropower potential of 23,765 MW could generate an estimated mean annual energy generation of about 99,159 GWh[22] which is over 60 times current consumption and can be used to further expand the economy and significantly increase revenues from electricity exports. Bhutan has targeted to develop 10,000 MW of additional hydropower capacity by 2020. To evacuate this additional power and to further develop hydropower plants to meet domestic needs and export power to India, Bhutan has developed a master plan to expand the transmission network.

It is estimated that some 90% of the household energy needs of the country are met from forest biomass. Developing additional hydropower and other renewable energy resources will lower the dependency on biomass and help meet Bhutan's constitutional mandate to maintain 60% of the country under forest cover to preserve its environment. The country also has significant potential to develop solar and wind energy projects, and plans to develop about 20 MW of generation capacity from various renewable energy sources by 2020-25.

The potential for biogas projects in rural areas is also being explored and a study conducted in 2009 by SNV of Netherlands has estimated that about 16,000 biogas plants could be cost effectively installed in the country. The potential to generate power from urban waste is also being examined, and estimates based on 2005 data indicate that about 3.4 MW of electricity could be generated from waste-to-energy systems.

Energy Access

The RGoB recognizes the importance of access to energy to meet basic energy needs and to support income generation activities to spur the rural economy, and has made rapid strides in increasing energy access. In 2009 energy access was about 65% and the government in its Vision 2020 had planned to expand electricity access to all by 2020, a target, which was later revised to 2017 and then further advanced to be met by 2013. As of June 2012, about 82.5% of households have been connected to grid and off-grid

[19] National Budget For The Financial Year 2012-13, Ministry of Finance, June 2012
[20] Bhutan Electricity Authority, Annual Report, 2010-11
[21] ibid, 24
[22] ibid, 23

systems, and the country is well on its way to achieving its target of universal electricity access by 2013. It is expected that roughly about 4,000 households in very remote locations will remain unconnected to the power grid. This is a significant undertaking, which requires the rapid expansion of rural electrification schemes, and the country is well on its way to achieving this target. While Bhutan will achieve universal electricity access, households will continue to depend on fuel wood to meet cooking and heating energy needs.

The RGoB recognizes that better access to energy services for rural communities can greatly help improve quality of life and create income generation opportunities, which fits well with the RGoB's plan to eradicate rural poverty and promote sustainable use of resources.

Section 2: Current situation with regard to SE4ALL goals

2.1 ENERGY ACCESS vis-à-vis GOAL OF SE4ALL

Bhutan stands out among other South Asian countries in provision on energy services to its population. While it is true that Bhutan has amongst the highest per capita consumption of firewood in the world and biomass accounts for about 90% of its household energy use, the country is making rapid efforts to tap its very significant hydropower potential and is well on its way to providing universal electricity access by 2013, which is well in advance of the SE4ALL goal to provide universal access to modern energy by 2030. Bhutan however needs to make efforts to provide modern energy for other applications such as cooking and heating, which are predominantly dependent on firewood especially in rural areas. Bhutan also meets its electricity demand largely from renewable small and large hydropower plants. The country has however been slow on using other renewable energy resources such as solar and wind, and plans to tap these resources to diversify its energy mix and improve energy security. Bhutan has not made significant efforts to improve energy efficiency (EE) in all sectors of its economy, and this is an area where it can make considerable progress through appropriate EE programs.

Modern Energy for Thermal Applications

According to a living standards survey conducted in 2007, the residential sector in Bhutan consumes about 49% of the total primary energy consumed in the economy, and firewood and biomass accounts for over 90% of this energy demand[23]. The share of electricity, LPG and kerosene, together is less than 10%. About 69% of households use electricity for lighting and 25% use kerosene lamps, though almost the entire urban population uses electricity and kerosene lighting is mainly used in rural areas. Energy use in the residential sector for thermal applications varies significantly in urban and rural areas. While some 72% of urban households depend largely on electricity and LPG for cooking and heating, over 80% of rural households, where 70% of the population resides, are largely dependent traditional fuels such as firewood and kerosene. According to the same survey, about 41% of households use wood for cooking, 34% use electricity and the remaining 25% use LPG as the main source for cooking. Not surprisingly, urban households predominantly use electricity or LPG for cooking and some 60% of rural households depend on firewood for cooking with the remaining using electricity and LPG. The survey estimated that some 44% of households in Bhutan do not have space heating in their dwellings, and houses with space heating rely on electricity in urban areas and traditional wood stoves in rural areas.

It is expected that even as Bhutan moves towards meeting its target of providing 100% electricity access to it population by 2013, rural populations may continue to be primarily dependent on firewood and kerosene for cooking and heating needs. Shifting energy use among rural populations to modern fuels such as LPG and electricity for all applications may not be readily possible given the cost differential between traditional and modern fuels. Also, given that Bhutan has no fossil fuel resources of its own, apart from some coal resources, the country will have to import additional fossil fuel which will further aggravate the already lopsided balance of payment situation and be an additional drain on expenditures given that these fuels are subsidized by the RGoB. Moreover, Bhutan will need to establish a supply chain to deliver modern fuels to remote rural areas, which may not be economical given the low population density and likely low level of fuel consumption in rural areas.

Households in rural Bhutan generally use traditional stoves with low efficiency and while smokeless stoves were introduced in the mid-eighties, the program was not successful since the new cook stoves did not meet the needs of traditional cooking. It may thus be more appropriate to improve the efficiency of use of traditional fuels through better designed improved cook stoves, space heaters and efficient household or community level biomass and biogas energy systems.

Electricity Access

[23] Bhutan Living Standard Survey, Bhutan Statistics Bureau, 2007

Bhutan has a total of 116,354 electricity customers, of which about 80% are residential customers; 27% in urban areas and 53% in rural areas[24]. As of June 2012, about 82.5% of all households have been provided electricity access with practically all urban households connected to the grid. As per the RGoB plan, the country plans to connect the remaining unconnected households, all in rural areas, to the grid by 2013. It is expected that roughly about 4,000 households in very remote locations will remain unconnected to the power grid[25]. Commercial and institutional customers constitute about 15% of the customer base and the industrial sector accounts for under 2% of customers.

Power Quality

The Bhutan electricity system is entirely dependent on hydropower plants whose output varies with water flows in the river. While Bhutan is a net exporter of power it has to import power from India to meet demand especially in winter months when river flows are low.

The BPC, which is responsible for power transmission, distribution and retail sales, has been successful in managing the power system despite the growth in the customer base and increased electricity demand, and has maintained fairly system reliability with a SAIFI[26] of 2.43 interruptions per customer per year and SAIDI[27] of 4.44 hours of interruption per customer per year in 2011, which is a improvement on the previous year. BPC maintains a large number of customer service centers, which it has been increasing to keep pace with increased demand and customers. According to BPC, an independent survey has indicated that 98.5% of its customers are satisfied with the service provided by the utility.

Electricity Tariffs

The Bhutan Electricity Authority (BEA) is the independent electricity regulator in the country and approves DGPC and BPC tariffs based on tariff applications made by the utilities. The current tariff structure is as follows.

The DGPC gets a tariff of 1.20 Nu/kWh for generated power and 0.13 Nu/kWh for Royalty power. BPC retail tariffs are as shown below.

[24] BPC Annual Report, 2011

[25] Discussions with BPC, held on June 12, 2012

[26] SAIFI - System Average Interruption Frequency Index is a commonly used reliability indicator by electric power utilities. SAIFI is the average number of interruptions that a customer would experience, BPC Annual Report, 2011

[27] SAIDI - System Average Interruption Duration Index is a commonly used reliability indicator by electric power utilities. SAIDI is the average outage duration for each customer served, BPC Annual Report, 2011

Tariff		1st August 2010 to 30th June 2011	1st July 2011 to 30th June 2012	1st July 2012 to 30th June 2013
Wheeling(Nu/kWh)		.111	.111	.111
Low Voltage				
Block	kWh/month	Energy Charges(Nu/kWh)		
I	0-100	0.85	0.85	0.85
II	101-300	1.47	1.54	1.62
III	Above 300	1.94	2.04	2.14
Low Bulk Voltage		1.94	2.04	2.14
Medium Voltage(6.6kV/11kV/33kV)				
Energy Charges(Nu/kWh)		1.63	1.71	1.79
Demand Charges(Nu/kW/month)		95	105	115
High Voltage(66kV and above)				
Energy Charges(Nu/kWh)		1.51	1.54	1.54
Demand Charges(Nu/kW/month)		85	105	105

Source: BEA

All categories of tariff are subsidized by the RGoB and the retail tariff schedule in the Table above reflects the subsidized tariff payable by customers. In 2011/12, the total subsidy amounts to about Nu 1,066m.

According to a survey conducted by the Bureau of Statistics, household expenditure on monthly energy costs is quite low and is under 3% for both urban and rural households, which may be due to the fact that traditional fuels are priced low and Bhutan subsidizes electricity and other fuels to the residential sector.

Energy for Productive Uses

Bhutan has accelerated the time frame to achieve universal access to electricity and to make modern energy available to the entire population to not only meet basic energy needs but also to spur economic activity and income generation opportunities in rural areas. Bhutan's approach of extending the rural electrification grid to connect all households as opposed to off-grid household electrification solutions has the potential to promote greater economic activity, and this is in fact one of the objective of the expanded and accelerated grid expansion program.

The industrial sector is however the largest consumer of energy for productive use in Bhutan and the sector's electricity use accounts for some 80% of all electricity consumption[28]. The industrial sector is also a major consumer of coal in the country. Due to the low domestic production of coal (supplemented by imports) the industrial sector also consumes firewood to meet its energy demand. The shift from firewood and other biomass fuels to modern fuels such as LPG and coal in thermal applications in the industrial sector would depend on the specific application and the cost differential between traditional and modern fuels.

The commercial and institutional sectors (tourism, commercial establishments such as offices, hotels, shops and restaurants), and bulk energy consumers like defence establishments also use energy for productive use and account for about 9% of electricity consumption in the country. The commercial sector is also a major consumer of firewood, kerosene and LPG. Displacing firewood use in the commercial sector would

[28] BPC data

depend on the end use for which these fuels are used and the cost differential between traditional and modern fuels.

It is however important to note that the growth of local enterprise and economic activity hinges not only on the availability of energy but also on a host of other enabling factors such as favourable policies, access to knowhow, access to capital, cost of capital, adequate supply chains and necessary infrastructure, consumer capacity to pay, capacity building and trained human resources, etc., which are all necessary to incubate income generation activities. Thus the mere provision of modern energy may by itself not spur economic growth, but the availability of commercial energy makes it possible to fuel business activities.

2.2 ENERGY EFFICIENCY vis-à-vis GOAL OF SE4ALL

Bhutan is at an early stage of economic development and its energy intensity is likely to be closely linked to GDP growth for the next several years. The energy intensity of the Bhutanese economy is very high and is roughly over 36,000 BTUs/$ of GDP[29], which is higher than the energy intensity in most Asian countries, and about four times that of the US and about seven times the energy intensity in Japan. It would thus appear that there is significant potential to improve efficiency of energy use in the country. No detailed studies of the potential for EE in the country have been undertaken so far, and it is thus difficult to identify specific actions to be taken to improve EE in the economy.

Bhutan does not have any Acts or Laws that address energy efficiency, and given the relatively low energy costs, customers have little incentive to implement EE. Since Bhutan has abundant hydropower, the utilities have not given EE the attention it deserves. An earlier program at the BPC to foster EE through 50% subsidy for CFLs and awareness campaigns is now no longer being promoted by the utility.

The RGoB however recognizes the need to promote energy conservation and efficiency improvement measures to enhance energy security in the country, and plans to develop an EE Policy for inclusion in the 11th Plan (2013-18). While no specific actions have been taken, a study conducted under USAID's SARI program[30] had examined the potential for an EE Standards and Labelling program and the study estimated that the use of efficient fluorescent lamps, rice cookers and refrigerators, complemented by a public awareness campaign to promote efficient appliances could potentially save 5 - 8 MW electricity peak demand over a 5-year period. The potential for EE in other sectors of the economy has not yet been examined. The UNDP has recently issued a tender to conduct a study to examine the potential for EE in various sectors of the Bhutanese economy.

2.3 RENEWABLE ENERGY vis-à-vis GOAL OF SE4ALL

Electricity generation in Bhutan is almost entirely from hydropower plants, with some limited diesel generation. The installed capacity includes about 8 MW of grid connected mini and micro hydropower plants. Given the abundance of relatively low cost hydropower, subsidized tariffs, and the relatively high cost of RE technologies such as solar and wind energy systems, it is challenging to promote RE in Bhutan. Despite these challenges, there are compelling reasons to promote RE in the country. Bhutan is presently a net carbon sink, but this is likely to change over the long term as the country develops and expands its economy. In response to concerns about climate change, the country declared its intention to remain carbon neutral for all time to come and a net sink for GHG emissions[31]. Meeting this goal will require the country to take adaptation and mitigation actions including offsetting some fossil fuel and firewood use in the economy. Increased use of RE will help meet these objectives and increase energy security and reduce the country's dependence on variable hydropower and imported fossil fuels.

[29] This is a rough estimate based on available data on primary energy use in 2009.
[30] Concept Paper: Energy Efficiency Standards & Labelling for Appliances, Bhutan, South Asia Regional Initiative on Energy, Nexant Inc., 2003
[31] The RGoB made this declaration at the 15th session of the Conference of Parties (COP15) of the UNFCCC held in Copenhagen in 2009.

Bhutan has prepared a draft Renewable Energy Policy to foster RE projects in the country and utilize and develop indigenous, local and dispersed clean energy sources as a long-term strategy for the sustainable and enhanced socio-economic development of the country. The draft RE policy promotes stand-alone systems, distributed generation systems, grid-connected RE systems, and fossil fuel substitution programs. In rural areas, the draft policy promotes use of modern energy sources to replace the use of firewood and kerosene for cooking, lighting and heating, and encourages community-based initiatives and distributed generation. In urban areas, the policy promotes the conservation of grid-based power and increased use of RE technologies such as solar heaters, solar rooftop and other stand- alone systems.

Bhutan intends to develop a RE roadmap for each of the RE technologies by mapping capacity, generation potential and cost of generation by location across the Kingdom, and to develop appropriate tariffs to incentivize private sector participation in the development of RE resources. Developing the RE sector will also require building the capacity of stakeholders and strengthening the regulatory framework for RE.

2.4 SE4ALL GOALS

Energy Access

Bhutan has an aggressive target to expand electricity access to its entire population. Earlier plans to provided electricity access to all by 2020 was first advanced to 2017, and advanced again to 2013. As of June 2012, about 82.5% of all households have been provided electricity access with practically all urban households connected to the grid. As per the RGoB plan, the country plans to connect the remaining unconnected households, all in rural areas, to the grid by 2013. Connection to the national grid will make electricity available to meet basic energy needs and for productive energy use. Roughly about 4,000 households in very remote locations will remain unconnected to the power grid and will be supplied energy through solar PV systems – the 10th Plan has budgeted installation of PV systems at 3,582 households[32].

While Bhutan will have achieved its goal of providing electricity access to all by 2013, well in advance of the SE4ALL target of 2030, a vast majority of its rural population may continue to depend on firewood for cooking and heating. Given the cost differential between the price of modern fuels and firewood, a shift to modern cooking fuels such as LPG will only take place as the economy grows and the purchasing power of the rural population increases.

Energy Efficiency

Bhutan does not have any Acts or Laws that address energy efficiency, and given the relatively low energy costs, customers have little incentive to implement EE. RGoB recognizes that EE can play an important role in reduce the energy intensity of the country, reduce energy imports and improve the balance of payment situation, and improve energy security. The country thus plans to introduce an EE Policy in the 11th Plan (2013-18), to promote greater EE in all sectors of the economy.

No detailed studies of the potential for EE in the country have been undertaken so far, and it is thus difficult to identify specific actions to be taken to improve EE in the economy. Earlier studies on EE Standards and Labelling Program estimated that the use of efficient fluorescent lamps, rice cookers and refrigerators, complemented by a public awareness campaign to promote efficient appliances could potentially save 5 - 8 MW electricity peak demand over a 5-year period. UNDP estimates that buildings in Bhutan use twice the energy for half the size compared to Nordic countries mainly due to poor insulation levels.

The UNDP has recently issued a tender to conduct a study to examine the potential for EE in various sectors of the Bhutanese economy. The study will form the basis for the formulation of an EE Policy. The baseline study will include four potential sectors: Transport, to examine reduction of fossil fuel dependency; Buildings, to examine opportunities for improved insulation levels, lighting, cooking and heating requirements; Industry, to examine opportunities for improved processes and technologies; and

[32] 10th Five Year Plan 2008-2013, Volume 1: Main Document, Gross National Happiness Commission, RGoB

Agriculture, to examine opportunities for appropriate and new methods of agriculture activities. The baseline study will identify the potential for EE, quantify the costs and benefits, and recommend policy and regulatory requirements and implementation strategies for each sectors.

The completion of the UNDP study will provide Bhutan with a basis for formulating an EE policy, and it is very likely that Bhutan will ramp up efforts to implement EE over the next plan period ending 2018.

Renewable Energy

Bhutan meets it electricity needs primarily from hydropower plants, which includes about 8 MW of mini and micro hydropower plants. The country plans to add an additional 10,000 MW of hydropower capacity by 2020, which will primarily be for exports but will also help Bhutan meets its demand in Winter months when generation from hydropower drops by about 80% due to reduced water flow in rivers. Given its vast hydropower potential and subsidized energy price, the country has not made significant efforts to promote small-scale RE projects, which are not always cost effective given Bhutan's situation. RGoB has however developed a draft RE Policy to promote RE and help the country meet its objectives of being a net carbon sink, reduce dependence on imported fuels, improve energy security, and be prepared to meet potential adverse environmental conditions which may impact the country's hydroelectric generation capacity. Bhutan intends to develop a RE roadmap for each of the RE technologies by mapping capacity, generation potential and cost of generation by location across the Kingdom, and to develop appropriate tariffs to incentivize private sector participation in the development of RE resources.

Bhutan targets to develop a total of about 20 MW of RE by 2020-25, with 5 MW capacity each from the electricity generated by solar, wind and biomass energy, and, remaining coming from biomass and solar thermal systems. This additional RE capacity will support both households energy use and energy for productive use which will potentially lower the demand on the grid and diversify energy supply. Bhutan has installed several solar PV systems and targets to electrify 3,582 households in remote rural areas who will not be connected to the electric grid, and the country plans to install 360 kW of pilot wind energy plants at 3 sites and is presently conducting site assessments. Bhutan has also applied for a GEF grant to support the preparation of a sustainable rural biomass scheme, which is expected to results in the installation of biomass plants and improved cook stoves.

The potential for using municipal solid waste (MSW) has not been explored in Bhutan and the UNDP is supporting a pilot project for a Public-Private Partnership in solid waste management. According to the UNDP[33], this pilot initiative "intends to improve service delivery of MSW management, create employment opportunities, and reduce environmental impacts of waste and their associated risks of pollution on human health through piloting of a pro-poor gender sensitive PPP model in MSW management focused on targeted urban communities within Thimphu Municipality." The project intends to create awareness amongst various stakeholders on concepts of the PPP model and strengthen their capacity through exposures to best practices and other regional experiences. This initiative will potentially provide opportunities for the private sector to participate in such energy projects and other non-state actors such as informal sector, CBOs, NGOs, etc. in service delivery, but also pave the way for greater importance and role for multiple perspectives and actors to determine the development outcomes within their locality.

[33] UNDP Bhutan website

Section 3: Challenges and opportunities for achieving SE4ALL goals

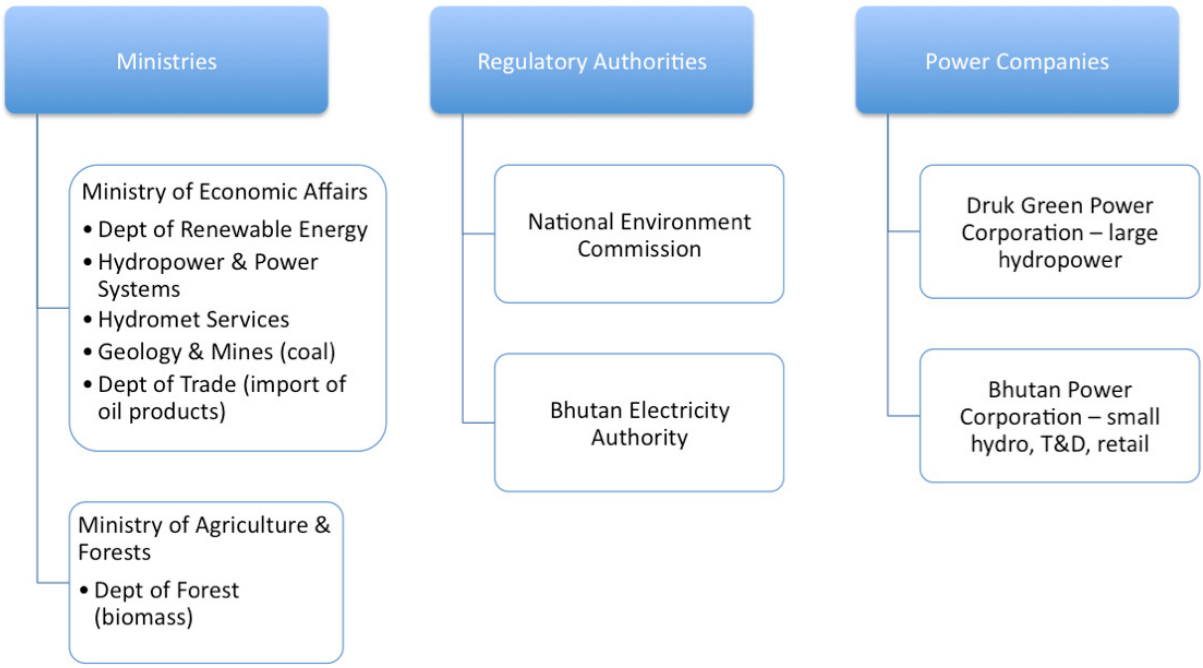
3.1 INSTITUTIONAL AND POLICY FRAMEWORK

Institutional Framework

The primary ministries and agencies involved with the energy sector in Bhutan are shown in the figure below. The principal RGoB administrator is the Ministry of Economic Affairs (MEA). Five departments under the Ministry overlook the energy sector – the Department of Renewable Energy (DRE), Department of Hydropower and Power Systems (HPPS), Department of Hydromet Services (HS), Department of Geology and Mines, and the Department of Trade. The DRE was only recently established and serves as the central coordination agency and the focal point for all matters related to development of renewable energy in the country. The department has three divisions, namely, (a) the Alternate Energy Division, which is the nodal agency for the development of all RE systems under 25 MW and implements the RE policies of the RGoB, (b) the Planning and Coordination Division, which undertakes policy and program planning for RE and EE, and (c) the Research and Development Division, which undertakes promotion of research and development of applied RE and Energy conservation. The Hydromet Services Department is responsible for hydrological and meteorological data gathering and also serves as the technical agency responsible for providing early warning of hydro-meteorological hazards. The Hydropower and Power Systems Department is responsible for power system planning. The Department of Geology and Mines is responsible for coal mining and minerals and the Department of Trade oversees the import of fossil fuels.

The two major power companies in Bhutan are the DGPC, which owns and manages the large hydropower plants, and the BPC, which owns and operates power plants under 25 MW and also operated the transmission and distribution system and retails electricity to customers. The BEA is the independent regulator with oversight over the power companies and electricity tariffs. The National Environment Commission (NEC) oversees all issues related to the environment in Bhutan including emissions from energy use in all sectors of the economy.

Figure: Primary Stakeholders in the Energy Sector



With regard to the SE4ALL goals of energy access, RE and EE, there are some other agencies with responsibilities in the energy sector. For instance, the Department of Forest is responsible for biomass use on the country and the Department of Livestock, also under the Ministry of Agriculture, is involved with biogas plants. Other agencies involved with energy use in the economy include the Department of Road Safety and Transport in the Ministry of Information and Communications, and the Department of Trade in the MEA.

The DRE with its three Divisions is the principal agency to broadly coordinate activities related to RE and EE in the country. In the electricity sector, the BPC is responsible for transmission and distribution of electrical energy and for EE implementation at the customer level, and other relevant agencies take the lead for biogas and biomass programs, and for activities in the transport sector. While the institutional responsibilities are clear, coordination, program planning, reporting and compliance will be challenging given the several ministries, departments, and companies involved with the energy sector.

Policy Framework

The principal laws, which govern or have an influence on the development of the energy sector in Bhutan are:

- Electricity Act of Bhutan, 2001
- Bhutan Sustainable Hydropower Development Policy, 2008
- Foreign Direct Investment Policy, 2010
- The Economic Development Policy of the Kingdom of Bhutan, 2010
- Bhutan Renewable Energy Policy, 2012 (DRAFT)

The Electricity Act of 2001 provides the framework for the institutional sector and governance of the electricity sector in Bhutan. Some of the provisions of the Act have been superseded by the creation of new institutions. The Hydropower Policy of 2008 provides the framework and guidelines for accelerated hydropower development in the country. The Policy allows the RGoB to develop hydropower projects with public, private or public-private-participation and in collaboration with government of development partner countries. The Foreign Direct Investment Policy also is supportive of private sector participation in the development of medium and large hydropower projects and other RE projects and provides incentives for foreign entities to invest in Bhutan's energy sector.

The Sustainable Hydro Power Development Policy 2008 and the Economic Development Policy (EDP) 2010 recognise the need to have Renewable Energy Policy for promotion of RE sources in order to ensure national energy security through a diversified energy mix. The Draft RE Policy of 2012 is an important document which elucidates the RGoB's objectives for developing the RE sector in the country and provides the policy framework to address key issues relating to the promotion of RE and public and private sector participation in the development of RE projects. The draft policy also addresses the issue of incentivizing RE given the low cost of large hydropower projects and the subsidized tariffs in Bhutan, which make small-scale RE generation unviable. However, this policy is still in draft form and it is not enforceable, which limits RE development (other than large hydropower plants). The lack on an enforceable RE policy provides no incentive to project developers to develop RE projects. The implementation of other RE projects such as solar, wind, biogas projects, and improved cook stove programs also suffer in due to the lack of clear policies, and the limited programs appear to be more driven by donor agencies than by RGoB agencies. The draft RE policy thus needs to be finalized and adopted to ensure the development all of indigenous, local and dispersed clean energy sources in the country.

Bhutan does not have an EE policy and its absence severely impedes the implementation of EE projects. The BPC is not required by the BEA to design and develop supply or demand-side EE programs, which coupled with the subsidized electricity tariffs, hinders the implementation of EE. There is thus an urgent need to develop and adopt a comprehensive EE policy to incentivize the public and private sector to implement EE projects. The UNDP is supporting the preparation of a study to examine the potential for

energy efficiency in the transport, buildings, industry and agriculture sectors, and it is expected that this study will provide the basis for the formulation of an EE policy.

It is evident that RE and EE policies are lacking and critical for promoting RE/EE development in the country. And, also there is a need for an "Energy Plus" approach in energy access and poverty reduction.

3.2 PROGRAMS AND FINANCING

Bhutan is undertaking a number of energy sector projects to add power generation capacity, expand energy access and implement RE systems. While a few programs are funded entirely by the RGoB, many other are co-funded by development partner countries and bilateral and multilateral agencies. The Governments of India, Austria and Norway are supporting several hydropower feasibility studies, the Indian Government also provides financing for hydropower plants, and ADB and JICA are supporting rural electrification projects in the country.

Apart from support for rural electrification projects, the ADB plans to support preparation of a Renewable Energy Master Plan and has provided other technical assistance support for capacity building in the energy sector.

The UNDP is supporting several initiative in the energy sector including support for a baseline study on EE potential in various sectors of Bhutan's economy, capacity development for addressing environmental challenges, piloting Public-Private Partnership in solid waste management within Thimphu Municipality, and studies to examine climate change induced risks from Glacial Lake Outburst Floods. The UNDP is also assisting Bhutan obtain a GEF grant to implement a biomass project.

The details of the on-going and planned programs are provided in Annex 1.

3.3 PRIVATE INVESTMENT AND ENABLING BUSINESS ENVIRONMENT

The energy sector in Bhutan has been principally developed by RGoB agencies with public funding and with additional support from development partner countries such as India, Netherlands, Norway, Austria, Japan and others, and multilateral agencies such as the ADB, UNDP and WB. The private sector has had a very limited role in the energy sector so far. The RGoB wishes to change this situation and promote and incentivize private sector to fully participate in energy projects, and its policies such as the Foreign Direct Investment Policy, the Hydropower Development Policy, and the draft Renewable Energy Policy are all supportive of greater private sector participation and investments in the energy sector.

RE Project Development

The draft RE Policy 2012, proposes that private sector can identify projects and submit them for approval to a Nodal Agency (Renewable Energy Department). However the draft policy disallows self-identified micro and mini (up to 1 MW) and small hydropower projects (up to 25 MW), and it is proposed that these projects would be identified and bid by the Nodal Agency. Mini/Micro hydropower plants constructed through the Government are to remain the property of the Government and management of the plant is to be transferred to communities. It is proposed that small hydropower project bids will be awarded on the basis of bids that offer the highest royalty.

The draft RE policy allows Joint Ventures, PPP, and Concession Agreements (CA). The draft policy also proposes that the BEA develop Feed-in-Tariffs for micro, mini and small hydropower projects. Tariffs for other RE projects would be based on competitive price bids.

As per the draft RE Policy, stand-alone RE systems based on various technologies (such as solar PV, small wind, solar home lighting system, solar lanterns, biogas plants, biomass, improved cook-stoves etc.), or a hybrid of RE technologies for the provision of decentralised energy for households and/or communities,

will be undertaken by the proposed Nodal Agency. The draft policy also proposes to allow communities, NGOs, and individuals to develop stand-alone RE projects.

It is proposed that micro, mini, and small hydropower projects are to be developed under the BOOT (Build-Own-Operate-Transfer) model[34], and other RE projects for electricity generation are to be developed under a BOO (Build, Own, Operate) model[35]. The private sector will be eligible to make investments in RE projects, but FDI is limited to 51% and is not allowed for micro, mini and small hydropower projects.

The policy proposes that the transmission utility will be required to provide access to power from RE projects, and Independent Power Producers (IPPs) be allowed to sell power to any consumer directly or to a distribution company. However, the local distribution utility would have the first right of refusal for purchase of power.

The draft RE policy proposes to establish a Renewable Energy Development Fund (REDF) to be managed by the Nodal Agency, which will help promote the development of the RE sector. The REDF would also be used to compensate distribution utilities for the difference between the feed-in-tariff and the average power purchase price, if the regulated utility is mandated to purchase RE power.

FDI in energy sector[36]

There are some limitations on foreign investors and ownership. FDI is allowed in renewable energy projects. However, in small hydropower projects up to 25 MW, FDI is allowed only as a minority shareholding and for micro and mini hydropower projects, FDI is not allowed.. Private investments in medium sized hydropower projects (defined as projects between 25 to 150 MW) require that a minimum of 26% equity is held by Bhutanese nationals and/or Bhutanese companies which are 100% owned by Bhutanese nationals (implying FDI of no more than 74%). The policy also limits single foreign investors to participating in no more than five Joint Ventures projects. Investments in large hydropower projects (150 to 1,000 MW) are however open for joint ventures with Bhutanese companies or eligible for 100% foreign direct investments. The equity participation by any single foreign investor is limited to three large projects with total installed capacity not exceeding 2,000 MW. The so-called mega hydropower projects (above 1,000 MW) are to be generally undertaken by the RGoB in collaboration with governments of development partner countries, but the policy does not preclude 100% foreign equity participation in such projects.

The hydropower policy of the country is also supportive of Public-Public-Partnership to develop hydropower projects, with the condition that the RGoB undertaking shall have a minimum of 51% shareholding in the Special Purpose Vehicle (SPV), which would own the project.

Fiscal Incentives[37]

RGoB policies provide several fiscal incentives to private sector investors in hydropower plants. For instance, private project developers are exempt from payment of corporate income tax for a period of ten years from the commercial operation date of the hydropower plant, which have been awarded on the basis of competitive bids. Project developers are also exempt from payment of all import duties and Bhutan sales taxes on import of plant and equipment during the construction period, and further, no sales tax or duties are to be levied on the export of electricity. Repatriation of capital and remittance of dividends will be allowed subject to the provisions in relevant RGoB laws governing foreign investments.

The draft RE policy proposes similar fiscal incentives for investments in RE projects. RE project developers are to be exempt from corporate or business income tax for a period of ten years from the date of commercial operation of the RE project. Projects developed in remote areas may be eligible for an additional five years tax holiday. RE project developer will also be exempt from payment of all import

[34] The projects are to be allotted to a developer for a concession period of 30 years, excluding the construction period.
[35] Such projects are to be allocated for a fixed economic life: wind - 20 years, biomass - 20 years and solar power project (PV and thermal) - 25 years, excluding the construction period
[36] Information based on the Foreign Direct Investment (FDI) Policy, 2010
[37] Information based on the FDI Policy and Hydropower Policy

duties and Bhutan sales tax on import of plants and equipment during the construction period, and sales tax and customs duty exemption shall be granted for purchase of spare parts for all RE projects. It is also proposed that investors in the manufacturing and integration of RE products in Bhutan will be exempt from income tax for a period of ten years.

Barriers to Private Investment

The commercial energy sector in Bhutan has principally been developed by the public sector with public financing and support from development partner countries and bilateral and multilateral agencies, and the country is only now opening up its energy sector to private sector participants and investors. Some of the barriers to private sector investment in energy access, RE and EE include the following:

Medium to Large Hydropower Projects:

Policies for medium to large hydropower projects: The Bhutan Sustainable Hydropower Development Policy of 2008 addresses development of hydropower projects over 25 MW and permits private sector participation in the development of such projects. The FDI Policy of 2010 specifies the conditions and limits for FDI in the energy sector and provides fiscal incentives with regard to corporate taxes, sales and imports duties, remittances, etc. These policies are however relatively recent. Moreover, the RGoB has adopted a target to develop 10,000 MW of hydropower projects by 2020 in cooperation with India, its key development partner country. This limits the scope for additional private sector involvement in the development of hydropower projects in the 25 MW+ capacity range.

Capacity of the Bhutan private sector to develop projects: The hydropower policy permits private sector investment including FDI in projects above 25 MW. However, at present, the private sector in Bhutan lacks the capacity and experience to develop hydropower projects. But as per the policy, Bhutanese companies could enter into joint ventures with foreign entities to develop medium to large hydropower projects. Such JVs could help build the capacity of local private sector to at least undertake technical advisory services for such large projects.

Capacity to finance projects: Developing hydropower project in the 25 MW+ range entails investments of over US$25-30m, which is presently beyond the capacity of the private sector in Bhutan. The local financial markets and financial institutions would also be unable to finance projects of this scale. The Bhutanese private sector could however develop partnerships with foreign firms and attract FDI to develop projects as per the provisions of the FDI Policy of 2010. As per the policy, FDI for projects in the range of 25-150 MW is limited to 74% with the rest to be held by Bhutanese entities. There are no FDI limits on projects in the 150-1,000 MW range. Projects above 1,000 MW are likely to be developed by the RGoB in cooperation with development partner countries. However, given the RGoB objective to develop 10,000 MW by 2020 in cooperation with India, somewhat limits the role of the private sector to participate in medium to large hydropower projects at least in the near term.

Infrastructure for project sites: Many of the potential hydropower projects identified in the master plan are in areas of Bhutan, which are not well connected by bridges and road links. The private sector is unlikely to make investments in hydropower projects in the absence of road and transmission access and other needed infrastructure at project sites.

Return on Investment: The retail tariffs in Bhutan are subsidized. The BEA as the independent regulator has been setting generation tariffs for power produced by the DGPC and BPC, which are both public entities, and also approving retail tariffs for BPC chargeable to customers. Public utilities like DGPC and BPC claim that they do not obtain a fair return on their assets. Private sector participants may be unwilling to make investments in the absence of clear policies on allowable returns to investors.

Micro, Mini, Small Hydropower & Other RE Technologies

Policies for micro, mini and small hydropower and other RE technologies: The draft RE Policy of 2012 addresses the development of hydropower projects below 25 MW and the development of other RE

systems including solar, wind, biogas, biomass systems, etc. However, this policy is still in draft form and is yet to be adopted. The policy should be finalized and adopted soon to promote private sector participation in smaller hydropower and other RE projects.

Capacity of the Bhutan private sector to develop projects: The draft RE policy permits private sector investment in hydropower projects and other RE technology projects. However the FDI policy of the country does not permit FDI in micro, mini and small hydropower projects though FDI is permitted in other non-hydro RE projects. At present, the private sector in Bhutan lacks the capacity and experience to develop small hydropower projects below 25 MW and has little experience with developing other RE projects. The private sector is capable of providing some engineering, construction and procurement (EPC) and consulting services, but there are no firms that could provide such services on a turnkey basis. The capacity of the private sector in Bhutan also needs to be strengthened to develop detailed project reports, business plans and implementation capacity.

Capacity to finance projects: The FDI policy does not permit FDI in micro and mini hydropower projects. However, for small hydropower projects, as per draft RE policy, FDI is allowed only as minority shareholding, which could be a barrier to private sector participation and investment in such projects since even a 1 MW project will likely require financing of over US$1.0m, which is currently beyond the capacity of local private sector investors. Even individual local financing institutions do not have the capacity to finance such scale of projects and would need a syndicate of banks.

Return on investment: The draft RE policy proposes that the BEA develop Feed-in-Tariffs for micro, mini and small hydropower projects, and tariffs for other RE projects would be based on competitive price bids. The policy also states that small hydropower projects (1-25 MW) would be awarded on the basis of bids that offer the highest royalty. The RE policy has however not yet been adopted, which creates uncertainty regarding the tariff mechanisms and returns on investment. The commercial bank lending rate of about 14.5% is very high and obtaining a reasonable return on investment would require very high tariffs.

Energy Efficiency Projects

Policies for EE: Bhutan has no policy for EE, which seriously impedes the implementation of EE projects in the country, and limits private sector participation in the provision of EE services. It is expected that an EE Policy will be formulated in the 11th Plan period (2013-18), which should help promote EE in the country.

Capacity of private sector to implement EE projects: The private sector in Bhutan has little experience with implementing EE services, but it has the management capacity to undertake such services when the market opportunity arises.

Capacity to finance projects: Given the relatively low cost of EE services, the private sector believes that financing EE projects would not be a hurdle.

Return on Investment: Given the subsidized retail tariffs customers have no incentive to implement EE, and the private sector is not likely to obtain a reasonable return by implementing EE services.

3.4 GAPS AND BARRIERS

Bhutan has utilized its vast hydropower resources to make significant improvements in electricity access and plans to achieve 100 percent electricity access by 2013. However, the use of firewood still dominates energy use in the residential sector, which consumes some 50 percent of primary energy use, and even the commercial and industrial sectors depend on firewood to meet some their energy demand. Thus while Bhutan may achieve 100 percent electricity access as per its target, much remains to be done to provide modern fuels to displace the use of firewood in the economy, which continues to be a fuel of choice for cooking and heating, especially in rural areas. Bhutan has not exploited the potential of utilizing other RE technologies such as solar, biomass, biogas, and wind energy systems to further improve provision of

modern energy to its population. The country also has the potential to implement EE which can reduce demand and improve the ability of the country to cost effectively meet energy demand.

The gaps and barriers to Bhutan's efforts to expand energy access, expand RE systems, and implement EE are discussed below.

Energy Access

Bhutan is well on its way to achieving its target of universal access by 2013. It is expected that roughly about 4,000 households in very remote locations will remain unconnected to the power grid, and will be supplied energy through solar PV systems. Bhutan's approach of extending the rural electrification grid to connect all households as opposed to off-grid household electrification solutions has the potential to promote greater economic activity, which is one of the objectives of the expanded and accelerated grid expansion program. While Bhutan will have achieved its goal of providing electricity access to all by 2013, well in advance of the SE4ALL target of 2030, a vast majority of its rural population will most likely continue to depend on firewood for cooking and heating. Given the cost differential between the price of modern fuels and firewood, a shift to modern cooking fuels such as LPG will only take place as the economy grows and the purchasing power of the rural population increases.

Policies for energy access: The RGoB's Vision 2020 had planned to expand electricity access to all by 2020, a target first revised to 2017, and then further advanced to 2013. However, the country does not have clear policy targets to address reduced use of fuel wood for cooking and heating.

Institutions and capacity: The BPC as the distribution utility has been charged with the mandate of expending the rural grid to meet energy access goals. The utility has demonstrated its ability to rapidly expand grid access and is well equipped to meet the target of 100 percent access by 2013. The Department of Renewable Energy coordinates rural electrification activities with BPC.

Developing Bhutan's vast hydropower potential, however, will require significant capacity building of its public and private agencies. Under the Accelerating Bhutan's Socio-economic Development initiatives, the Ministry has signed a Memorandum of Understanding with Indian firms to train young Bhutanese.

Financing: The RGoB has budgeted Nu 1,204.34 m for on-grid electrification, and Nu 14.51 m for providing solar PV systems for remote households who will not be connected to the grid[38]. The government has budgeted these amounts to meet the "electricity for all" target by June 2013.

Renewable Energy Systems

Bhutan presently meets it electricity needs primarily from hydropower plants with an installed capacity of about 1,488 MW, which includes about 8 MW of mini and micro hydropower plants. The country plans to add about 10,000 MW of hydropower by 2020. Bhutan's abundance of relatively low cost hydropower coupled with the relatively high cost of RE technologies and subsidized tariffs makes it challenging to promote RE in Bhutan. However, there are compelling reasons to promote RE in the country. Bhutan is presently a net carbon sink and the country has a stated goal to remain carbon neutral for all time to come and a net sink for GHG emissions. Meeting this goal will require the country to expand RE systems which will also help meet the objectives of improving energy security and reducing the country's dependence on variable hydropower and imported fossil fuels.

The lack of a national policy for development and utilization of renewable energy resources, inadequate institutional set up, ineffective implementation framework, lack of standardized technology, lack of access to funds, limited private sector involvement and inadequate training and capacity building at various levels are some of the constraints and barriers hindering the supply of RE systems.

Bhutan has developed a draft RE Policy with provisions and incentive to expand development of RE systems in the country, and has targeted to develop a total of about 20 MW of RE by 2020-25. Achieving these

[38] National Budget for the Financial Year 2012-13, Ministry of Finance, June 2012.

goals will require the RGoB to finalize and adopt this policy so it becomes effective and spurs the development of RE.

Policies for energy access: Bhutan has prepared a draft Renewable Energy Policy to foster RE projects in the country and utilize and develop indigenous, local and dispersed clean energy sources as a long-term strategy for the sustainable and enhanced socio-economic development of the country. The draft RE policy promotes stand-alone systems, distributed generation systems, grid-connected RE systems, and fossil fuel substitution programs. In rural areas, the draft policy promotes use of modern energy sources to replace the use of firewood and kerosene for cooking, lighting and heating, and encourages community-based initiatives and distributed generation. In urban areas, the policy promotes the conservation of grid-based power and increased use of RE technologies such as solar heaters, solar rooftop and other stand- alone systems. Bhutan intends to develop an RE roadmap for each of the RE technologies by mapping capacity, generation potential and cost of generation by location across the Kingdom, and to develop appropriate tariffs to incentivize private sector participation in the development of RE resources.

Bhutan targets to develop a total of about 20 MW of RE by 2020-25, with 5 MW capacity each from the electricity generated through solar , wind and biomass, and remaining coming from biomass and solar thermal systems.

Institutions and capacity: The Department of Renewable Energy in the Ministry of Economic Affairs is the principal agency which coordinates RE activities in the country. The Department coordinated activities with other public agencies including the BPC, DGPC, BEA, Environment Commission, and the Ministry of Agriculture and Forests. The DRE plans to develop a roadmap for each of the RE technologies by mapping capacity, generation potential and cost of generation by location across the Kingdom, and work with the BEA to develop appropriate tariffs to incentivize private sector participation in the development of RE resources. The DRE will need to augment its capacity and resources to meet the mandate envisioned in the draft RE Policy. While the country has installed a large number of solar PV systems, the institutions involved will need to strengthen their capacity and gain experience in promoting and developing other forms of RE technologies including wind energy systems, biomass and biogas systems, improved cook stoves, etc. The capacity of the private sector to implement RE systems and the capacity of the local financial institutions to finance RE systems also needs strengthening. The country would greatly benefit from a well-defined capacity development program, which develops the long-term capacity of its institutions and personnel to plan and develop RE programs.

Financing: No specific budget has been prepared for developing RE in the country. The target of developing a total of about 20 MW of RE systems by 2020-25 would suggest that financing needs are in the range of about US$30-40m.

Development partner countries and bilateral and multilateral agencies are supporting Bhutan in developing RE systems. The country has also applied for a GEF grant to support the preparation of a sustainable rural biomass scheme, which is expected to results in the installation of biomass plants and improved cook stoves.

Energy Efficiency

Bhutan is at an early stage of economic development and its energy intensity is very high. While it is likely that energy intensity will closely follow the GDP growth rate for the next several years, it would appear that there is significant potential to improve efficiency of energy use in the country. However, no detailed studies of the potential for EE in the country have been undertaken so far, and no EE specific programs have been developed. A study conducted by a USAID program on EE Standards and Labelling Program estimated that the use of efficient fluorescent lamps, rice cookers and refrigerators, complemented by a public awareness campaign to promote efficient appliances could potentially save 5 - 8 MW in peak demand over a 5-year period. The UNDP has recently tendered a study to assess the potential for EE. The study will examine the potential for EE in the transport, buildings, industry and agriculture sectors, and it is expected that this study will provide the basis for the formulation of an EE policy. Implementing EE would

make more electricity available for exports at a higher price, and this aspect should be considered in developing EE policies.

Since Bhutan has abundant and relatively low cost hydropower, the utilities have not given EE the attention it deserves. An earlier program at the BPC to foster EE through 50% subsidy for CFLs and awareness campaigns is now no longer being promoted by the utility.

Policies for EE: Bhutan does not have an EE policy, which seriously impedes the implementation of EE projects in the country. The BEA also does not require BPC to implement EE programs among its customers.

RGoB recognizes that EE can play an important role to reduce the energy intensity of the country, reduce energy imports and improve the balance of payment situation, and improve energy security. The country thus plans to introduce an EE Policy in the 11th Plan (2013-18), to promote greater EE in all sectors of the economy.

Institutions and Capacity: Given that there is no EE policy, no specific institution has primary responsibility for coordinating EE activities in the country. The BPC as the only distribution utility could undertake EE programs, but it is presently not required by the BEA to implement EE and BPC may not be interested as energy conservation will reduce its revenue from electricity sales. No agency is responsible for implementing EE to reduce use of other fuels including petroleum products, coal, and firewood. The private sector has to play a significant role in implementing EE and it has the engineering and management capacity to do so provided there were supportive policies.

Subsidized tariffs: Given the relatively low cost hydropower driven electricity supply and the subsidized retail tariffs for low voltage and medium voltage consumers, neither the utility nor the customers have any incentive to implement EE. The right price signals based on marginal costs of supplying power is needed to promote EE.

Financing: In the absence of an EE policy and in the absence of goals and specific targets, the financing requirement for EE has not yet been estimated.

Annex 1: On-going initiatives by the Royal Government of Bhutan and Development Partners

The RGoB is undertaking a number of energy sector projects to add power generation capacity, expand energy access and implement RE systems. While a few programs are funded entirely by the RGoB, many other are co-funded by development partner countries and bilateral and multilateral agencies. The on-going and planned programs in the energy sector are summarized in the Table below. Some additional information on ADB, UNDP and NORAD supported programs is also provided.

Government of India: Support for various hydropower feasibility studies and financing for hydropower plants

Government of Austria: Support for hydropower feasibility studies

Government of Japan/JICA: Support for rural electrification projects

ADB: Support for rural electrification projects, preparation of a Renewable Energy Master Plan, technical assistance support for capacity building in the energy sector. Tentative plan to support development of the Nikachhu hydropower project with an indicative proposed financing of $120 million comprising $40 million ADF hard-term loan and $80 million OCR which is subject to availability and prerequisite requirements for accessing OCR

UNDP: Baseline study on EE potential in transport, buildings, industry and agriculture, and support for development of an EE policy (Jan-Dec 2012, $45,000); Low Emission Capacity Building to develop national capacity to address current environmental challenges and mainstream environmental concerns into policies, plans and programs enhanced (May-Oct 2012, $32,100); Revision of National Environment Strategy (Jan 2012-June 2013, $150,000); Piloting Public-Private Partnership in solid waste management to improve service delivery of MSW management, create employment opportunities, and reduce environmental impacts of waste and their associated risks of pollution on human health through piloting of a pro-poor gender sensitive PPP model in MSW management focused on targeted urban communities within Thimphu Municipality in collaboration with Ministry of Works and Human Settlements, Royal Society for Protection of Nature; and Private Firms (Jan 2010 – Dec 2012, $200,000); and Reducing Climate Change Induced Risks from GLOF (Glacial Lake Outburst Floods) studies to examine climate change induced risks from GLOF (May 2012-April 2015, $4.345m). UNDP as the Implementing Agency has applied for a GEF grant on behalf of Bhutan for a project entitled "Bhutan: Promoting Sustainable Rural Biomass Energy", whose objective is to mainstream sustainable biomass energy production, conversion and utilization.

Government of Norway/NORAD: Cooperation between Bhutan's Department of Hydropower and Power Systems (DHPS) and Norwegian Water Resources and Energy Directorate (NVE) for the project "Strengthening of the Energy Sector – Phase IV" and Bhutan's Department of Geology Mines (DGM) and the Norwegian Geotechnical Institute for "Mitigation of Geo-hazards related to Hydropower-Phase IV." A total financial grant of Nu 288 million has been committed by Norad to support the accelerated hydropower development program of the country, to increase the institutional capacity within the energy sector in Bhutan and to further mitigate geo-hazards associated with hydropower development. Phases I, II and III (2001-2011) of the cooperation have made substantial contributions to the development of the institutional capacity of the sectors, and Phase IV will build on past achievements with a view to prepare more hydropower projects for development as per the Hydropower Policy of Bhutan and to manage risks, identify hazards and develop early warning systems for mitigating natural hazards threatening lives and property.

Table A-1: On-Going Energy Sector Projects in Bhutan

Activity	Amount, NU. m	Funding Source
Construction of Dagachhu Hydro-electric Project	53.92	Austria
DPR of 770 MW Chamkharchhu - I (Digala) Hydro- electric Project	24.292	RGoB/GoI
DPR preparation for 600 MW Kholongchhu HP	24.291	RGoB/GoI
DPR updation of (2,560 MW) Sunkosh HP	25.273	RGoB/GoI
PFR/DPR preparation of Kuri-Gongri (1,800 MW) HP	100.123	RGoB/GoI
DPR preparation for (540 MW) Amochhu HP	26.497	RGoB/GoI
DPR preparation for (600 MW) Wangchhu HP	22.908	RGoB/GoI
DPR preparation for (180 MW) Bunakha HP	13.813	RGoB/GoI
Institutional Co-operation Project with Norway-Phase IV	29.292	RGoB/NORAD
Prefeasibility studies of three Hydropower Projects	28	NORAD
DPR study of Khomachhu HP	15	NORAD
Procurement of plants and equipment for Flood Warning Stations, Hydromet	6.695	India
Installation of GLOF Early-Warning System in the Punakha-W/Phodang valley	4.299	PHPA
Rural electrification under JICA (JBIC) project (Phase I)	70	RGoB
Rural electrification under GoA project, Phobjikha (Phase VI)	10.682	Austria
Rural electrification under ADB project (Phase V)	55.603	RGoB
Rural electrification under ARE project (ACO-LAYA)	11.92	RGoB
Rural electrification under JICA (JBIC) project (phase II)	70	RGoB
Pilot Wind Project	1.543	RGoB
Operation and maintenance of Solar PV systems under ADB/JFPR funding	14.508	RGoB/ADB
Development of Micro Hydropower Plant in Lingzhi	23.179	Austria
Development of Micro Hydropower Plant in Soe	17.172	Austria

Source: National Budget for the Financial Year 2012-13, Ministry of Finance, June 2012

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