SUSTAINABLE
ENERGY FOR ALL

Rapid Assessment Gap Analysis
Honduras

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DRAFT

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KEY ABBREVIATIONS AND ACRONYMNS

CDM	Clean Development Mechanism (Of Kyoto Protocol)
CFL	Compact Fluorescent Lamp
CNE	*Comision Nacional de Electricidad* (National Electricity Commission, Honduras)
HDI	Human Development Index
ENEE	*Empresa Nacional de Energia Electrica* (Honduran State-owned Power Utility)
ESMAP	Energy Services Management Assistance Program (part of World Bank)
GDP	Gross Domestic Product
KWh	Kilowatt hour
kV	Kilo-volts
LNG	Liquefied Natural Gas
TOE	Ton(s) of Oil Equivalent
TWh	Terawatt hour(s)

EXECUTIVE SUMMARY

In spite of the abundance of domestic energy sources, hydropower and solar in particular, Honduras significantly relies on imported oil for thermal power generation. As of 2010, over 53% of generation came from oil, and about 42% from hydropower. The country's installed capacity, estimated at 1611 MW (2010), is unable to meet the power demand. Overall, about 72% of the population has electricity access. In the rural areas the access is much lower; just 54%. Lack of access to energy has been a major constraint to economic development and in improving population's living standards. The precarious balance between power supply and demand is a threat to the country's energy security and economic growth.

In recent years, the government of Honduras (GOH) has implemented several interventions, including promulgation of policies to improve the energy situation. Increasingly, the government has also looked to its large indigenous resources, in particular hydropower, to generate power. Geothermal and wind have also gotten some attention. Several new projects, including those with donor technical and financial support, are in pipeline or under implementation. The government has also opened up its markets to several (power) generators in the form of Independent Power Producers (IPPs) who sell electricity to ENEE, the national utility.

Rural energy access is also getting priority attention. These areas, where majority of the Hondurans live, could benefit from decentralized systems such as those based on pico-, micro-, and mini-hydropower. Biomass, current major source of rural energy, however needs to be used on a sustainable basis.

However, a lot more is needed before self-sufficiency and energy security is achieved. The significant inefficiencies in the institutional and regulatory framework need to be removed. Greater reliance on private sector for the much-needed development of hydropower and other renewables will require regulatory and other support in addressing environmental and social risks for acceptable development costs.

To ensure financial stability of the electricity sector, more efficient tariffs and better-targeted and transparent subsidies such as for the poor are needed. The government should also more aggressively implement energy conservation measures. Such measures, when successfully implemented, can also cost-effectively increase power supply. Harmonization of rules governing power exchanges such as with the Central American Electrical Interconnection (SIEPAC), the regional exchange, may also be needed.

GOH should seek long-term self-sufficiency through diversifying energy mix, improved regulatory and business environment, strengthened institutions that are also on sound financial footings and other measures. Current vertical integration of ENEE, the state-owned utility, also needs to be reviewed in favor of unbundling. All such measures can bring in the desired goals under SE4ALL.

1.0 OBJECTIVES OF THE STUDY

The purpose of Rapid Assessment and Gap Analysis is to provide:

- A quick summary of the energy situation in the country (Section 1) within the context of its economic and social development and poverty eradication;
- A good review of where the country is in terms of the three SE4ALL goals (Section 2), and
- A good estimate of the main challenges and opportunities vis-à-vis the three goals of SE4ALL where the major investments, policies and enabling environments will be required (Section 3)
- A sound basis and background for an Action Plan that may follow as part of the SE4ALL activities in the country

2.0 COUNTRY OVERVIEW

The Republic of Honduras is the second largest country by area in Central America with 112,492 km². The country's mountainous region covers nearly 80% of its total land. As of May 2010, total population was estimated at 8,041,654. Its economically active population accounts for 42.1% of the national total, of which about 96.0% are employed, 54.1% located in rural areas and 45.9% in urban areas. The country's population growth rate is about 2.1% and per capita GDP is USD 1,900[1] and for 2011, the GDP (at the official exchange rate) is estimated at $175.3 billion. The estimated revenues for the year are: $3.011 billion and expenditures of $3.696 billion[2], creating a 4% GDG budget deficit.

Figure 1: Map of Honduras

Source: CIA Handbook, 2010

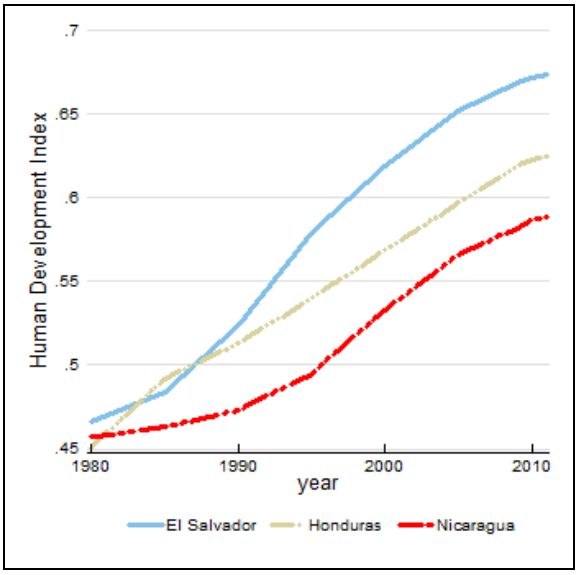
Published data shows GDP (2010) composition by sector is divided between: agriculture: 12.5%, industry**:** 26.5%, and services**:** 60.9%. Major agricultural products include: bananas, coffee, citrus, beef and seafood. Key industrial products include: sugar, coffee, and wood products.

Honduras, in spite of export of goods and services accounting for over 55% of the GDP, is among the poorest countries in the region. The country is rife with economic inequalities. About 60% of the country's population remains below poverty or extreme poverty levels. Rural poverty is among the most severe in Latin America. Approximately 53% of the population is rural. It is estimated that 75% of the rural population lives below the poverty line, and about 86 percent of the extreme poor live in rural areas. Drug trafficking and crime are fueled by poverty and rising unemployment.

[1] Climate Investment Funds; SREP/SC.6/6, Agenda Item 6: October 26, 2011
[2] The CIA Handbook, 2010

Honduras's Human Development Index (HDI) value[3] for 2011 is 0.625—in the medium human development category—positioning the country at 121 out of 187 countries and territories. Between 1980 and 2011, Honduras's HDI value increased from 0.451 to 0.625, an increase of 38.0 per cent, or an average annual increase of about 1.1 per cent. Published estimates call for further improvements over the next decade. *Figure 2: Trends in Honduras's HDI 1980-2011* highlights this aspect, comparatively evaluating Honduras with two neighboring countries, El Salvador and Nicaragua.

Figure 2: Trends in Honduras's HDI 1980-2011



Despite its current poor economic situation, Honduras has enough natural resources to be able to achieve energy self-sufficiency, either by the use of hydroelectric resources, whose theoretical potential is estimated at 5000 MW, or the use of its solar energy potential, which is significant because of its geographical location.

3.0 ENERGY SITUATION

Traditionally, Honduras has used a limited variety of energy sources, and the country, unable to meet its energy needs, imports oil. The power secto in Honduracs is managed by the state-owned, vertically-integrated utility, Empresa Nacional De Energyia Electrica, (ENEE). ENEE engages in generation, transmission and distribution of power in the country's SIN power grid.

3.1 Energy Supply (energy mix and import/export)

[3] Human Development Index (HDI) of the United Nations Development Program (UNDP) The HDI is a summary measure for assessing long-term progress in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. The HDI allows a comparative vision of the country within a worldwide context, and also allows for separation and comparison of achievements and shortcomings at the level of departments and municipalities, showing inequalities at the regional level regarding achievements in health, education and income. This index is complemented by the Human Poverty Index (HPI), which concentrates on measuring the privations of the poorest.

Energy matrix in Honduras has a high consumption of oil products[4], all imported, mainly from the USA. Honduras has no oil refineries in the country. The predominantly thermal, oil-based power systems—represent almost 2/3rd of the total installed capacity—make Honduras highly vulnerable to often increasing and volatile oil prices. Domestic energy sources include hydropower, timber and coal.

At the national level, energy mix in Honduras comprises 43% of fuelwood, which provides about 86% of total residential energy consumption. The non-electrical renewable energy, such as for heat and mechanical power includes woody and non-woody biomass, solar energy, wind, and geothermal and hydro resources. Woody and non-woody biomass is the most used source of energy and dominates both the demand- and supply- sides of the economy.

3.1.1 Power Sector

Electrification in Honduras is low and uneven relative to other countries in Latin America. However, the country does not not import any electricity. Published data shows the installed capacity in Honduras, as of 2010, at 1,611 MW. The demand for 2010 is estimated at 1240 MW and is expected to grow 3.5% annually. *Table 1: Installed Capacity in MW* also shows various energy sources used.

Table 1: Installed Capacity in MW

Year	Total	Hydro*	Diesel	Gas	Coal	Cogeneration
1990	532.6	431.0	86.6	15.0	0.0	0.0
1995	755.9	434.2	205.7	116.0	0.0	0.0
2000	919.8	435.2	382.1	102.5	0.0	30.0
2005	1,526.8	479.1	915.4	72.5	0.0	59.8
2006	1,588.0	502.9	952.8	72.5	0.0	59.8
2007	1,572.8	519.7	912.8	72.5	0.0	67.8
2008	1,597.1	522.0	912.8	72.5	8.0	81.8
2009	1,610.4	526.4	912.0	72.5	8.0	91.5
2010	1,610.4	526.4	912.0	72.5	8.0	91.5

Role of private producers is indicated by *Table 2: Installed Renewable Capacity in Honduras by Private Producers (2008)*. Since then, while private sector role in power generation has increase, GOH needs to do lot more to help increase power supply.

[4] The heavy dependence on oil was an unfortunate result of the 1994 electricity sector reform (No 158-94) that inadvertently favoured such dependence due to cheap oil prices in 90's and early 2,000's. Hydrocarbon technologies were far less capital-intensive than hydroelectricity and thus easier to finance for the private sector. This changed the almost 100 % renewable- based electricity generation to one dominated by thermal plants (53% in 2010).

Table 2: Installed Renewable Capacity in Honduras By Private Producers, 2008, in MW

Technology	Project	Capacity	Technology	Project	Capacity
Run-of-the-River Hydropower Plants	La Nieve	0.48	Sugarcane Bagasse	AYSA	8.00
	Zacapa	0.50		La Grecia	12.00
	La Esperanza	12.76		CAHSA	25.75
	Babiliona	4.00		AZUNOSA	4.00
	Yojoa	0.63		Tres VAlles	7.80
	Rio Blanco	5.00		Chumbagua	14.00
	Cececapa	2.86		CELSUR	16.65
	Cuyamapa	12.2		*Subtotal*	*88.28*
	Cuyamel	7.80	Biomass from methane capture	Lean	0.50
	Cortecio	3.19		Ecopalsa	1.00
	San Carlos	2.26		Aguan	0.50
	Coronado	4.00		Subtotal	2.00
	Sub-total	*61.48*		**Grand Total**	**151.68**

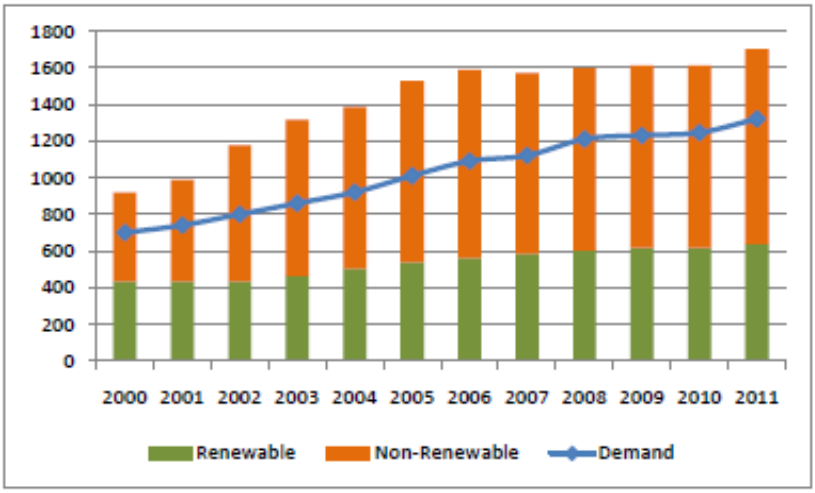
* Source: SREP, op cit, page 21

In addition to domestic power generation, potential to increase energy supply exists through the Central American electricity market, by means of the Electric Interconnection System of the Central American Countries[5]. The system inter- connects five countries through a 230-kV and 1800 km transmission network. This regional market could benefit all Central American countries, Mexico and the US, because of its diversity and complementarities of energy sources.

3.2 Energy Demand

The growth in electricity demand over the last decade has remained between 6% and 8% a year, with no growth in 2009, following the impact of the international financial crisis on the economy and the internal political crisis the same year.

Figure 3: Energy Supply and Demand (MW)

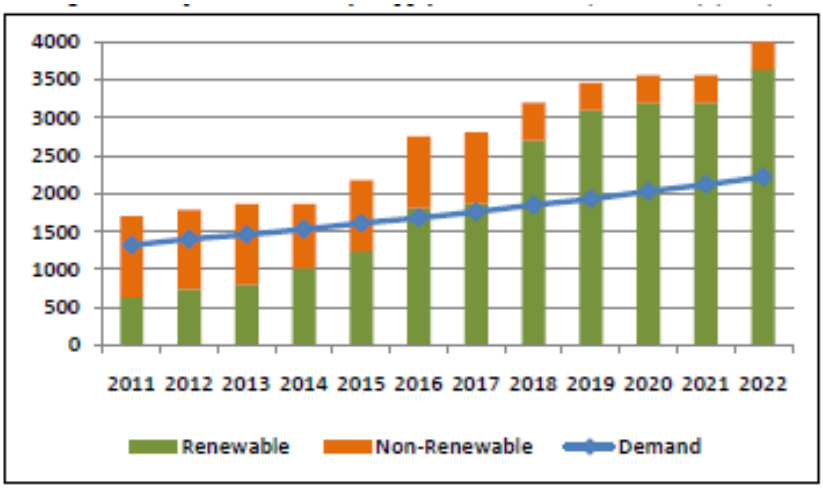


[5] SIEPAC, 2010.Availableat: /http://www.eprsiepac.com/descripcion_siepac_transmision_costa_rica.htmS.

Figure 2 depicts the energy trends between 2000 and 2011. It is apparent that the share of renewables, in particular hydropower, has been increasing, albeit at a slower rate.

For the 2010 to 2011 period, ENEE projected that the demand would grow 3.5%. However, the National Expansion Plan, 2007-2020, expected enegy demand to grow 5.7% annually. The varition may be due to different assumptions. *Figure 3* depicts the projected change in demand of electricity in Honduras during the indicated period.

Figure 4: Projected Electricity Supply and Demand (MW), 2011-2022



Source: SREP, Climate Investment Funds, SREP, SREP/SC.6/6, October 26, 2011; meeting in Washington DC, November 1, 2011

In terms of electricity consumption, as of December 2010, the household sector in Honduras is in first place around 47%, followed by the commercial sector at 25.1%, and the industrial sector (big and medium-size industries) at 24.5%. For administrative purposes, the country is divided into three areas: Central-South, Northwest and the Atlantic Coastline. The Northwest area reports the highest energy consumption at 50.8%, followed by the Central-South area at 39.5% and the Atlantic Coastline area at 9.7%, according to published data as of December 2010.

Per capita consumption is estimated at 180 kWh. The price averages US $0.08/kWh[6], an affordable rate for many in Honduras. The tariff in the neighboring countries of El Salvador, Guatemala and Panama averages around US $0.165/kWh.[7]

3.3 Energy and Economic Development

Honduras is a growing economy with high-energy intensity. The total national budget for 2011 is $7.04 Billion, a 10% increase relative to 2010. With power demand growing at an estimated 3.5% per annum, the country's majority lacks adequate access to energy, which in turn, lowers

[6] ESMAP "Regional Power Integration, Structural and Regulatory Challenges". Page 26, ESMAP/the World Bank, January 2011.
[7] World Bank, January 2011, "Regional Power Integration, Structural and Regulatory Challenges". Page 26.

the country's overall productivity. The GDP per unit of energy use[8] (PPP dollar per kg of oil equivalent) in Honduras was 6.53 in 2009, slightly higher than 6.28 for the year 2008.[9]

Lack of access to services disproportionately affects the poor in Honduras as evidenced in the electricity sector. Lack of energy services is correlated with many of the elements of poverty, such as low education levels, inadequate health care and limited employment possibilities. Electricity can be used to provide essential services such as water pumping, lighting and food processing in rural areas.

3.4 Energy strategy and relevant targets (access, capacity, generation, energy security)

Given the country's heavy dependence on imported oil for thermal power generation, the Government of Honduras (GOH) has increasingly looked in to using (indigenous) alternatives, in particular hydropower expansion, as well as other renewables. GOH, by 2022, aims to reverse the existing structure of the electricity sector to a ratio of 60% renewable and 40% fossil. The proposed shift in energy mix will not only save valuable foreign exchange but will also comply with the provisions of the Country Vision and National Plan Law constituted into State Policy by Decree No. 286-2009 of National Congress.

To increase energy supply, GOH has put in place a number of short-, medium- and long-term strategies. GOH's has set a target of 85% electricity coverage by 2015[10]. Several plans are under review. For example, ENEE is developing major expansion projects including 2000–2014 generation expansion plan as well as the National Grid Expansion Project, EXSINII. With donor and domestic support, GOH committed US $463 million during 1999 - 2010 for electrification. The assistance helped the state-owned national utility ENEE, increase grid coverage to 81.27%, with 99.94% in urban areas and 63.36% in rural areas.[11] *Table 3: Changes in Electricity Supply* depicts the improvements.

Table 3: Changes in Electricity Supply

Year	Population ('000)	Inhabitants per household	Total households ('000)	Residential customers ('000)	Electrification rate (%)
1985	4,041	6.5	621.6	192.0	30.9
1990	4,758	6.5	732.0	286.1	39.1
1995	5,603	6.2	903.7	412.9	45.7
2000	6,363	5.9	1,069.4	588.9	55.1
2001	6,530	5.9	1,106.8	649.4	58.7
2002	6,695	5.9	1,140.5	678.3	59.5
2003	6,861	5.8	1,174.8	718.9	61.2
2004	7,028	5.8	1,207.6	752.7	62.3
2005	7,197	5.8	1,240.9	809.8	65.3

[8] GDP per unit of energy use is the PPP GDP per kilogram of oil equivalent of energy use. PPP GDP is gross domestic product converted to current international dollars using *purchasing power parity rates*. An international dollar has the same purchasing power over GDP as a U.S. dollar has in the United States.

[9] In the US, it is 6.53, as of 2010, See: http://www.indexmundi.com/facts/united-states/gdp-per-unit-of-energy-use.

[10] Percentage electricity coverage, an indicator of the degree of the country's electricity development defined as "the ratio expressed by the number of households with access to electricity and the total housing stock."

[11] SREP, Climate Investment Funds, SREP, SREP/SC.6/6, October 26, 2011; meeting in Washington DC, November 1, 2011

Year	Population ('000)	Inhabitants per household	Total households ('000)	Residential customers ('000)	Electrification rate (%)
2006	7,367	5.8	1,279.0	869.9	68.0
2007	7,538	5.8	1,308.7	953.6	72.9
2008	7,707	5.8	1,338.0	1,030.4	77.0
2009	7,877	5.8	1,367.5	1,101.2	80.5
2010	8,041	5.8	1,386.5	1,126.8	81.3

In addition, a number of projects (large- and mini- hydros) based on domestic resources have also been identified for development in the short-, medium- and long-terms. *Table 4* highlights GoH's hydropower projects promoted.

Table 4: Large-scale Hydropower Projects

Hydropower Project	Capacity (MW)
Patuca I, II and III	524
Jicatuyo	173
Los Llanitos	98
El Tablón	20
Expected total	**815**

Overall, the government plans for the long-term include[12]:

- Investment in hydroelectric projects, transmission and distribution, (160 MW). These are expected to come online during 2013-2015.
- Promoting hydropower and other renewables to reverse the current thermal dominated generation mix.
- Initiating a competitive process for purchasing renewable-based electricity.
- Implementing an energy efficiency program
- Implementing other thermal projects to complement renewables and energy efficiency programs.
- Eliminating ENEE's deficit through measures such as tariff rationalization.

For the rural areas, micro-hydro construction and solar energy installations will get a major focus of GOH's efforts. In this area, the German Technical Cooperation (GIZ) has been the leading player with more than 123 kW of installed capacity.[13] A number of such areas still largely depend on isolated systems. *Table 5* exemplifies key projects. It will be useful to map other renewables such as wind to explore their potential in Honduras.

Table 5: Rural Electrification Projects with Pico, Micro, and Mini Hydropower Plants in Honduras

Department	Project	Installed capacity (kW)	Donors	Beneficiaries (households)
Atlántida	El Recreo	12.5	EnDev-HO	N/A
Colón	El Satalite	7.5	EnDev-HO	N/A
Atlántida	La Muralla	7.5	EnDev-HO	N/A

[12] Project Appraisal Document, 2008, World Bank Report No. Report No: 45791-HN
[13] Zelaya, M., 2009: Diagnosis of isolated systems and rural electrification. Database of DGE-Honduras

Department	Project	Installed capacity (kW)	Donors	Beneficiaries (households)
Yoro	Chorroviento	10	EnDev-HO	N/A
Yoro	Guardaraya	15	EnDev-HO	N/A
Lempira	San Manuel Colohete	12	EnDev-HO	
Colón	Quinito	10	EnDev-HO	N/A
Atlántida	Ni Duermes II	12	EnDev-HO	N/A
Colón	Plan Grande	12	EnDev-HO	N/A
Atlántida	Las Quebradas	12	EnDev-HO	N/A
Sub Total benefiting from En-Dev		***1,280***		
Francisco Morazán	Los Lirios	0.7	GAUREE Project (EU + ENEE)	22
Comayagua	Yure	100	GAUREE Project (EU + ENEE) UNDP-GEF	706
Colón	Las Champas	80	PIR Project (BM+GEF+FHIS) GAUREE Project (EU+ENEE) UNDP-GEF	150
Lempira	Río Claro	100	GAUREE Project (EU+ENEE) UNDP-GEF	1,037
Olancho	Wampu	42	UNDP-GEF	450
Olancho	Paulaya	82	UNDP-GEF	730
Olancho	Río Negro	43	UNDP-GEF	2,629
Total installed capacity (kW)		***558.2***		

Source: SREP, Climate Investment Funds, SREP, SREP/SC.6/6, October 26, 2011; meeting in Washington DC, November 1, 2011

By taking needed measures to increase energy supply security, develop its renewable energy potential, improve efficiency of power production and consumption, and also address regional power integration agenda, Honduras can meaningfully increase power supplies and add to its economic growth. The Central American Electrical Interconnection System (SIEPAC), of which Honduras is a partner, is an important initiative towards an integrated regional electricity market. The measure can potentially ward off the projected capacity shortfall of 315 MW, expected by 2012/13.

4.0 ENERGY ACCESS VIS-À-VIS GOAL OF SE4ALL

4.1 Overview and Assessment

In the early 1990's, given its low cost, oil was the dominant energy source in Honduras; all of it imported. Given the lower capital costs and perception of lower investment risks, the private sector installed oil-based thermal power generation. Such investments also provided a much-needed relief to public sector entities with little access to capital. Nevertheless, it made Honduras dependent on oil and its fluctuating oil prices; the share of hydropower declined from 100 percent in 1990 to 37% in early 2000s[14]. Given the (often) rising oil prices, climate change and other

[14] ESMAP, January 2011, op cit, January, page 25.

concerns including the excessive financial strain on national budget, GOH, for adding power supply, has increasingly looked into renewable, in particular hydropower options.

4.2 Modern Energy for Thermal Applications

Modern energy for thermal applications such as cooking, heating etc. continues to be in limited supply in Honduras. While some areas are well served, many, particularly the country's rural areas lack access to electricity and biomass continues to be a dominant fuel for cooking and over 69% of Honduras' population uses solid fuels, primarily wood.

Off-grid solutions such as diesel, solar or micro-hydro power plants may provide some good options for thermal application. Use of diesel however is associated with environmental and health risks. For cooking, use of improved cookstoves to gain higher energy efficiency and minimize or eliminate severe health hazards is increasingly being looked into.

According to the study on firewood consumption produced by SERNA, EAP and ECLAC (April 2011), per capita consumption is estimated at 5.2 kilograms per day, with minor variations between rural and urban areas and between households that use firewood as their *only fuel* and those that combine wood with another fuel source. Spending on firewood for use in traditional inefficient stoves (5% to 10% efficiency) has an impact on household economy. The cost of buying firewood in urban areas is at least two dollars a day. *Table 6: Combination of Energy Sources for Cooking by Area (Rural/Urban)* provides a breakdown of fuel sources.

Table 6: Combination of Energy Sources for Cooking by Area (Rural/Urban)

Energy Source	Urban	Rural	Total
Wood	33.7%	59.2%	46.8%
Wood + gas	8.9%	9.9%	9.4%
Wood + electricity	12.4%	11.8%	12.1%
Wood + other	0.0%	0.6%	0.3%
Do not use wood	45.0%	18.5%	31.4%
Total	**100%**	**100%**	**100%**

In recent years, governmental and private institutions, international cooperation agencies and various NGOs have sponsored programs to create awareness among families about the damage to health and the environment caused by the use of traditional stoves, promoting the installation and use of improved models, which are at least 40% more efficient than traditional stoves.[15] The improved versions reduce both fuel consumption and damage to people's health. Although the new stoves have been well received by users, their introduction in Honduras has been limited; their current share is only 9.9% in rural areas and 2.9% in urban areas, so there are still about 800,000 traditional stoves in the country.[16] Table 16 shows distribution of stoves by area.

These isolated cook stove dissemination efforts have not led to the development of sustainable business models. The experience in Honduras shows that it would be particularly relevant to establish minimum technical performance and social acceptance standards and a certification scheme (building on the certification center currently operating at the El Zamorano University - EAP), as well as guidelines for the access to carbon markets (building on the experience of projects that are already mobilizing resources form the carbon markets).

[15] SREP, op cit, page 33
[16] SREP, op cit, page 34

In Honduras and few other countries, Plancha stove design gained some popularity. The stove drastically reduces indoor air pollution by almost totally enclosing the fire and sealing the flue gas passage. In this case the cooking pots are placed on a metal griddle which is heated by the hot combustion gas coming in direct contact with its bottom surface.[17]

A regional country, Guatemala, considered a 'Cookstoves' Laboratory', has made major strides in this direction. The counry's popular ONIL stoves reduce Carbon Monoxied (CO) emissions by more than 95% and fuel consumption by about two-thirds[18]. ESMAP of the World Bank has done considerable work relating to developing and disseminating informaion on improved cookstove. GOH should look in it for potential use in Hondura since promoting and disseminating improved cookstoves can help reduce solid fuel consumption and lower health risks. Greater use of such stoves can also help in reducing deforestation and desertification, which improves water supply and reduces vulnerability to disaster risks, in addition to helping efficient and sustainable use of woodfuels.

Due to cultural and economic aspects, a transition to cooking systems with liquefied petroleum gas (LPG) or electricity has not been feasible in most cases. LPG is not an affordable fuel for most rural households in Honduras, and subsidizing is not a viable option. Subsidies, including for improved Cookstoves, distort markets, prevent consumer feedback fro reaching manufacturers or suppliers and retailers, thwart efforts at sustainable commercialization. Home heating is generally not required in Honduras.

4.3 Access to Electricity

According to World Bank, as of 2010, about 72% of Honduras' population had access to electricity, as compared to 69% in 2006. Residential energy consumption is around 47% of the national consumption. 86% of this comes from biomass, primarily firewood[19].

Honduras has the lowest rural electrification rates in Latin America after Nicaragua. About 54% of the rural population lacks access to electricity; thus about 46% only is covered. The Poverty Reduction Strategy (ERP) sets a target of 85% electricity coverage by 2015 for Honduras.

Many households, even with access to electricity, still use firewood as the main source of energy for cooking. In urban and peri-urban areas, 55% of homes use firewood, of which almost a quarter (21.3%) combines wood with other fuels. In rural areas firewood still dominates in about 81.5% of households, 59.2% as primary source and 21.8% mixed: either wood-electricity or wood-LPG.[20] *Table 7: Combination of Energy Sources for Cooking in Urban and Rural Areas* highlights this situation.

[17] The Plancha stove is a popular stove design. Built from steel, brick, or cement, the Plancha stove is a sealed stove with a steel or cast-iron cooking surface. This permits the combustion gases to be exhausted from the living quarters via a chimney. Frying of breads (i.e., tortillas) and other foods is performed directly on the cooking surface of the stove. In contrast, placing a pot containing the food on the cooking surface performs cooking operations requiring boiling or simmering. Because of this two-tiered arrangement (flame-stove, surface-pot-food), the Plancha stove is thought to be less efficient than stoves in which the cooking pot is in direct contact with the flame.

[18] See: www.pciaonline.ogr/node/550.

[19] http://endev.info/index.php/Honduras

[20] According to the study on firewood consumption produced by SERNA, EAP and ECLAC (April 2011), per capita consumption is 5.2 kilograms per day, with minor variations between rural and urban areas and between households that use firewood as their only fuel and those that combine wood with another fuel source. Spending on firewood for use in traditional inefficient stoves (5% to 10% efficiency) has an impact on household economy. The cost of buying firewood in urban areas is at least two dollars a day.

Table 7: Combination of Energy Sources for Cooking in Urban and Rural Areas

Energy Source	Urban	Rural	Total
Wood	33.7%	59.2%	46.8%
Wood + gas	8.9%	9.9%	9.4%
Wood + electricity	12.4%	11.8%	12.1%
Wood + other	0.0%	0.6%	0.3%
Do not use wood	45.0%	18.5%	31.4%
Total	**100%**	**100%**	**100%**

Source: Study of firewood consumption, April 2011, produced by SERNA, EAP and ECLAC, based on the results obtained in the National Survey of Firewood Consumption in Honduras; Quoted from SREP, page 26.

For renewable energy developers for grid connection, the cost of financing in Honduras is considered very high. This presents an investment challenge. In addition, long- term financing is generally not locally available but GOH is proposing corrective measures. In many countries, private finance practitioners prefer feed-in tariffs, perhaps given the positive experience with such policy instruments.

In terms of sustainable supply, there is limited access to sustainable energy services especially in rural areas. However, proper quantification of the lack of access is not possible given the lack of credible data. Moreover, the process is time-consuming given the need for feasibility studies, procurement of funds and to mitigate site-specific constraints. The government is finally showing some political will and selectively implementing rural electrification through various technologies.

In the urban sector, electricity tariffs continue to be below cost recovery and do not reflect the economics of supply and encourage waste and lowers revenues. This is a major cause of weak financial footing of ENEE, the state-owned utility. Increased power access plans such as under SREP call for ENEE to be the entity responsible for project implementation that will work closely with CPME. It is hoped that this arrangement will work optimally in bringing increased power availability at affordable prices. As one of the pre-requisites, ENEE needs to be on sound financial footings.

Access to electricity, over the years, however has considerably improved. As new plans are implemented, further improvement is likely. It is estimated by SREP that of the total population of Honduras, the grid cannot serve an estimated 10% of rural households. In urban areas, many people use small generators to produce electricity for home use. In all, in Honduras, roughly speaking, over 2 million people lack access to power.

The electricity sector in Honduras is largely stated-owned and vertically integrated. The state owned utility, Empresa Nacional de Energgia Electica (ENEE)—owns about 40 percent of generation and 100 percent of the transmission and distribution systems. The country relies on a thermo-based power system (accounting for nearly two-thirds of its total installed capacity), which is very vulnerable to high and volatile international oil prices. *Figure 3: Projected Electricity Supply and Demand, 2011 – 2022* highlights the situation.

Availability and Reliability of Supply

Though the national grid is not of high integrity, the quality of power supply, generally speaking, is relatively good with only occasional incidents of blackouts, mostly resulting from system

failure. However, due to the insufficient supply in relation to demand, a 24-hour load shedding has also been sometimes necessary. The situation is of considerable improvements from 2007 power rationing in Honduras. In comparison with other countries, Honduras has a few long outages, while countries in the region have more frequent, though shorter ones.

4.4 Modern Energy for Productive Uses

Access to electricity for productive uses is limited at this time primarily due to limited supply. Such lack is particularly severe in rural areas. There is urgent need to increase access to allow the entire population access modern energy and use it for such productive purposes as agro processing, small and medium enterprises, and for better social services such as education, health, communications and water supply.

5.0 ENERGY EFFICIENCY VIS-À-VIS GOAL OF SE4ALL

Honduras has a very large potential for developing energy efficiency programs. For example, large improvements could be made in the areas of lighting and air conditioning for both the residential and commercial sectors, where the implementation of measures in the area of demand-side management and the rational use of energy could help prevent unplanned blackouts, and cost-effectively provide additional power. Also, significant potential exists for saving household energy use through better designed wood stoves, use of CFL bulbs, increasing tariffs to minimize wasteful use of energy and also put ENEE on better financial footing, bringing in better technologies, education and awareness campaigns and other measures.

5.1 Overview and Assessment

A number of energy efficiency (EE) measures have been implmented in the recent past in Honduras. For example, between 2000 and 2007, under the *Generación Autónoma y Uso Racional de Energía Eléctrica* (GAUREE) project, financed by the European Union, thousands of CFL bulbs were given to 800,000 households, lowering the consumption of energy by 50 million kWh per year. The Inter-Institutional Group for the Efficient Use of Energy (GIURE) in 2008 implemented through ENEE, several strategies including promotion of gas stoves, use of Clean Development Mechanisms (CDM), educational campaigns, efficiency in the industrial and commercial sectors, and others. These activities are estimated to have saved 100 MW of electricity in 2008.

At present, energy efficiency initiatives in Honduras are increasing owing to high-energy costs. However, much remains to be done. In addition, there is already a law (draft) to promote the rational use of energy through the creation of the Institute for Rational Use and Energy Efficiency. The institute will carry energy efficiency campaigns such as awareness on use of energy savers (CFLs), improved cook stoves, energy efficient appliances etc. throughout the country. In 2009, 6 million incandescent light bulbs were replaced by compact fluorescent lamps (CFL) in the residential sector. This step represented a decrease in consumption of 53 MW for the 2008–2009 period.

In Honduras, the transmission technical and non-technical losses are high, estimated 28%. A large number of Honduras's industries operate at a low power factor due to inefficient motors and other loads in the facilities. To improve on this situation, the power utility, ENEE has put in place a penalty for below a power factor below 0.894 and a reward to consumers that maintain a power factor above 0.894. These activities are part of improving energy efficiency. Such measures can help save energy.

5.2 Energy Intensity of National Economy

Energy intensity (energy per dollar of GDP) is estimated at around 142 per million dollars.[21] It is low by U.S. standards but comparable to European countries that make up Organization of Economic Cooperation and Development (OECD). Low energy intensity is indicative of lower GDP.

6.0 RENEWABLE ENERGY VIS-À-VIS GOAL OF SE4ALL

Solar technology can provide clean energy with huge benefits for health and quality of life. GOH, in order to cover supply shortfalls and shift from oil-based thermal power is increasingly looking into using renewables for power supply. As of 2010, renewable energy resources make up about 33 % of total energy production, mainly coming from hydro plants, while biomass is growing in importance. Non-hydro renewable includes: wind, geothermal and solar.

As part of its efforts to increase the use of renewables, GOH is close to completing the new generation capacity of about 150 MW mainly from renewable power proposed for completion during 2007 – 2011. Likewise, several other renewable energy projects based on renewables are planned. Timely completion of various projects under implementation or planned will help Honduras avoid reliance on expensive emergency power, as part of the near-term corrective measure. In addition, GOH should shift subsidies from diesel to renewable energy—in a gradual manner.

Gradual removal or minimizing subsidies can help improve competitiveness of renewables as energy feedstock. All such efforts need to be continued and improvised to help meet increasing energy demand.

6.1 Overview and Assessment

Starting with 1998, to reduce the country's vulnerability to internationsl oil price volatility,[22] the Honduran National Congress granted by Decree 267 of 1998 a series of tax incentives to promote electricity generation from renewable energy systems and cogeneration with capacity not exceeding 50 MW. More recently, in 2010, for the first time ENEE, through a public bidding process agreed to purchase electricity from renewable energy sources. Forty-eight projects were awarded Power Purchase Agreements (PPAs) for a total of 708 MW of renewable energy and an estimated investment of about $ 2.50 billion.

In addition, the Government of Honduras has identified two major areas where the development of renewable energy (RE) can play a major role to promote a faster progression of the country along a low-carbon development path: (i) the supply of additional power to serve industrial, commercial and residential customers connected to the grid; (ii) the provision of sustainable rural energy services, in particular the scaling-up of access to electricity services and to clean energy for cooking. Renewable natural resource potential is indicated below:[23]

- Hydroelectric: 5,000 MW (only 10.5% has been used, as of 2010

[21] Estimated from "Regional Power Integration, Structural and Regulatory Challenges"; ESMAP/World Bank, January 2011, page 25

[22] This heavy dependence on oil causes serious problems in the Honduran economy, jeopardizing investment in the Government's social programs (mainly in education, health and public safety).

[23] http://www.hondurasisopenforbusiness.com/files/pdf/Oportunidades_de_inversion_Energia_ingles.pdf

- Biomass: ≥ 300° MW
- Wind: ≥ 1,200 MW
- Geothermal: ≥ 112.3 MW
- Photovoltaic/availability of solar energy: 5.2 KWh/m2 day or 6 sun hours

Honduras has a significant potential of untapped indigenous renewable energy resources. Given the likely long-term trend of high oil prices, these resources could be developed at competitive prices, reversing the thermal-dominated system to a hydro-dominated system again. Currently, only hydropower and biomass are used on a large scale for electricity generation.

6.2 On-grid and Off-grid Renewables

Among the renewables, hydropower has been estimated to show a potential of about 3200 MW. However, to-date, only a small percentage has been exploited. Large hydropower plants can feeds into the grid where the electricity supply is adequate. Sixteen new large hydropower projects are likely to be commissioned before 2011/12. Smaller hydros can be used with mini-grids or stand-alone applications such as agro-processing, irrigations etc., much needed in rural areas.

Grid or non-grid renewable-based energy projects that are currently under construction in Honduras are mostly small plants each of which has a capacity of less than 20 MW per project.[24] GOH is also looking into using carbon finance under Clean Development Mechanism (CDM) to finance projects. Currently, two hydro projects in Honduras, La Esperanza and Rio Blanco, 13.5 MW and 5 MW, respectively, are the first plants to obtain carbon dioxide (CO_2) certificates under CDM.

In addition to hydropower, GOH is also looking into wind energy. A private firm, Mesoamerica Energy, is developing a wind energy project through its subsidiary, Energía Eólica de Honduras, S.A. (EEHSA), in the municipalities of Santa Ana and San Buenaventura, 20 km south of Tegucigalpa.[25] Its capacity accounts to approximately 6.5% of the entire capacity installed in the country. All power generated at Cerro de Hula will be exported to the state power utility Empresa Nacional de Energía Eléctrica, under a 20-year power purchase agreement. The 102-megawatt Cerro de Hula wind farm in Honduras will be the largest wind farm in Central America and one of the biggest in the whole of Latin America. It is also the first utility-scale wind farm in Honduras.

In October 2008, the firm executed a Power Purchase Agreement (PPA) for 100 MW with ENEE, reaching financial closing in November 2010. A consortium made up of Gamesa and Iberdrola Ingeniería y Construcción was awarded the turnkey construction and turbine supply contract. Construction began in December 2010. The park was officially inaugurated on February 22, 2012[26].

6.3 Use of Renewable Energy Sources for Thermal Applications

Outside hydropower and limited wind projects, other renewables such as Photovoltaics and solar thermal for thermal energy have not been explored in Honduras. Many countries, including China, Germany, Israel and Spain have already shown that schemes such as capital subsidies,

[24] http://www.ahpper.org/honduras2.htm
[25] The financing package for the project has a 70 percent / 30 percent debt-to-equity ratio. The U.S. Export-Import Bank and the Central American Bank for Economic Integration have jointly provided debt-financing support of the $220 million.
[26] http://www.mesoamericaenergy.com/en/projects/honduras.html

renewable energy certificates, feed-in tariffs (favorable rates paid to grid-connected renewable energy systems), net metering (paying those who generate renewable energy for their excess power) and a solar photovoltaic mandate can successfully promote solar Photovoltaics for electricity generation and thermal application.

Some projects in Honduras are looking in to exploring geothermal energy for power production. As of 2011, three renewable energy projects with good energy potential have been studied in detail by GOH. Geothermal energy can be used to move a turbine and generate electricity. Potential geothermal areas and MW's include: Platanares 48, Azacualpa 36, Sambo Creek 15, San Ignacio 14, Pavana 11, and El Olivar 1, to a total geothermal energy potential of 129 MW. Honduras has a project in San Andrés Mine is located in the department of Copán, the national Geoplataners is now responsible for conducting the studies and development of the project and is designed to produce 10 MW of power.[27]

In the biomass arena, currently, woodfuels are the major thermal source of energy, mostly for cooking. Some biogas projects in Honduras, for example, EECOPALSA, on a smaller scale, 1.33 MW, capture methane from oxidation lagoons oil palm located in El Progreso, and Yoro.

Private funds in renewable energy projects are constrained by lack of funds, high borrowin costs, increasing tariffs (for industrial sector, in particular), and know-how. Under international donors' project, *Scaling Up Renewable Energy Program* (SREP), one of the funds under the Clean Investment Funds (CIFs), the program has provided funds for pilot project to demonstrate the viability of energy access through renewable energy.

SREP is designed to provide impetus and harmonize with existing initiatives and the overall institutional architecture, enabling small scale renewable energy projects to be constructed. SREP fund will provide the bridge needed for local entrepreneurs facing financial barriers. These would ultimately add clean energy to the national energy grids, and reduce greenhouse gas emissions, while serving as role-models to the rest of the region.

6.4 Use of Renewable Energy for Productive Applications

Rural electrification, including through use of renewable energy (RE), often does not automatically create development benefits that are commensurate with the investment. It is, therefore, important to look and enhance productive uses of RE. Productive uses could be of several types. Broadly, they could be divided into those characterized as self-supply or as providing service to the local community and the second is characterized by a focus on and production for external markets. Common examples are crop drying or processing and water pumping are particularly important to small-scale agriculture.

Current portfolio of energy projects in Honduras contain only limited applications that are exclusively composed of productive uses components. There is a need to expand this to create income-generating opportunities.

6.5 Consolidated Summary

There is a strong potential and urgent need to develop renewable energy as power source and also to help reduce the use of oil, all of which is imported. Another way to cost-effectively increase energy supply is through (successful) implementation of energy efficiency measures. Increasing

[27] http://www.ahpper.org/honduras2.htm

energy supply will help increase access, improve its productive uses and bring better living standards.

7.0 SE4 ALL GOALS

To meet SE4ALL goals, the GOH need to develop and implement a multi-pronged strategy. It should increasingly look into developing hydropower and other renewable sources of energy. Such an approach will also help diversify the energy supply, making Honduras less dependent on imported oil and generate economically produced power, in most cases. Levelized costs (2010) for hydro plants in Honduras fall between low-cost (US$ 50-60/MWh), and high-cost ones (US$ 90-116/MWh). Open cycle gas turbines and medium speed diesels are estimated to be in the range of US$ 140 – 170/MWh. Coal-fired plants are estimated to be lower and fall in the range of 100-120/MWh.

GOH would also need to improve its management and implementation capacity, in addition to legislative framework as it relates to energy management and for attracting private capital. Such and other measures, details beyond the scope of this study, will help Honduras meet SE4ALL goals while assuring a sustainable supply of energy for its citizens. A well-developed approach and its sound implementation will:

- Ensure adequate supply to meet demand and provide for expanding demand.
- To build new transmission and distribution lines to evacuate new generation plants and improve power service delivery to different areas of the country.
- Address new connection barriers (connection costs, regulatory and non regulatory barriers)
- Take advantage of new technologies and improvement in technologies (LED's, solar systems)
- Use of decentralised generation, off-grid and stand-alone energy systems.

7.1 Challenges and Opportunities for achieving SE4ALL Goals

The government of Honduras is facing multi-pronged challenges towards ensuring a reliable, efficient, and sustainable energy supply under difficult circumstances. The power sector, overall, is in crisis: high electricity losses - technical and non-technical losses accounted for 28% in 2010 according to published data, lack of cost-recovery tariffs, negative cash generation, loss of ENEE's net worth, high dependency and volatile costs on imported liquid fuels for power generation, tight supply/demand balance, and a backlog of transmission investments are among the key challenges facing GOH.

Substantial and immediate corrective measures are urgently needed to prevent deepening of the power shortage to meet demand. Electricity demand is expected to grow at a high rate, some estimates show as high as 7 percent per year; at the lowest levels, about 300 – 350 MW in new generation capacity will be needed 2012/2013. The need could change depending upon economic and other needs.

High international oil prices are likely to persist, and generation costs may remain high and volatile. In addition, there is no fiscal space to finance the electricity sector or increase electricity subsidies. Hence the need to explore cost-effective power supply options is crucial.

GOH however has several tools that it can use to remove or mitigate the barriers. For example, opportunities include: improving financial health of ENEE through tariffs that reflect cost, minimizing the commercial and technical power losses, implementing energy efficiency measures, using renewable energy to augment the supply and reducing or eliminating subsidies over time.

8.0 INSTITUTIONAL AND POLICY FRAMEWORK

Institutional and policy framework is the backbone for developing and implementing energy project. It is important that the key institutions have sound financing and management expertise and are not under undue political influence. Sound institutional and policy framework is also important to attract foreign investment capital.

Since the late 1990s, the GOH has initiated numerous policies, attracted private capital. The government has provided public funds to drive the deployment of renewable technology. For example, the introduction of feed-in tariffs[28] regulation in Honduras, including connection to the grid, electricity purchases and preferential premiums, has provided the legal requirement for independent power producers to access the renewable energy market. To attract private capital, tariffs need to be high enough to cover costs and guaranteed for a long enough period to assure investors of a sufficient rate of return.

Private sector participation in energy is limited to generation. Nevertheless, attracting the private sector for the development of these capital-intensive projects with long construction periods by 2013 poses a major challenge. For example, it will be necessary to complete technical and economic feasibility studies and environmental impact assessments, find and select project sponsors, and implement an adequate financing structure (public/private partnership) to manage market and project risks. There may be additional site-specific needs. During the last few years, GOH has also granted concessions to private companies, most of them with Honduran capital, for the construction and operation of power plants using renewable resources such as hydroelectric, biomass and wind resources.

8.1 Institutions Responsible for Energy Development

The electricity sub-sector in Honduras is mainly driven by two state agencies: the National Energy Commission, CNE, and the National Electric Power Company, ENEE. The CNE is the regulator and ENEE is a state-owned company with vertical integration features, responsible for the entire operation of the electric power system. ENEE continues to buy all electricity via long term power purchase controls and manages the National Transmission System, SIN and the distribution. As of December 2010 ENEE generated only 36.6% of the total electric energy, purchasing 63.4% of the generated energy from the private sector[29]. See also Section 3.3.

GOH, however, need to further strengthen the technical and management capacity of its key power institutions. In particular, ENEE, the national utility has under-performed in terms of: (i) weak corporate governance and institutional instability associated with frequent management changes, (ii) high non-technical losses and poor bill collection resulting in inadequate revenue

[28] Feed-in tariff and quotas are price-driven regulatory instruments, which, instead of establishing a target, offer financial assistance per unit of electricity or capacity for the generation of renewable energy. The schemes accompanying these instruments either pay a predetermined price per unit of production (feed-in tariffs) and do not depend on the cost of production, or else they pay as quota, in which case the market price of electricity increases by the premium set.

[29] http://www.hondurasisopenforbusiness.com/files/pdf/Oportunidades_de_inversion_Energia_ingles.pdf

generation, (iii) insufficient supply capacity to meet demand, and (iv) below-cost electricity tariffs, coupled with ill-targeted subsidies.

To improve efficiency, ESMAP recommends restructuring ENEE and create Independent Business units (IBUs) for distribution, transmission/dispatch, and generation. Keeping separate accounts and transfer prices, will provide incentives to improve efficiency (performance of individual units can be monitored and rewarded), facilitate regulation of distribution and transmission.

8.2 Thermal Energy for Households

Biomass - fuelwood, agribusiness activities, including sugar mills, African oil palm producers and lumber mills, biogas from treatment ponds, and similar wastes - is the most common source of thermal energy for household use such as for cooking as well as electricity generation in many locations. The estimated potential resource of biomass waste is 300 MW, according to a report of the Bariloche Foundation commissioned by SERNA. In late 2009, sugar mills had a combined installed capacity of 88.2 MW and produced surplus electricity for sale to the grid totaling 156.1 GWh, representing 2.4% of the total generated in the country. See also, *Table* 2: Installed Renewable Capacity in Honduras by Private Producers, 2008, (in MW)

Going forwards, several export opportunities associated with the CAFTA and the good experiences of these cogeneration systems are stimulating additional investments in the sugar industry in systems with better efficiency to produce power. This has the potential to double the existing installed capacity.

8.3 Power Sector

Honduras has implemented an energy matrix diversification policy in order to reduce energy price volatility, decrease generation costs and improve energy security in the country. The country's natural resources have enormous potential and show the potential to develop at competitive prices considering that the oil price will keep moving in an upward trend for a long time. Additionally, the implementation of the regional SIEPAC project will expand the regional energy market potential and is likely to promote the development of big generation projects. In terms of SE4ALL goals, going forwards, the following is listed.

- Physical Access: Access to electrification would be provided through various means, as listed earlier. Included are the public and private sector partnerships. Separate regulatory accounts, transparent pricing, and benchmarking to help develop competition—reduce barriers to open access and increasing autonomy of dispatch - and similar measures are useful to improve access.
- Availability: A number of planned projects, as listed earlier, would increase power availability in Honduras
- Reliability: Given proposed improvements in ENEE and increased private sector participation in various facets of energy in Honduras, improved reliability of services can be expected.
- Sustainability: It is hoped that all the above factors will improve sustainability of power. In addition, GoH may consider creation of a public entity dedicated exclusively to the formulation, implementation and continuous updating of a sustainable and comprehensive national energy policy. This will help close the gap of the large dispersion in the decision- making process and in the management of projects and future investments in energy. Such an entity, must however efficiently take advantage of

existing resources to ensure quality of service, its sustainability and mitigating private participation risks, real or perceived.

The electric system of Honduras currently has seven hydroelectric power plants and three thermal power plants owned by ENEE. The largest of them is the *Francisco Morazán* Hydroelectric Power Plant with an installed capacity of 300 MW. Additionally, the private sector, as of 2010/2011 has a total of 39 power plants distributed as follows: thirteen (13) small hydroelectric power plants, ten (10) power plants using biomass and one (1) power plant using *bio-diesel*, which contribute to renewable energy generation. There are also 15 thermoelectric generation power plants. The installed capacity is highlighted by *Table 8: Installed capacity as of December 2010* and provides an overview of the mix of resources used to provide power as well as increasing role of the private sector. The trend could prove useful for GOH policy makers.

Table 8: Installed capacity as of December 2010

Power Plants	Installed Capacity (MW)
Hydroelectric power plants owned by ENEE	464.4
Thermal power plants owned by ENEE	124.6
Private thermal power plants	867.9
Private hydroelectric power plants	62.0
Private biomass power plants	91.4
TOTAL	**1610.3**

To help meet current and projected power demand, ENEE has an Expansion Plan that incorporates several small- and medium-scale renewables-based power projects. The Plan anticipates the withdrawal of some thermal power plants and the construction of big power plants using wind and biomass resources as well as hydroelectric power plants with an aggregate capacity of 358 MW. As a result of the Plan and on-going activities, energy mix changes from 1990 to 2010 have occurred.

Table 9: Main indicators in the electricity market

	1990	1995	2000	2005	2007	2008	2009	2010
Electricity coverage	38.1%	45.3%	54.0%	63.9%	71.4%	76.4%	79.3%	81.3%
Recent evolution, installed capacity (MV)								
Hydro	431	434	435	479	520	520	522	526
Co-generation	0	0	0	60	68	80	42	20
Diesel	87	206	382	915	913	899	870	892
Gas	15	116	103	73	73	73	73	73
Coal	0	0	0	0	0	8	8	8
Biomass				91		91		
Total	**533**	**756**	**920**	**1,527**	**1,574**	**1,580**	**1,606**	**1,610**
Renewable capacity percentage	80.9%	57.4%	47.3%	31.4%	33.0%	32.9%	38.17%	38.32%
Maximum demand	351	504	702	1,014	1,126	1,205	1,203	1,245
Recent evolution of the net generation (GWh)								
Hydro	2,279	1,676	2,262	1,718	2,214	2,305	2,797	3,080
Co-generation	0	0	0	115	109	243	34	9
Diesel	0	882	1,441	3,764	4,007	4,210	3,409	3,433
Gas	0	239	362	274	NA	57	56	12
Coal	0	0	0	0	0	0	45	47

Biomass				156		142		
Total	**2,279**	**2,797**	**4,065**	**5,871**	**6,330**	**6,815**	**6,497**	**6,723**
Renewable generation percentage	100.0%	59.9%	55.6%	29.3%	35.0%	33.8%	45.4%	47.9%
Public net generation (GWn)	2,279	1,915	2,262	1,653	2,023	2,010	2,565	2,731
Private net generation (GWn)	0	883	1,477	3,972	4,311	4,805	3,974	3,991
Net generation (%)	0.00%	31.56%	39.50%	70.61%	68.06%	70.51%	60.77%	59.37%
System losses (%)	23.2%	27.0%	18.1%	23.3%	21.2%	20.6%	22.5%	23.6%

Source: http://www.hondurasisopenforbusiness.com/files/pdf/Oportunidades_de_inversion_Energia_ingles.pdf

9.0 PROGRAMS AND FINANCING

GOH has introduced several measures, some ongoing and others, planned or proposed, to increase energy supply, energy access, affordability and sustainability. Included in these are measures to increase use of renewables for grid- and non-grid power and energy efficiency as well as increase private sector participation. All these interventions are in line with SE4ALL goals. The followings lists key approaches to meet these goals.

- Energy supply It would be increased through planned projects, energy efficiency measures, increasing tariff (which will save on wasteful use of energy), and better metering, monitoring etc. to prevent thefts. Private sector will be an active partner in increasing power supply. Relevant additional information is included elsewhere in the report. Rural areas are getting priority consideration.
- Access: Access to electrification would be provided through various means, as listed earlier. Included are the public and private sector partnerships. Separate regulatory accounts, transparent pricing, and benchmarking to help develop competition—reduce barriers to open access and increasing autonomy of dispatch—and similar measures can significantly help improve access. Power availability and affordability should increase given potentially increased power supply as well as private sector participation, as listed earlier.
- Demand: For the poor, GOH provides lifeline rates for electricity. Poverty alleviation schemes, on-going and planned, upon successful implementation, increasingly will help uplift people from poverty. With increased income, the group is likely to experience economic growth and potentially better living standards. Better energy management will ensure sound demand management, as well.
- Sustainability: With domestic and international donor assistance, GOH is implementing initiatives such as towards improving Cookstoves as well as disseminating information on (indoor) smoke's adverse health impacts. Some reforestation activities are also underway.

As part of the poverty reduction program, and to improve energy supply, an Investment Plan (IP) was prepared under the leadership of Government of Honduras (GOH), which established a SREP technical committee with representatives of the Ministry of the Presidency (SDP), Ministry of Finance (SEFIN), Ministry of Natural Resources and Environment (SERNA), the National Energy Commission (CNE), *Empresa Nacional de Energía Eléctrica* (ENEE), and a representative of the private sector from the Honduran Association of Small Renewable Energy Producers (AHPPER). Expansion plans include the addition of 2,095 MW of net generating capacity over the period 2008–2022. In addition, GoH is taking other additional measures.

During 2009 and 2010, the government awarded several contracts approved by the National Congress of the Republic. Additionally, a memorandum of understanding was signed with Sinohydro, a stated-owned company of the People's Republic of China, for the construction of the Patuca III Project (or Piedras Amarillas) with a capacity of 104 Megawatts, and the construction of two additional projects on the same river is anticipated in the short term: Patuca IIA (or La Terrosa) with 150 MW and Patuca II (or Valencia) with 270 MW, making a total anticipated capacity of 524 MW. Los Llanitos (98 MW) and Jicatuyo (173 MW) hydroelectric power plants are also top priority projects open to foreign investment.[30] *Table 10: Expansion Plan 2011- 2010* provides a historic perspective.

Table 10: Expansion Plan 2011- 2010

	1990	1995	2000	2005	2007	2008	2009	2010
Electricity coverage	**38.1%**	**45.3%**	**54.0%**	**63.9%**	**71.4%**	**76.4%**	**79.3%**	**81.3%**
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Biomass							91	91
Total	**533**	**756**	**920**	**1,527**	**1,574**	**1,580**	**1,606**	**1,610**
Renewable capacity percentage	80.9%	57.4%	47.3%	31.4%	33.0%	32.9%	38.17%	38.32%
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Diesel	0	882	1,441	3,764	4,007	4,210	3,409	3,433
Gas	0	239	362	274	NA	57	56	12
Coal	0	0	0	0	0	0	45	47
Biomass							156	142
Total	**2,279**	**2,797**	**4,065**	**5,871**	**6,330**	**6,815**	**6,497**	**6,723**
Renewable generation percentage	100.0%	59.9%	55.6%	29.3%	35.0%	33.8%	45.4%	47.9%
Public net generation (GWn)	2,279	1,915	2,262	1,653	2,023	2,010	2,565	2,731
Private net generation (GWn)	0	883	1,477	3,972	4,311	4,805	3,974	3,991
Net generation (%)	0.00%	31.56%	39.50%	70.61%	68.06%	70.51%	60.77%	59.37%
System losses (%)	23.2%	27.0%	18.1%	23.3%	21.2%	20.6%	22.5%	23.6%

Source: http://www.hondurasisopenforbusiness.com/files/pdf/Oportunidades_de_inversion_Energia_ingles.pdf

Overall, going forwards, GOH's energy policy is focused on the following.

a) Reduce dependency on fossil fuels to generate electric energy through the promotion of renewable energy generation.
b) More intensive use, development and promotion of bio-fuel production taking advantage of the production potential of the African palm tree, pine nut kernel, and agricultural and forestry waste;

[30] http://www.hondurasisopenforbusiness.com/files/pdf/Oportunidades_de_inversion_Energia_ingles.pdf

c) Strengthen and modernize the Transmission and Control Infrastructure of the National Interconnected System within the framework of better integration to the regional electricity market aimed to grid maintenance and loss reduction based on an energy efficiency promotion policy in Honduras.
d) Improve institutional and implementation support including through assistance from international donors.

10.0 PRIVATE SECTOR AND ENABLING BUSINESS ENVIRONMENT

Private sector participation in energy has been increasingly, albeit at a slower pace, in Honduras. For example, in 2010, the participation of the private sector in electric power generation represented 60% of the total power produced in Honduras.[31] For private sector investment, the following is worth noting:

a) Honduras has vast renewable resources to generate electricity.
b) A legal electricity sub-sector framework open to local and foreign investment.
c) Provide legal guarantees and competitive tax incentives.
d) Eliminate barriers to regional trade.
e) Institutional strengthening and establishment of regional regulations.
f) Establish national and regional infrastructure.
g) Simplify administrative procedures to set up businesses.
h) Establish minimum environmental protection and development standards.

To strengthen private sector participation and to attract foreign capital, GOH has developed several regulatory measures. For example, the Law of Incentives for Renewable Sources, Decree 85-98 and Decree 70-2007, establishes a series of incentives for the promotion of electricity projects based on renewable energy sources. The incentives specified by the law are for those using hydraulic, geothermal, solar, biomass, wind, alcohol, urban solid waste, and vegetal sources.

Moreover, in order to guarantee the promotion of projects based on renewable resources, GOH requires that contracts for electricity from renewable resources will have dispatch priority over others using non-renewable resources**.** As a result of additional contracts' approval by the National Congress, the implementation of 50 private power plants is expected in the next five years. Most of them will be hydroelectric power plants but some of them will be wind, geothermal and biomass power plants. Approximately 250 MW of the total capacity have been reserved for ENEE, and the remaining capacity, approximately 450 MW will be intended for the Big Consumers.

Notwithstanding the above, several barriers still exist for increased private sector participation. Key one include:

- High Cost: While there is a strong political motivation to improve access to electricity of rural populations, particularly those far from the grid. However, the cost of doing so has become increasingly high and there has been little effort to adopt new technologies and approaches. Grid extension is virtually the only approach by ENEE / OES-FOSODE to rural electrification and little attention has been paid to decentralized options.

[31] http://www.hondurasisopenforbusiness.com/files/pdf/Oportunidades_de_inversion_Energia_ingles.pdf

- Uncoordinated Approach: Other actors like SERNA or NGOs act uncoordinated from OES-FOSODE and lack sufficient financial resources to carry out dissemination programs for off-grid technologies.

- Lack of skills: For example, in operating small power generating plants and mini grids. There are few examples where micro- and mini-hydropower plants are managed successfully in rural areas in Honduras and the number of sufficiently qualified persons is low. This refers to technical skills necessary to maintain and repair the system as well as to management skills regarding appropriate fee-setting and operation of the plant.

- Insufficient availability of micro-finance schemes: Such as for energy technologies in rural areas. Large parts of the country have almost no access to institutional micro-finance services and must rely largely on moneylenders, suppliers, family and friends for short term seasonal loans. There are no secure liquid savings options available to these households, which would enable them to build assets over time. Existing micro-finance institutions often have a narrow credit product line (e.g. Soluz offers credit sales but only with down payment off 50% and a payback time of up to 6 months), limited experience in rural markets and a lack of access to best practice information and technical tools.

- Lack of a marketing and maintenance structure for energy technology devices: This is particularly true in rural areas. Almost all retailers are established in cities with no outlets are in the rural communities. Thus, clients have to travel to cities to purchase energy devices and for repair orders, which is difficult for most rural families. Establishing rural outlets are considered not to be profitable due to the high costs for transportation and mobilization, the dispersed nature of the populations and the low income and low demand of the local population.

While private sector has made in-roads toward energy generation, especially from renewable, including hydro, the progress could have been better with timely mitigation of the barriers. Several private entities such as Mesoamerica have successfully entered the market.

It is anticipated that by the year 2022, the energy sector will have implemented public, private and mixed investments for the development of renewable energy generation projects in a way that the energy matrix will show a net share equivalent to 60% serving the total demand of the household, commercial and industrial sectors through the use of renewable energy sources. Energy investments will transform the generation matrix and renewable energy will have a majority 80% share and fossil fuels will have a 20% share.

11.0 GAPS AND ANALYSIS

In addition to power generation shortfalls, there also exists a large backlog of transmission and sub-transmission investments. These could not be implemented as planned due to financial constraints and ENEE had to install expensive diesel generation in some congested industrial areas in the north and downgrade the transmission planning reliability criteria. Further delays in strengthening the transmission networks will increase the probability of blackouts, operating costs, and electricity losses, and worsen the quality of service. GOH must look into such situations on a priority basis.

In addition, GOH's energy policy must be able to develop various energy sources and guide both the government and the private sector, to the planning and development of alternative energy sources and sustainable growth of the Honduran economy. Current thermal dominance of the oil-

based power is very expensive since all the oil is imported and the price shows high volatility. It is imperative that GOH on an expedited basis moves towards significantly adding renewable, for example, hydro and biomass, to the energy mix.

The current interaction gap between the energy institutes such as ENEE, and the economic ministries of Honduras need to be (significantly) narrowed. This will help in better utilization of the benefits of the on-going dynamic technological advances that can drive economic growth. ENEE structure needs to be looked into. A number of central American countries have implemented vertical unbundling of their utilities with significantly positive impacts.

GOH has taken some commendable steps towards improving the existing situation. For example, the government has implemented a generation diversification policy through the execution of generation projects using renewable sources, especially hydroelectric sources, by the private sector (recent bid for 250 MW) and the public sector with the signing of the memorandum of understanding with Sinohydro, a state-owned enterprise of the People's Republic of China, for the construction of the 104 MW Patuca III or Piedras Amarillas Project.

Currently, as stated earlier, the hydroelectric potential of Honduras is approximately 5,000 MW, of which only approximately 10.5% is used. Likewise, the wind energy potential in the country is estimated at approximately 1,200 MW and a very small fraction is currently in use. In general, the following barriers could be summarized:

- High upfront cost of renewable energy technologies like solar or the small hydros;
- It takes long time to mobilize funds, require excessive government guarantees and often, capital is over priced;
- Limited public and domestic financial resources to invest in large infrastructure power projects;
- Uncertain global energy markets have reduced capital inflows into the emerging markets;
- Lack of institutional and regulatory framework of PPPs; and
- A lack of institutional capacity to deal with such issues as integrated least-cost system planning, increased access, and sustainability of hydro resources.

Annex 1: On-going Initiative By the Honduras Government and Development Partners

The following lists major ongoing and/or planned power projects in Honduras.

Description	Funding (in US $)
Construction of the Amarateca Substation, 230/128 KV. 150 MV; 230/ 34.5 KV, 50 MVA	26,880
Expansion of the Naco Substation and construction of the Erandique and Chichicaste	2,800
Substations	
Construction of the138 kV SPSS-Naco, 69 kV Las Flores-Erandique, and 69 kV Danlí- Chichicaste lines.	9,000
Construction of the 34.5 kV sub-transmission line from the Erandique Substation to the municipality of La Virtud.	732

The following projects will be funded through private renewable generation

Construction of the Cuyamel Substation and the 138 kV Masca-Cuyamel line, 40 km.	11,406
Construction of the León Substation, installation of a 138/69/34.5 kV 50 MVA transformer, opening of L.516 Line and construction of two (2) 477 MCM Flicker conductor lines of 13.66 km each	7,429

The Empresa Nacional de Energía Eléctrica (ENEE) has programmed the execution of the following projects with national funds:

Description	Funding (in US $)
Construction of the Catacamas Substation and the 69 kV Juticalpa-Catacamas Line, 40 km, single circuit, 477 MCM; expansion of the Juticalpa Substation.	7,779
Expansion of the Zamorano Substation.	1,258
Expansion of the Cañaveral Substation.	1,913
Expansion of the Siguatepeque Substation on the high voltage side (138 KV) and on the medium voltage side (34.5 KV), opening L550 line and new 34.5 KV distribution circuits.	1,305
Construction of the La Victoria Substation, 138/13.8 KV, 50 MVA.	5,548
Construction of the Cerro Grande Substation.	3,175

Published information suggest that the following projects can be funded through public-private partnership.

Description	Funding (in US $)
Construction of the Centro Substation, the Bellavista-Centro line, 2.5 km, single circuit, 477 MCM conductor 138 kV, and expansion of the Bellavista Substation.	7,146
Construction of the Cerro Hula-Danli Line, 80 km; and a 50 MVA_230/34.5 kV Transformer.	11,700
Construction of the Tocoa Substation.	4,225
Expansion of the Masca Substation on the high voltage side (138 kV) arranged in a loop, expansion on the medium voltage side (34.5 kV) and a 50 MVA/138/34.5 kV) transformer.	2,407
Expansion of the Isletas Substation.	1,541
Expansion of Toncontín Stage II	7,700
Construction of the San Pedro Sur - Ciudad El Progreso Line, 45 km; expansion of the Progreso Substation and SPS	7,603
Construction of the Ocotillo Substation.	5,507
Construction of the Buenos Aires Substation	5,548

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