Climate Investment Fund

SCALING-UP RENEWABLE ENERGY PROGRAM (SREP)

SREP - Investment Plan for Haiti

March 27, 2015

Ce document est en révision par le Ministère des Travaux Publics, Transport et Communications (MTPTC) et est donc une version provisoire. Il sera publié dans sa version finale après approbation et traduction en langue française.

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ACRONYMS AND ABBREVIATIONS

BME	Bureau of Mines and Energy
BRH	Bank of the Republic of Haiti
CBA	Cost Benefit Analysis
CDM	Clean Development Mechanism
CEAC	Cooperative Electrique de l'Arrondisement des Coteaux
CFI	Centre de Facilitation des Investissements
CIAT	Interministerial Committee for Regional Development
CIDA	Canadian International Development Agency
CIF	Climate Investment Fund
CMEP	Council for Modernization of Public Enterprises
CO2	Carbon Dioxide
CTF	Clean Technology Fund
CTIPFAN	Climate Technology Initiative Private Financing Advisory Network
DID	Desjardins International Development
ECVMAS	Enquête sur les Conditions de Vie des Ménages Après le Séisme
EDH	Électricité d'Haïti
FI	Financing Institution
GDP	Gross Domestic Product
GoH	Government of Haiti
HFO	Heavy Fuel Oil
HTG	Haitian Gourde
IAP	Indoor Air Pollution
ICF	Interim Cooperation Framework
IDB	Inter-American Development Bank
IEA	International Energy Agency
IFC	International Finance Corporation
IHSI	Haitian Institute of Statistics and Informatics
INFP	l'Institut National de la Formation Professionnelle
IP	Investment Plan
IPP	Independent Power Producers
kW	Kilowatt
kWh	kilowatthour
LAC	Latin America and Caribbean
LCOE	Levelized Cost of Electricity
LNG	Liquefied Natural Gas
LV	Low Voltage
M&E	Monitoring & Evaluation
M2M	Machine-to-Machine
MARNDR	Ministry of Agriculture, Natural Resources, and Rural Development
MCFDF	Ministère à La Condition Feminine Et aux Droits de la Femme (Ministry of Womens Affairs and Womens Rights)
MCI	Ministry of Commerce and Industry
MDE	Ministry of Environment
MEF	Ministry of Economy and Finance
MENFP	Ministre de l'Éducation Nationale et de la Formation Professionnelle

MFI	Microfinance Institution
MG	Micro-Generation
MJSP	Ministry of Justice and Public Security
MNFA	Government of Norway Ministry of Foreign Affairs
MTOE	Million Ton Oil Equivalent
MTPCT	Ministry of Public Works, Transportation and Communications
MV	Medium Voltage
MW	Megawatt
MWp	Megawatt-Peak
NGOs	Non-Governmental Organizations
NRECA	National Rural Electric Cooperative Association
NREL	National Renewable Energy Laboratory
OIA	Operations Improvement Agreement
OLADE	Latin American Energy Organization
PADF	Pan American Development Foundation
PCU	Project Coordination Unit
PIDG	Private Infrastructure Development Group
PNDSE	National Energy Sector Development Plan
PPA	Power Purchase Agreement
PPCR	Pilot Program for Climate Resilience
PREPSEL	Projet de Réduction de Pertes dans le Secteur Electrique
PV	Photovoltaic
RENET	Renewable Energy Education Network
RESEPAG	Strengthening Agriculture Public Services Program
SAC	Semi-Autonomous Centers
SE4All	Sustainable Energy for All
SELF	Solar Electric Light Fund
SHS	Solar Home System
SME	Small-Medium Enterprise
SPP	Small Power Producers
SREP	Scaling-up Renewable Energy Program
UN	United Nations
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
US DOE	United States Department of Energy
WB	World Bank
WBG	The World Bank Group
WTP	Willingness to Pay

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FIGURE 1. GEOGRAPHICAL MAP OF HAITI

Source: http://mapsof.net/uploads/static-maps/un_haiti.png

1 COUNTRY CONTEXT: ENERGY STATUS AND POLICIES

1.1 HAITI'S CURRENT DEVELOPMENT STATUS

Haiti accounts for one third of the Hispaniola Island in the Caribbean, neighbouring the Dominican Republic and covers a territory of 27,750 km^2. The Haitian Institute of Statistics and Informatics (IHSI), estimates the current population at 10.9 million people,[1] which makes Haiti one of the most densely populated countries in the Latin America and Caribbean (LAC) Region.[1] In addition, at least 2.5 million Haitians are estimated to live abroad. The Haitian diaspora is an important source of remittances, which is estimated to amount to well over US$1.8 billion annually.[2] This is comparable in magnitude to approximately one third of Haiti's GNP and in fact exceeded all international assistance combined following the 2010 earthquake.

FIGURE 2. HAITI'S 10 ADMINISTRATIVE DEPARTMENTS

Administratively, the country is organized into 10 departments (Figure 2); more than a third of the Haitian population lives in the Western department (Ouest), which contains the capital (Port-au-Prince) metropolitan area. Haiti has experienced steady urbanization over the last 30 years, with rural population share declining from 75.5% in 1983 to 55.6% in 2003, projected to fall to 48.1% by 2015.[3]

Haiti's GDP per capita stands at US$820 in 2013[4]—compared to LAC average of US$11,770.[5] According to the latest ECVMAS household survey in 2012, 6 million out of 10.4 million (almost 60%) of the

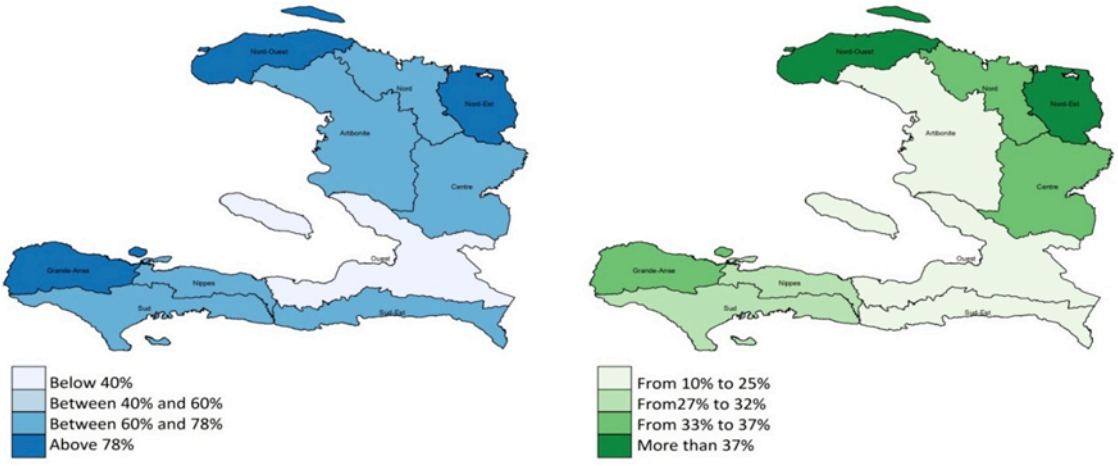
[1] Haiti Census, 2003
[2] FONKOZE, 2012
[3] Haiti Statistical Institute
[4] World Bank, 2014
[5] PPP, 2011

population was poor, living under the national poverty line of US$2 per day, and almost a quarter of the population was extremely poor, living below US$1 a day. Haiti ranks 161st in the UN's 2014 Human Development Index (2014). Economic development has repeatedly been interrupted by external shocks, including food and fuel price fluctuations and natural disasters. The most devastating impact was registered from the magnitude-7.0 earthquake on January 12, 2010, which killed, according to Government sources, around 300,000 people and displaced 1.5 million in Haiti's capital and nearby towns, making it one of the deadliest natural disasters on record. It resulted in damages and losses of around US$8 billion (120% of GDP). One third of the country's civil servants and most of government buildings disappeared in the earthquake. The country is only now beginning to recover from this disaster.

There is an increasing disparity in poverty between urban and rural areas. 38% of the population in rural areas is still unable to satisfy its nutritional needs and almost 70% of rural households are considered chronically poor – being both below the poverty line and lacking access to basic goods and services, making it especially difficult for them to emerge from poverty. Eighty percent of those classified as extremely poor live in rural areas.

The poverty also varies geographically. The poorest Departments are the farthest from the capital and the most isolated—North-West, North-East and South (Figure 3). In addition, Haiti is the most unequal country in the LAC region. The richest quintile holds over 64% of the total income of the country, compared to the poorest quintile holding less than 1%. As of 2012, the Gini coefficient is 0.61, the highest in the region.

FIGURE 3. POVERTY (BLUE) AND EXTREME POVERTY (GREEN) BY DEPARTMENT



Sources: ECVMAS 2012; World Bank

In order to decrease rural and urban disparities, the Government has embarked in the process of decentralization since 1987. Since 2006, the law on decentralization allows

municipal government, among others, to implement municipal production, distribution and commercialization of energy, as well as manage municipal energy infrastructure.[6]

Although the framework for decentralization exists, in practice access to public services and public goods mainly occurs in the largest metropolitan areas. The capital metropolitan area is rapidly growing, and at nearly three million people—and an infrastructure dating back to the late 1970's—the urban center is unable to function with efficacy; the negative externalities hinder further growth. Therefore, Government policies continue targeting investments and job creation in secondary cities. Access to reliable and affordable energy in secondary and tertiary cities, as well as in rural areas, is a lynchpin to this decentralization process. Government strongly believes that SREP can play a supportive role to increase access to decentralized sources of power, particularly in isolated rural areas.

1.2 ENERGY DEMAND

Haiti's energy sector is characterized by intensive use of biomass fuel (mostly firewood and charcoal), imported fossil fuels and a largely untapped renewable energy potential. Total primary energy consumption in Haiti is 0.38 tons of oil equivalent (toe) per capita, one of the lowest in the world, and only a fraction of the average consumption in LAC countries.

According to the International Energy Agency (IEA), Haiti consumed a total of 4 million tons of oil equivalent (MTOE) in 2012, of which 20% (0.8 MTOE) consisted of net imports of conventional energy sources. Haiti's total petroleum product imports amounted to US$755 million in 2012.[7] In the same year, biomass (wood and charcoal primarily, but also sugar cane/bagasse waste in much less volume) represented 75% of total energy consumption, petroleum products comprised 23%, and hydropower accounted for 3% . The residential and commercial sectors account for most of the energy used in Haiti.

Charcoal, made from the rapidly declining resource of trees in Haiti, is the single largest source of household energy in urban areas (91% of households use charcoal).[8] In rural areas, woodfuel (twig) dominates as the primary fuel for household cooking. Inefficient cooking practices, coupled with high population density and severe poverty, place an enormous burden on Haiti's natural resources.[9] Efforts are ongoing to increase adoption of efficient cook stoves to reduce charcoal consumption and combat deforestation.

Electricity is available to only about a third of Haitian's population. In rural areas, electricity is rare (5%) and the Haitian households primarily rely on kerosene lamps and

[6] Decree of February 1st 2006, articles 114 - 115
[7] BRH
[8] Berkeley Study, 2003
[9] UNEP, 2013

candles. Following the 2010 earthquake, the dissemination of solar lanterns by NGOs (first phase) and sales by private companies (second phase) have helped reduce the consumption of kerosene used for lighting, but most of the unelectrified population still relies on kerosene. According to Entrepreneurs du Monde, nearly 7% of an average Haitian household budget is devoted to lighting; emerging results of the ECVMAS 2012 and Digicel/iiDevelopment 2014 survey[10] are in line with this estimate. Poor households spend relatively more on lighting than better off households. Improving access to reliable modern electricity services, particularly in rural areas, is therefore one of the key Government priorities.

The electricity demand has been rapidly increasing in the recent years, following Haiti's economic growth.[11] But the structural lack of power supply capacity has increased the volume of unmet demand, and the development of autonomous generation, both for personal and professional / community uses. The current peak demand is estimated at over 500 MW and is estimated to surpass TBD MW by 2020. It is therefore essential that Haiti's generation, transmission and distribution capacity increases correspondingly, so that economic growth is not constrained by electricity shortages. Renewable energy plays a prominent role in Government's plan to expand generation capacity, and the Government considers SREP the key tool for bringing in the required transformative change to attract renewable energy investments.

1.3 ELECTRICITY SUPPLY

The main provider of electricity services in Haiti is the national, Government-owned utility Electricité d'Haiti (EDH).

Generation and transmission

EDH generates approximately 15% of energy produced in Haiti, with the rest coming from independent power producers and the Tripartite Cooperation (Haiti-Venezuela-Cuba)[12] Current electricity infrastructure is aging and has been poorly maintained. Installed generation capacity is about 320 MW (Table 1), of which only 176 MW is available[13]—

[10] In the context of the Third Rural Energy Forum in November 2014, consultations with potential 1,400 urban and rural household beneficiaries were held through a telephone survey carried out in partnership with Digicel (Haiti cell phone operator). iiDevelopment then analyzed the data to inform the SREP-Haiti IP.
[11] More precise demand growth projections are currently being developed under the new Electricity Master Plan.
12 Since 2007, the Bolivar - Pétion - Martí Convention (Venezuela - Haiti - Cuba) confirmed the participation of the Venezuelan International Brigade in what is defined as 'integral development': cooperation for the transformation of the structural problems of Haiti. That same year, the Tripartite Intergovernmental Cooperation Office Haiti - Cuba – Venezuela was installed in Port-au-Prince. Specific plans include cooperation in the areas of health and education, agriculture and fair trade, as well as three 'grannacional' projects related to energy resources.
[13] EDH, March 2015

insufficient to meet estimated peak load demand of more than 500 MW, resulting in frequent load-shedding and service interruptions.[14] Most of the power is supplied through oil-based thermal generation (81% of diesel and fuel oil), with hydropower contributing 19%. Other than hydropower, there is no other grid-connected renewable energy capacity.

The largest hydro plant is Péligre (54 MW), currently under rehabilitation together with the associated transmission line connecting the plant to the metropolitan area, resulting in a temporarily reduced power output from the plant. Once completed, increased hydropower and transmission line capacity will facilitate integration of intermittent renewable energy into the grid.

EDH owns eight other hydro plants of smaller sizes, of which, however, only one is fully operational.

Distribution

EDH operates one main interconnected grid covering the metropolitan area and 11 isolated grids,, serving about 260,000 "active" customers (Annex VI).[15] Most of these customers are on the main grid covering Port-au-Prince and the surrounding areas, where also most industrial and business customers are. In 2014, EDH's 1,308 industrial customers represented about 40% of the power demand. The isolated grids serve the rest of the country, with power mostly supplied intermittently by diesel units and some hydropower, both with O&M problem

EDH faces considerable technical, managerial and financial challenges. Technical and non-technical losses are at 65%, large part of which can be accounted for by the illegal grid connections. In addition, collection rate is only at two thirds—meaning that EDH recovers only 22% of the value of electricity it generates. The losses contribute to an annual financial deficit of US$200 million—equivalent to 4% of the national budget.. Consequently, EDH faces difficulties to pay for fuels, basic maintenance services and other operating costs, and is relying on Government subsidies to bridge the gap.

[14] EDH, PPCR – CIAT

[15] "Active" describes customers that are connected legally and regularly pay bills according to EDH. The total number of people with electricity access (including "irregular" users) is larger, estimated at 350,000+.

TABLE 1. EDH GRIDS – CAPACITY AND CUSTOMERS

Grid	Installed capacity (kW)	Available capacity (kW)	Number of active customers
Metropolitan	248,000	98,800	160,487
Centre (Onde-Verte)	650	500	788
Nord	14,400	10,500	17,435
Nord-ouest	2,500	2,200	3,557
Nord-est	5,750	4,500	4,540
Sud(Cayes)	11,600	7,600	21,246
Sud-est(Jacmel)	5,150	4,450	11,413
Sud-est(Bainet)	310	200	included in Jacmel
Artibonite	24,650	19,200	20,645
Grand-Anse (Jeremie)	2,450	2,200	3,327
Ouest(Arcahaie)	2,000	0	2,611
Ouest (La Gonave)	425	350	625

Source: EDH, 2015

The average daily electricity service of only 16 hours compels most industries to self-generate, reducing their competitiveness. It is estimated that the cumulative capacity of individual diesel gen-sets in the country is more than 200 MW (more than the available power of 150 MW supplied through EDH). More recently, solar PV power has started to emerge as an alternative for self-supply in both urban and rural areas, but the solar PV industry in Haiti is still very small and in the naascent stage.

1.4 ELECTRICITY PRICING

Current electricity tariffs were established in 2009, however, as part of an ongoing Electricity Master Plan study, EDH is conducting an investment plan and tariff reform analysis.

Tariffs are distinguished by user (residential, commercial, and industrial and organizations), by location (within or outside Port-au-Prince) and by kWh usage. Users are charged a monthly fee, plus an additional tariff based on usage. Residential tariffs (US$0.21/kWh) are below the average of the Caribbean region, but tariffs for the industrial and commercial customers are on the higher end of the regional range (US$0.30/kWh). Connection fees are also differentiated by the type of the user, and are about $65 for residential customers. Higher rates are charged for commercial and industrial customers.

1.5 ENERGY POLICY AND STRATEGIC FRAMEWORK

The Government vision for the energy sector is based on the Strategic Plan for the Development of Haiti (SPDH), which sets a path for Haiti to become an emerging economy by 2030.

The SPDH plan envisages, inter alia, to strengthen the private sector and the provision of basic services to the population including electricity. The Martelly[16] administration has identified energy as one of its five priorities—the five 'E's (alongside education, employment, environment and rule of law – 'état de droit'). The January 2012 Draft Energy Policy Report (Avant-Projet de Politique Energétique d'Haïti) defined the Government's five key objectives of its energy policy as follows: (i) Ensure sufficient supply to meet demand and support economic growth; (ii) Promote energy savings and efficiency; (iii) Promote development of indigenous renewable sources of energy; (iv) Pursue exploration of fossil fuel sources in Haiti; and (v) Create a regulatory framework to encourage the development of supply while protecting the environment.

The present National Energy Sector Development Plan for the period 2007-2017 recommends specific improvement and development measures for the energy sector but is now rather outdated, as it was completed before the 2010 earthquake which dramatically altered the energy sector development needs. EDH is in the process of developing a new Electricity Master Plan, which should be available in late 2015.

The January 2010 earthquake exacerbated the challenges faced by the sector by worsening EDH's financial situation and undermining institutional and managerial capacities. The earthquake also damaged or destroyed a wide range of electricity infrastructure, increasing the emphasis on the physical inventory and the need to rehabilitate assets.

In the post-earthquake years, the Government therefore focused on rebuilding the essential energy infrastructure and making sure that critical loads were supplied in short- and medium- term. This reconstruction of energy infrastructure now being mostly completed, the Government is moving to longer-term priorities embodied in the SPDH plan.

Reaching the SPDH goal of becoming emerging country by 2030 will require dual electrification efforts: (i) supporting **off-grid** electrification efforts for rural areas that will not be served by EDH; and (ii) improving EDH performance and supporting **on-grid** generation capacity to enable EDH to provide reliable and affordable electricity services in urban areas and surroundings.

[16] Presidential and legislative elections launched in November 2010, were concluded in May 2011, with the swearing in of President Michel Joseph MARTELLY. He was the first opposition candidate in Haiti's history to accede to the post by democratic transition.

In this context, power sector reform and measures to improve financial performance of EDH are of critical importance. The Government's approach to address EDH precarious financial situation consists of three parallel tracks:

1. *Reduce EDH losses* by targeted investments in rehabilitation of existing transmission and distribution lines and a comprehensive plan to reduce commercial losses, starting with improving collections through the installation of new meters. The Government has developed a specific loss reduction program, which is now also being adopted as one of the key elements of the IMF program for Haiti World Bank's Rebuilding Infrastructure and Access Project is providing technical support and financing for its implementation. The key elements of the program are included in Box 1.

2. *Increase availability and reduce costs of power supply*, decreasing EDH dependency on the expensive fossil-fuel generators provided by IPPs. The diversification options include rehabilitation of existing hydro plants, LNG imports for power generation, and an increased share of renewable energy in the generation mix. The Government sees the SREP program as a catalyst to implement this ambition.

3. *Prepare the ground for a broader legal, institutional and regulatory reform*, which would clarify the legal framework, open the electricity sector to competition, incentivize private sector investments and establish a regulatory agency. The lack of a clear regulatory environment is considered as one of the main bottlenecks to developing the energy sector in general and scaling-up renewable energy activities in particular. The legal framework, based on *1989 Organic Law of Electricity* is by now very outdated, and discourages private sector investments. The resulting lack of competition is hurting consumers and constraining further development of this critical sector. The Government is currently carrying out various studies to help it structure these broader sector reforms.

1.6 THE RURAL ELECTRIFICATION CHALLENGE

Rural Electrification Status and Expenditure Patterns

The latest available official electrification rate according to EDH is 30%, but estimates vary due to unreliable statistics.[17] The electricity consumption per capita is more than 80 times lower than the average for the LAC region at about 30 kWh per year, reflecting the severe supply constraints discussed above, the low electricity access, and low-income levels. The distribution of electricity access is also highly unequal: while electricity access in Port-au-

[17] The recent ECVMAS 2012 and Digicel/iiDevelopment 2014 surveys suggest a significantly higher rate of access for 2014 (approaching 50%), especially if illegal connections and solar home systems are fully accounted for. ECVMAS 2012 estimates an electrification of 35% in 2012, and Digicel/iiDevelopment Survey 2014 found evidence for an even higher electrification rate (depending on definition) by December 2014 (around 45% after accounting for the inherent phone survey bias). However, it should be noted that both of these were not primarily geared towards measuring grid access rates, so they only provide rough indications of national access growth; the SREP baseline surveys will therefore establish a more exact baseline.

Prince is relatively high if irregular connections are accounted for, access in rural areas remains extremely low.

On average, households in Haiti currently spend about US$30 per month on electricity or electricity-substitutable expenditures. However, the Departmental and rural/urban averages vary strongly, and spendings are distributed such that the poorest half spend much less than this average, as Table 2 in the next section show.[18]

BOX 1. GOVERNMENT'S PROGRAM FOR REDUCING EDH LOSSES

EDH Management has recently developed an ambitious performance improvement and loss reduction program, which is now being finalized with direct involvement of MTPTEC and MEF, and support from MDBs and the IMF.[19] World Bank's Rebuilding Infrastructure and Access Project is providing technical support and financing for the implementation of all activities related to this plan, as needed. Short term objectives of this plan are to achieve overall yearly savings amounting over US$ 70 million to the utility (around 40% of the annual budget transfers to EDH), through (a) an optimization of fuel and electricity purchase (where the savings potential on EDH costs is the most important), and (b) significant improvement of all parts of the commercial value chain (new meters installation, automatic billing and bill recovery) with the objective of improving the commercial losses by 6% in one year.

Renewable Energy solutions to electricity needs

With EDH absent in most of the rural areas, local governments and users have been largely left on their own to find solutions to their electricity needs. Up to very recently, individual diesel systems (for AC power), kerosene and candles (for lighting) were the only available options for most people and diesel gen-sets for businesses in rural areas. As most households own cell phones, they also spend considerable amounts for their charging at commercial charging stations. While more than 36 smaller towns have diesel-powered mini-grids built by the municipal governments only a few of those are still in (regular) operation—and where they are, service is typically available for only a few hours in the evening.

More recently, renewable energy technologies, especially solar PV, have started to penetrate rural areas, reflecting the global trend of falling costs of solar PV, availability of low-cost, high-performance LED-lights, and the emergence of new business models aiming at serving rural customers.

According to a SREP/IDA-funded Digicel/iiDevelopment phone survey of 1,400 urban and rural households in November 2014, the penetration of solar lanterns and small kits in rural areas is high in international comparison. However, it varies considerably

[18] ECVMAS 2012 and Digicel/iiDevelopment 2014 Survey data

[19] IMF intends to include this EDH recovery plan as a structural measure of its 2015-2018 program in Haiti, to support the rapid reduction of budget transfers to the state power utility

geographically: The share of households with a solar lantern or small system ranges from 9% in the Central Department to almost 40% in South-East, with national penetration at about 16-17% (See Appendix for details).

TABLE 2. PENETRATION OF RENEWABLE ENERGY TECHNOLOGIES IN RURAL AND URBAN AREAS

Share of HH owning shs or pico	Rural	Urban	Grand Total unweighted	Number of Hosehold	HH with solar	HH without solar
ARTIBONITE	10%	10%	10%	402,126	40,213	361,913
CENTRE	10%	9%	9%	163,133	15,207	147,926
GRAND ANSE	19%	37%	26%	98,725	25,445	73,280
NIPPES	31%	44%	35%	81,236	28,256	52,980
NORTH	18%	12%	16%	213,773	33,533	180,240
NORTH EAST	12%	17%	15%	81,183	12,490	68,693
NORTH WEST	24%	26%	25%	146,283	36,834	109,449
PORT AU PRINCE	6%	16%	10%	890,601	88,470	802,131
SOUTH	39%	27%	34%	162,019	55,655	106,364
SOUTH EAST	44%	26%	37%	141,996	53,113	88,883
				2,381,075	**389,216**	**1,991,859**
				thus weighted average Haiti:		
				100%	**16%**	**84%**

Source: Digicel/iiDevelopment Survey (2014)

Paradoxically, the earthquake served as the catalyst for the initial speed of diffusion of off-grid renewables in Haiti. With much of the electricity infrastructure destroyed, solar lanterns have been brought into the country as part of the post-earthquake assistance. These lanterns, originally used by displaced people in the camps, have eventually found their way to rural areas and triggered demand for similar products. The quality of some products, however, is an issue. It is estimated that there are at least about 300,000 solar lanterns/kits in use in Haiti,[20] but only about half of them are quality-certified products, distributed mostly by local SMEs and NGOs. The four leading lantern distributors in Haiti have cumulatively sold well over 150,000 Lighting Global quality-certified lanterns,[21] providing basic electricity services to more than half a million people.

The post-earthquake assistance has also triggered investments in street lighting. Originally started as a reconstruction effort, the program has eventually been expanded to rural areas, and has actively been supported by the Government, mainly through the "Ban m limye, Ban m lavi" ("Give me light, give me life") program. There are about 13,500 solar streetlights installed in 140 municipalities of Haiti's 10 Departments.

The increased involvement of diaspora, NGOs and the private sector has led to the emergence of several new, highly innovative approaches to support provision of

[20] Digicel/iiDevelopment phone survey
[21] Sales reported by the solar lantern distributors

sustainable energy services in off-grid areas. Annex IV provide examples of these Haiti-grown innovative business models, ranging from micro-finance for solar lanterns, to leveraging mobile payments platforms for providing off-grid energy services, and to deployment of smart village micro-grids. Many of these initiatives have key attributes for replicability and scalability under SREP.

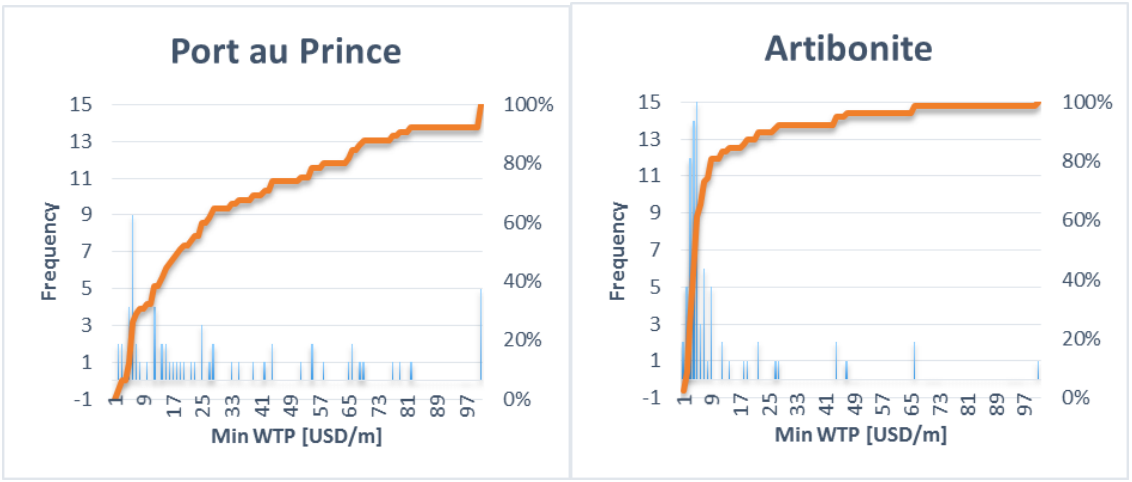
1.7 GENDER, ECONOMIC AND SOCIAL DIMENSION OF ENERGY IN HAITI

Development and Energy

The 2015 Haiti Poverty Assessment by the World Bank states that, despite a decline in both monetary and multidimensional poverty rates since 2000, poverty still remains high per regional standards. Access to basic services is generally low and is characterized by glaring inequalities. The Poverty Assessment highlights that special attention should be given to vulnerable groups such as women and children and to rural areas, where extreme poverty persists and where income inequality is increasing.

Households pay significant amounts for electricity and its substitutes. Surveys carried out in preparation of the IP found that more than 50% of households pay more than $20 per month. However, expenditure patterns vary geographically (Table 3) and between urban and rural areas. For example, in Artibonite, about 80% of the population spend less than UD$8 per month on electricity (and its substitutes), while in Port-au-Prince, only 10% pay less than that. (Figure 4 shows these different willingness to pay distributions patterns.)

FIGURE 4. ELECTRICITY EXPENDITURE PATTERNS IN ARTIBONITE AND PORT-AU-PRINCE



Source: Digicel/iiDevelopment Survey 2014

TABLE 3. AVERAGE ELECTRICITY EXPENDITURE BY DEPARTMENT

Average current substitutable energy expenses [$/m]	Rural	Urban	unweighted average
ARTIBONITE	$ 13.04	$ 23.65	$ 16.85
CENTRE	$ 22.84	$ 29.43	$ 25.06
GRAND ANSE	$ 20.78	$ 34.86	$ 27.51
NIPPES	$ 10.66	$ 26.72	$ 14.99
NORTH	$ 14.68	$ 36.66	$ 24.16
NORTH EAST	$ 17.95	$ 24.74	$ 22.37
NORTH WEST	$ 22.32	$ 37.14	$ 29.57
PORT AU PRINCE	$ 42.80	$ 44.76	$ 43.67
SOUTH	$ 11.37	$ 31.17	$ 18.47
SOUTH EAST	$ 13.22	$ 23.47	$ 16.72
(blank)			
thus, aprox. weighted national average			$ 29.55

Source: Digicel/iiDevelopment Survey 2014

Recognizing that access to modern energy and development are intrinsically linked drives the Government's efforts to increase access to modern energy services for its people. The Poverty Assessment highlights the importance of electricity as one of the key inputs to elevate productivity and create jobs for both employers and the self-employed by undertaking complementary investments in basic infrastructure and removing the constraints on access to inputs. This includes augmenting both credit and skills; with a special attention to women, who are particularly disadvantaged in labour markets.

Gender and Energy

Regarding women and children, the Poverty Assessment has gathered the following findings, which can help inform the design of gender-sensitive SREP interventions:

Economic Empowerment. Women and girls are particularly vulnerable because they often face obstacles to the accumulation and use of their assets, particularly their human capital. Despite sizable progress in education, adult women are still less well educated than adult men. Women in the Haitian labour market are significantly less likely to be employed and earn significantly less than men. Creating economic opportunities for women is one of the important measures to address the immediate and long-term needs of women and girls.

Voice, Participation and Agency. Low participation in the public sphere are widespread in Haiti. As an example, in the 49th Lesgilature from 2010 to 2014, only 4% of all parliamentary seats were occupied by women, placing Haiti 136th of 142 countries, and well below the regional average of 26%. At the national level, as of April 2014, 8 of 23 ministers (a ratio higher than 30%), and 3 of 20 secretaries of state were women. At the local level, women account for only 12% of all mayors.

Gender related activities in Haiti

The Government has taken steps to expand women's representation. One important step is the creation of the Gender Equality Office in Parliament and amendment of the Constitution to stipulate a quota of at least 30% women in all public offices. But there is no enforcement mechanism yet, and as such implementation remains low at all levels of formal political life.

In order to support the Government's efforts towards strengthening women in society, various governmental and non-governmental stakeholders have launched gender initiatives. In the energy sector, the Gender and Energy Interagency Commission was created in August 2014. The Commission was established by the Bureau of the Minister Delegate to the Prime Minister in charge of Energy Security, the Bureau of Mines and Energy and Electricity of Haiti with support of Latin American Energy Organization (OLADE). This commission, now operating under leadership of the Bureau of Mines and Energy, aims at promoting gender equality in the field of energy for sustainable development. It intends to build alliances across the country's institutions to coordinate efforts and ensure the implementation of the desired changes in the context of gender equality in all of them. It also regroups representatives of the Ministry of Economy and Finance, the Ministry of Women's Affairs and Women's rights (MCFDF), and the State University of Haiti. OLADE is currently supporting capacity building to provide the members of the commission with proper training and expertise. The Commission plans a Workshop on Gender and Energy on April 21 and 22, 2015, enabling Haitian women to gain a better understanding of renewable energy and the importance of community work in rural secluded areas.

On the ground level, several initiatives demonstrate that integrating women in the supply chain can not only enhance women's livelihood but can also improve the off-grid energy business and its sustainability. For example, MicamaSoley works closely with Haiti's largest micro-finance institution FONKOZE to distribute its solar products through women groups (Box 2).

BOX 2. HAITI SAFICO/MICAMASOLEY

SAFICO is a Haitian manufacturing and trading company that has existed for more than 60 years. In 2009, SAFICO created a "social" division, MicamaSoley, offering products that improve the lives of Haitians in rural Haiti, such as solar-powered lights, cell phone chargers and water filters. In its approach, MicamaSoley leverages existing distribution networks through a Partnership with Fonkoze, Haiti's largest microfinance institution, and the NGO CARE. SAFICO/MicamaSoley has sold successfully more than 54,000 solar lamps and systems mainly through women and women groups.

Fonkoze serves approximately 60,000 poor and ultra-poor women in rural Haiti, with 46 branches located throughout the country.[22] These female credit customers who are principally market women are organized in about 2,000 Credit Centers. Each Credit Center elects a female Chief to act as liaison with Fonkoze and to oversee the customers who in turn oversee a group of 10ish women which are all receiving micro loans. The hierarchical structure helps to keep on track with repayments, offer peer support, etc. In order to receive a loan, every woman goes through an extensive training and education program. MicamaSoley's distribution model through Fonkoze targets these Chiefs who are introduced to different products and who receive one solar lamp to take home and try out with no obligation. Few weeks later, Chiefs can either purchase the lamps or give them back. Those who purchase can then go on to purchase more lamps at wholesale to sell at retail price to members of their Credit Centers or to the general public. MicamaSoley returns to each of the branches every 5–6 weeks to keep the women supplied. Since 2009 and through this channel, MicamaSoley has recruited and trained over 1,200 Fonkoze Credit Center Chiefs and has sold over 50,000 solar lamps.

MicamSoley's second distribution network was developed with the NGO CARE, through a program, directed at helping women, called the Village Savings and Loan Associations (VSLAs). VSLAs are based on traditional savings methods existing around the world under various names; sol (in Haiti), susu, tandas, hui, etc. With support from CARE, VSLAs (20 to 30 women) meet weekly and save small amounts of money each week which are then made available to members as loans on an as-needed basis plus interest. Once a year all of the savings and accumulated interest are distributed amongst the members of the VSLA. When CARE identifies a natural leader in a VSLA, they offer training to become a Village Agent (VA) to help form other VSLAs. About 90% of the Vas are women. The collaboration with MicamaSoley has helped the VAs to become financially independent of CARE – by training and supplying them to be resellers of solar lamps. The idea is primarily to sell the lamps to the approximately 500 VSLAs that have been formed so far but also the general public in order to help them earn additional income to continue in their role as VA. In total, MicamaSoley has trained over 100 VAs and sold over 4,000 solar lamps through this channel.

[22] Fonkoze was founded in 1994/1995. Its name is an acronym for the Haitian Creole phrase "Fondasyon Kole Zepòl" meaning "Shoulder-to-Shoulder Foundation." https://www.youtube.com/watch?v=tq8uSiP6_lQ.

SREP will benefit from these lessons learned and will work closely with the Gender and Energy Interagency Commission to mainstream gender considerations in individual project interventions. The renewable energy capacity building platform developed under SREP can become an important tool for closing the opportunity gap between men and women in Haiti.

1.8 INSTITUTIONAL FRAMEWORK

The Ministry of Public Works, Transport and Communications (MTPTC) is the lead Government agency for the energy sector in Haiti. Official oversight of energy access activities is being handled by the offices of the MTPTC through the Energy Cell, created in late 2012.

The Bureau of Mines in Energy, established in 1986, operates under the supervision of MTPTC. Its mission is to promote research and efficient exploitation and use of the country's mineral and energy resources.

Electricity of Haiti (EDH), the State owned corporation, is the country's utility company primarily responsible for the electric power generation, transmission, and retail distribution.

There is no regulatory agency. EDH is being overseen by MTPTC and the Ministry of Economy and Finance (MEF), which provides subsidies to cover EDH losses.

Other Government ministries and agencies involved in the energy sector include:

- *The Ministry of Environment* (MDE), mainly responsible for environmental protection. As a transversal institution, it also can play a key role in promoting sustainable energy through, inter alia, the reduction of charcoal consumption, an increase in household energy with improved cook stoves, the diversification of energy resources towards renewable energy and an increase in rural energy access.

- *The Ministry of Commerce and Industry* (MCI), responsible for developing businesses within the country in order to improve job opportunities. This ministry is also aware of energy needs and has been involved in creation of energy-related laws, as for example the LPG law that will help improve household energy for cooking. This ministry is also involved in the franchising zone, in which electricity is required for most of those industries.

- *The Ministry of Economy and Finance* (MEF), responsible for budget support. This Ministry oversees budgets of the other government ministries, agencies and EDH and has the responsibility to supervise the other ministries on the agreements signed between Haiti and the development partners.

- *Interministerial Committee for Regional Development* (CIAT), which is the committee for territorial development and is chaired by the Prime Minister. The committee's mission is to define government policy on land use, protection and watershed management, water management, sanitation, planning and equipment.

- Center for Facilitation of Investments (Centre de Facilitation d'Investissement, CFI) created in 2007 in order to streamline the investment process by simplifying bureaucratic procedures and providing a range of economic and commercial information to potential investors,

Government is currently devising a plan for a new institutional structure for the electricity sector, in line with a broader reform agenda described in Section 1.5.

1.9 ROLE OF THE PRIVATE SECTOR

The private sector has become a key contributor to economic growth in numerous sectors. Haiti's private sector consists mainly of small and medium enterprises. There are around 900,000 micro, small and medium-sized enterprises, 60,000 of which are SMEs—small firms (with between 10 and 49 employees), and mid-size companies (with 50-250 staff). The private sector is dominated by the manufacturing sector (particularly the textile and garment industries) and the agricultural sector.

The energy sector has traditionally been demonitated by the state-owned EDH. As of recently, however, there has been an increasing activity of the private sector – both as operators and financiers. As part of SREP preparation, IDB is currently carrying out an in-depth supply chain assessment, which has identified about 30 local firms active in the solar supply chain, and about 10 genset suppliers.

1.9.1 INDEPENDENT POWER PRODUCERS

Although EDH has its own generation park and technically holds a monopoly over the country's electricity system, most power is currently produced by independent power producers (IPPs), including Sogener, E-Power, and HaytracIn total, IPP provide 130 MW operating capacity of which about 100MW for the metropolitan area. All IPPs produce power from thermal sources (diesel and heavy fuel), with a Power Purchase Agreement (PPA) with EDH. The private sector has also been exploring opportunities for grid-connected renewable energy (mostly solar and wind), with several developers discussing potential projects with the Government, but so far no PPA for renewable energy has been signed as potential RE IPPs are constrained by the PPA payment capacity of EDH (and the Government in case of an attached sovereign guarantee), which is a result of EDH's high technical and commercial losses and low payment-collection efficiency (See Section 2.2 on the key barriers).

1.9.2 RE DISTRIBUTED GENERATION, INCLUDING PRIVATE SECTOR, COOPERATIVES AND NON-GOVERNMENTAL ORGANIZATIONS (NGOS)

Considering the current limitations of the grid-connected renewable energy opportunities, most of the renewable energy activities have concentrated on off-grid market. In principle, off-grid market consists of two types of customers: (i) business and industrial customers – particularly in urban areas – that intentionally decided to isolate themselves from the EDH grid (due to reliability issues) and self-generate; and (ii) households, businesses and institutions in unelectrified areas – mostly in rural towns and villages.

Consequently, an industry has developed for both streams: There are several companies that offer solar PV alternatives to businesses to displace or complement their diesel generation, but the installed PV rooftop capacity is still very small (estimated below 4Wp). In addition, a number of private companies, NGOs and the first rural energy cooperative (established by NRECA in 2014) provide off-grid electricity services in rural areas – through village grids or individual systems. See Annex 4 for the description of innovative Haiti-grown business models to serve the base of the pyramid consumers. Furthermore, Several local companies also specialize on supplying and in one case manufacturing street lights.

In total, 27 companies involved in Haiti solar business approaches, and 10 companies active ingenset supply have been identified and analyzed as part of a supply chain analysis.

Several private sector players have recently initiated the creation of Haiti's first Renewable Energy Association, which would allow the private renewable energy sector to speak with one voice. Private sector interests and current initiatives in renewable energy sector will be reinforced with the support of SREP and will be fundamental in meeting SREP results.

1.9.3 FINANCIERS

Haiti's financial system includes a banking sector with eight commercial banks,[23] more than 220 credit cooperatives, and 21 Microfinance Institutions (MFIs). Branches from the commercial banks are highly concentrated in the greater Port-au-Prince region; more than two thirds of all commercial bank branches are located in Port-au-Prince metropolitan area and, of the eight commercial banks, only five have operations outside the city. Rural areas are mostly served by credit cooperatives. About 90% of the existing credit cooperatives operate in rural areas.

Microfinance fills the gap left by credit cooperatives and commercial banks. However, as of March 2008, there were approximately 150,000 borrowers from MFIs, three times the number of borrowers in the commercial banking sector. The average loan size outstanding

[23] Banque Nationale de Crédit, Banque Populaire Haitienne, Banque de l'Union Haitienne S.A., Capital Bank S.A., Citibank N.A. Haiti, The Bank of Nove Scotia, Société Générale Haitienne de Banque S.A. and Unibank S.A.

for the entire micro-finance sector was US$540 and less (source: case study on Haitian Microfinance Industry, 2008).

Commercial funding for renewable energy is still rare in Haiti. A Clean Technology Fund (CTF) funded project is currently under preparation for Haiti, which intends to establish a 'Renewable Energy Financing Facility' to be managed by a competitively selected financial intermediary (FI). The CTF project design envisages a credit line to private sector providers of renewable energy services and products (including NGOs, cooperatives, rural retailers and MFIs) for the investment in off-grid renewable energy projects. The CTF project is expected to build a robust energy project pipeline and further increase interest and capacity of Haitian's financing institutions (see Annex 5 for further CTF project details).

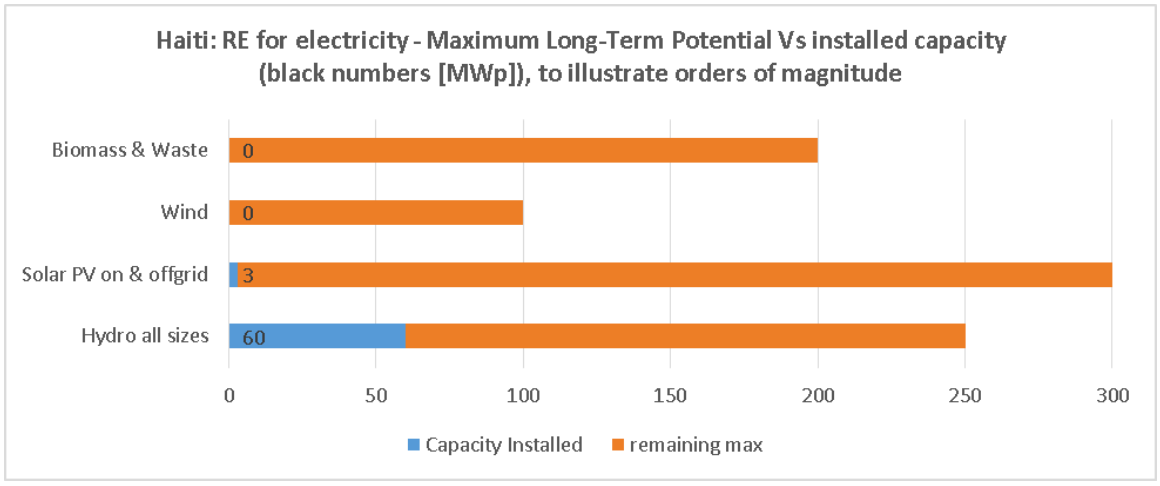
2 RENEWABLE ENERGY SECTOR CONTEXT

2.1 RENEWABLES IN HAITI'S ENERGY SECTOR

Haiti will need about TBD MW of new generation capacity by the year 2020. This means expanding their existing available capacity five-fold. A recent World Bank report[24] shows that in order to expand electricity supply, Haiti needs to diversify its power sources, and moving away from the expensive use of diesel and fuel oil. EDH is currently developing a new Electricity Master Plan, and it is expected that renewable energy will feature prominently in the least-cost expansion path. Needless to say, greater use of renewable energy would also help Haiti to set energy sector on a lower-carbon path.

Haiti has excellent renewable energy potential, including hydro, wind, solar and biomass, which is largely untapped, as confirmed by a variety of recent and ongoing studies. The following sections summarize this situation for each of the main RE resources.

FIGURE 5. A BIRDS-EYE VIEW OF HAITI'S RE POTENTIAL



Source: SREP Task Force

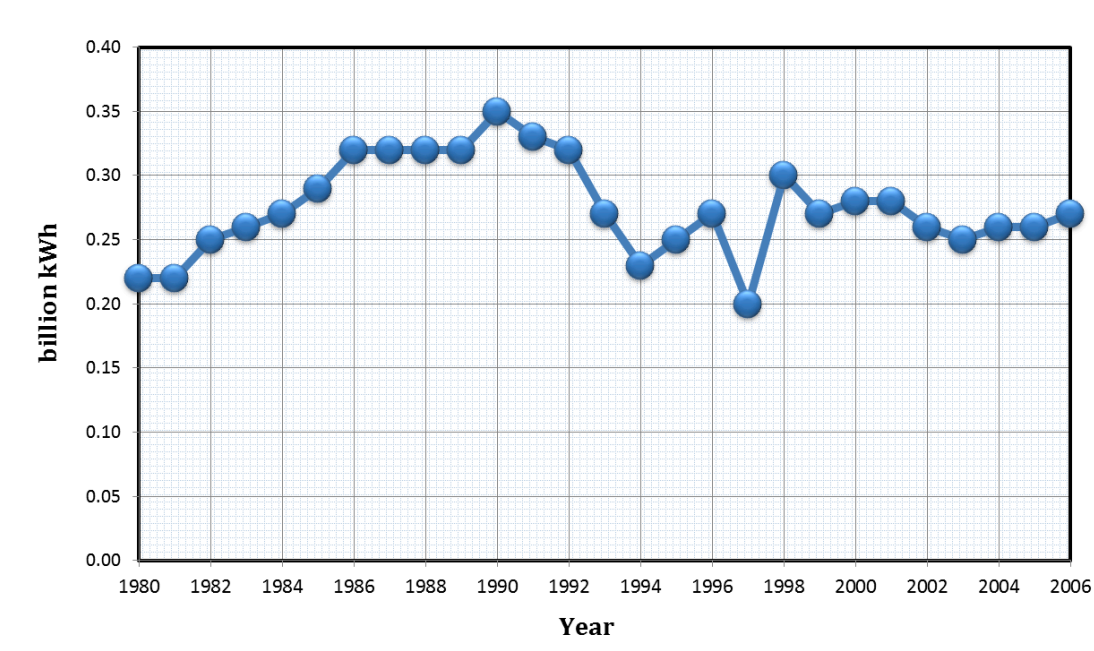
Despite the ubundance of reneable energy resources, the progress on harnessing them has been slow. Large hydropower (if considered RE) makes up the greatest share of RE power production currently in Haiti, whereas micro- and mini-hydropower remains largely unexplored. Some biomass-powered projects are being developed but are not yet completed. Wind energy has not been exploited yet (except a 1978 pilot project in Port-de-Paix, which is, however, no longer operational – Project Brief 2), and solar energy has been exploited only on small scale, by way of solar lanterns and as a self-supply option for businesses to displace diesel and for rural off-grid electrification.

[24] EDH, 1976 and Soleo, 2012

2.1.1 HYDROPOWER

The overall hydropower potential for Haiti is estimated at over 200MW (across all hydro segments) The currently installed hydropower capacity is slightly over 60 MW. There are seven operational hydropower sites; the largest hydropower site is Péligre with an installed capacity of 54 MW (currently undergoing rehabilitation). In addition, EDH currently owns six mini & small hydro plants (under 2.5MW each), amounting to a total capacity of 7.5 MW, but only five of them are operational and with constrained ouput due to a need for urgent repairs and rehabilitation. Figure 6 shows Haiti's hydroelectric power production by year from 1980 to 2006; Figure 7 (next page) illustrates the strong seasonal variability.

FIGURE 6. HAITI HYDROELECTRIC POWER PRODUCTION BY YEAR



Source: http://www.eia.gov via
http://www.indexmundi.com/energy.aspx?country=ht&product=hydro&graph=production

It is estimated that the potential for medium-sized hydropower is about 130 MW (three sites). This includes a 32 MW Hydro Electric Dam upstream of the existing Péligre dam in the Artibonite Department, which is under discussion for development with *Sinohydro* (China) per signed agreement of February 2015.

Furthermore, the potential for small-hydro, which remains largely untapped, is estimated at more than 100 MW.[25] This estimate is in line with Worldwatch Institute's 2014 analysis, shown in Table 4. In parallel, EDH has compiled a list of potential mini hydro sites of sizes

[25] EDH, 1976 and Soleo, 2012

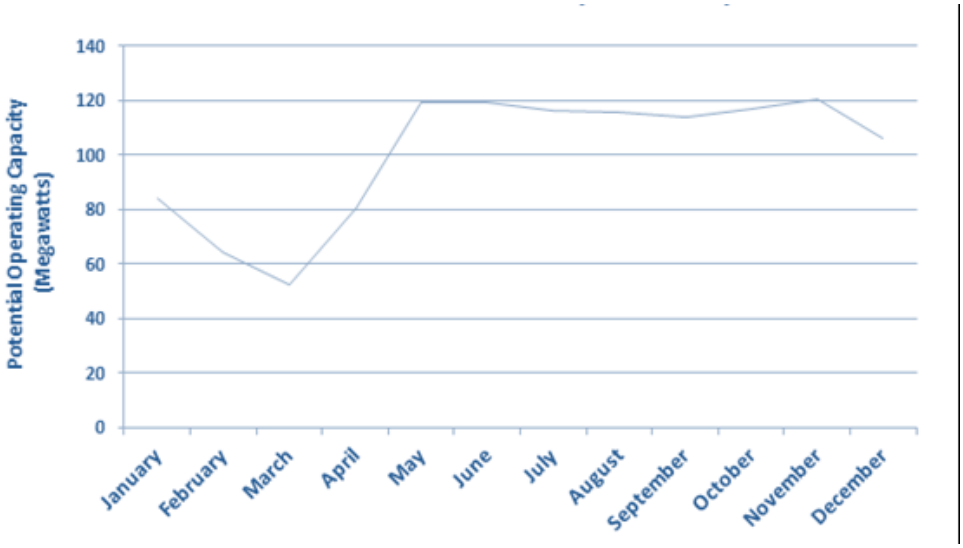
from 0.1 to 2.6 MW, with falls going from 50 to 400 meters, amounting to a total capacity of 23 MW.

TABLE 4. ESTIMATES FOR REMAINING "ADDITIONAL" PICO-TO-SMALL HYDRO POWER POTENTIAL IN HAITI BY REGION

Region	Potential Capacity (MW)	Annual Energy Output (GWh)
Ouest	36.6	320.7
Sud-Est	17.9	157.2
Grande-Anse	14.4	126.0
Nippes	10.3	89.9
Centre	7.3	64.3
Sud	6.2	54.0
Artibonite	3.6	31.9
Nord-Ouest	2.9	25.5
Nord	2.0	17.7
Nord-Est	1.1	9.3
Total	**102.3**	**896.5**

Source: Worldwatch (2014) based on Soleo (2011/2012)

FIGURE 7. SEASONAL VARIABILITY OF HYDRO POWER

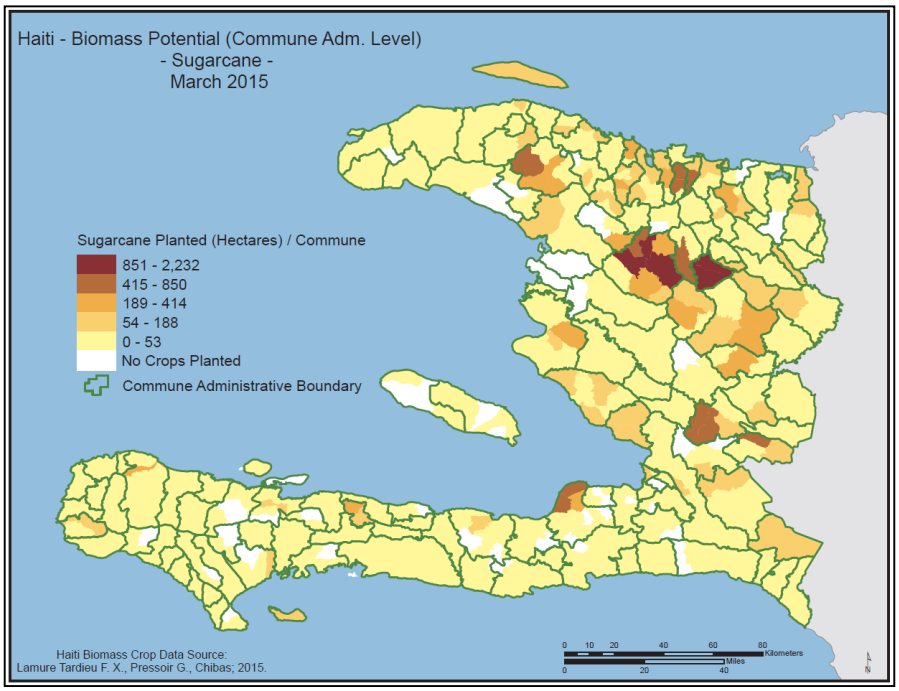


Source: Worldwatch (2014)

2.1.2 BIOMASS

Charcoal and firewood are the main source of thermal energy in the country and constitutes more than 70% of the total energy supply in Haiti; however not all of this can be considered renewable as it contributes to ongoing deforestation. Biomass, if used direct for electricity production could generate up to 300 MW of power. This assumes that 100% of the currently available feedstock is converted to power. The majority of this power (81%) is from wood products, while the remainder is from sugarcane (13%) (Figure 8), rice (4%), and coconut and coffee (less than 1% each).[26]

FIGURE 8. HAITI SUGARCASE BIOMASS POTENTIAL



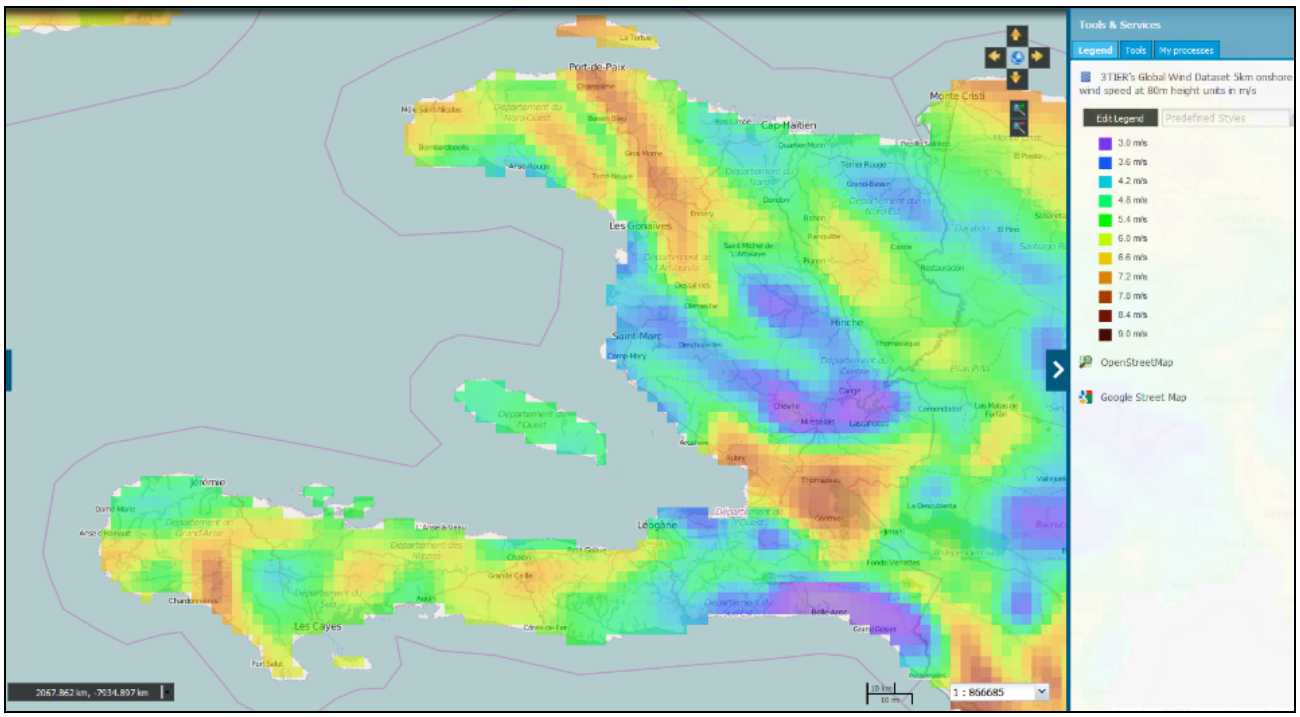
Biomass projects in Haiti have been looking into using feedstock like jatropha, sugar cane, eucalyptus and oil palm, for conversion to biofuels. Based on the current level of production for the biofuel crops, Haiti may be able to generate up to 154 million liters of ethanol. This assumes that 100% of the currently available feedstock is converted to ethanol. The majority of this ethanol is from sugar (56%) and corn (44%), while a small amount (less than 1%) comes from sorghum.[26] In addition to ethanol, Haiti may also be able to generate up to 30 million liters of bio- diesel. This estimate assumes that 100% of the currently available feedstock is converted to bio-diesel. Almost all of this bio-diesel is from coconut (70%), with the remainder from sesame (27%) and cottonseed (3%).[26] Jatropha is also receiving much attention in terms of a potential biofuel for Haiti; however, more studies are needed to validate the potential investment returns.[27]

[26] UNEP, 2006. Report: Background Data Collection on Bio-energy in the Caribbean and Central America
[27] Winrock International, 2008. Presentation: Diversifying the Energy Matrix: The Role & Opportunities for Biofuels

2.1.3 WIND

Currently, there is no grid-connected wind generator operational in Haiti; however, wind is considered among the country's promising renewable resources, with a potential estimated capacity of at least 70-80 MW.[28] Apart from publicly available wind potential maps (e.g. IRENA – Figure below), site specific speed measurements and feasibility studies for projects of significant sizes (10 MW and above) are under way by individual project promoters and investors. The final results of these studies will be known towards the end of 2015. The involvement of multiple local and international investors in specific wind projects as such gives an indication of the market readiness on supply side. The Government, with support of the EU, has also conducted a study at three sites; the results are publicly available at BME and MTPTC websites. [29]

FIGURE 9. MAP OF WIND POTENTIAL IN HAITI



Source: IRENA Global Atlas. 3Tier wind layer. Public at http://irena.masdar.ac.ae/

As illustrated by the publicly available wind speed map above, particularly promising areas for wind sites in Haiti include, amongst others (see Worldwatch 2014 for other potentially interesting sites):

- The *central wind corridor* crossing the Lac Azueï in the Western Department north-east of Port-au-Prince – in Plaine du Cul de Sac between two big mountain chains

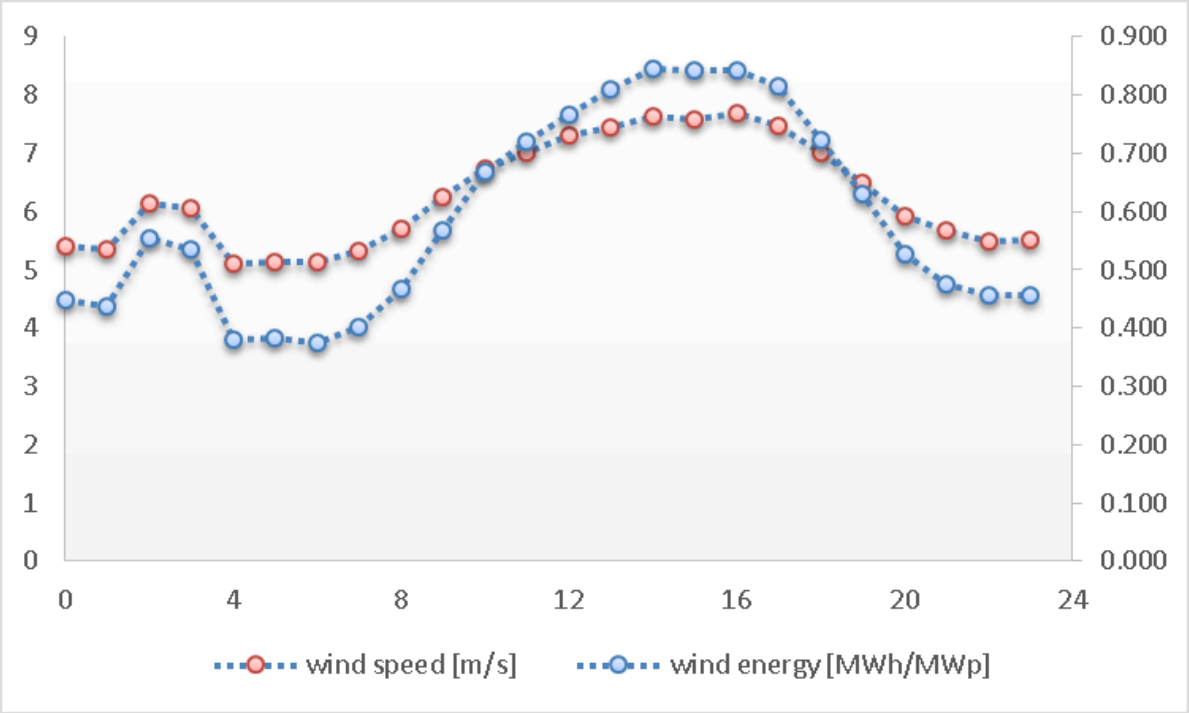
[28] This is the installed potential according to the study developed by the Belgium Company 3E in 2010. Potential were estimated for three sites of Haiti: Cap Haïtien, Jacmel and Lac Azuei.
[29] www.bme.gouv.ht

named La Selle and Chaine des Matheux (wind speed estimates vary considerably for this area, so actual measurements at appropriate heights are needed).

- The *northern wind corridor* in the North-West Department, near the island of La Tortue, which is part of the larger "canal du vent" between Haiti and Cuba (estimated at 6-9 m/s).[30]

As wind energy is highly volatile, detailed measurement at appropriate heights (ideally 80-100m) is needed not only for actual project siting and design – but also to gauge the diurnal patterns (available estimates vary) as this will have a direct impact on the actual benefits (in terms of fuel savings) and dispatchability of the injected wind power.

FIGURE 10. ILLUSTRATION OF TYPICAL DIURNAL WIND ENERGY PROFILE WITH X=HOUR OF DAY AND Y= AVERAGE WIND ENERGY (MORE PRONOUNCED THAN WIND SPEED VARIABILITY, DUE TO CUBIC RELATION



Source: Meteonorm/iiDevelopment (2015)

[30] In 1978, a wind farm of 150 kW was installed by EDH in Port-de-Paix, with support of the German development cooperation. The plant is no longer in operation since 1991 due to a lack of technological skill and capacity for maintenance.

2.1.4 SOLAR

Haiti has an excellent solar energy resource (Figure 11), with high-level irradiation across all Departments and months of the year. This potential as of yet remains largely untapped, regarding both solar PV (for electricity) and solar thermal uses (for water heating and small productive applications). Currently, there is no relevant grid-connected solar PV generation in Haiti. However, the country has gained significant experience recently related to the deployment of off-grid solar PV in two distinct, nascent market segments:

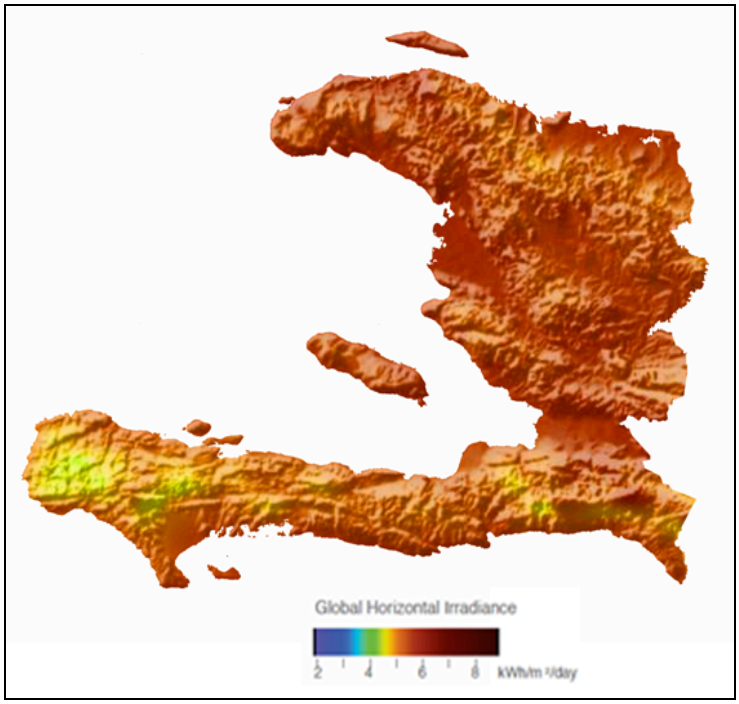
(i) PV companies start serving the urban business market (that is, commercial and industrial users who are currently (partially or fully) self-supplying in light of the grid unreliability, and now wish to complement current expensive diesel generation with PV as a co-generation "fuel saver") via an emerging leasing model (PV companies providing long-term lease of the PV equipment, for which users pay a fee), with typical PV capacity per site ranging from tens of kWp up to MWp scale (e.g. 1 MWp of solar power for Mariott); and

(ii) PV companies serving off-grid markets (see Chapter 1.6 Rural Electrification Challenge) via PicoPV systems, solar PV for schools, and solar streetlights (combined installed capacity of about 0.7 MW, albeit of mixed quality). There are also PV systems for schools and clinics – the largest is Mirebalais Hospital, which operates a 400 kW system. Many of these off-grid solar PV companies have stated an interest in the on-grid PV market if enabling conditions are generated, especially for the distributed SME-level "fuel saver" market segment above. One of the local companies is designing and manufacturing its own solar PV systems.

Due to the spatial stability of PV irradiation, the relative abundance of possible PV installation sites compared to total national demand, and the scalability from Wp to MWp, the technical PV potential is virtually unlimited. The economically viable PV potential keeps increasing due to rapidly falling Capex (see chapters on economic analysis), so that the benefits of deferting investment need to be weighed against forgone savings. However, PV is already least cost in 2015 for most offgrid users on econmic terms (but not necessarily on financial terms, as high risk premiums result in extreme discount rates), and below Port-au-Prience benchmark thermal LCOE (again, only on economic terms). The practical PV potential has been previously estimated at around 200 MWp in urban areas and over 1,600 MWp throughout the country.[31]

[31]http://www.caricom.org/jsp/community_organs/energy_programme/electricity_gifs_strategy_final_report_summary.pdf

FIGURE 11. SOLAR ENERGY RESOURCE MAP OF HAITI



Source: GOH/3Tier

2.2 BARRIERS TO RENEWABLE ENERGY DEVELOPMENT AND MITIGATION MEASURES

Transforming Haiti's energy sector through the large-scale deployment of renewable energy faces numerous institutional, regulatory, and legal challenges, as well as information, knowledge and capacity constraints and economic and financial uncertainties. The key barriers and mitigation measures cited below were identified through consultations with relevant stakeholders (see Annex 3). SREP will help unlock individual barriers through "learning by doing" and related demonstration effects. Instead of putting all resources into one large project, SREP will finance several smaller projects that will help test possible regulatory and risk mitigation approaches and build confidence and capacities of both private sector and government for a scale up in the future. We consider this the optimal approach (in terms of total SREP effect) in a country where many potentially viable RE market segments are at a very early stage due to market inefficiencies.

TABLE 5. MAIN BARRIERS AND CONSTRAINTS TO RENEWABLE ENERGY DEVELOPMENT

Main barrier and Constraint	Mitigation Measure
Weak financial situation of EDH. EDH currently recovers only about 22% of the value of power it supplies due to high technical and commercial losses. The current EDH financial situation poses significant risks for private investors, even if the PPAs can be backed by Government guarantees.	To improve the financial situation of EDH, the Government will focus on reducing EDH losses and reduce costs of power supply. The reduction of EDH losses will be achieved by targeting investments in rehabilitation of existing transmission and distribution lines under the supervision of the World Bank, and a set of measures to improve commercial performance, starting with an improved collection system and improved metering. Section 1.6 describes in more detail the Government loss reduction plan (back by IMF). The diversification of EDH power supply options will lower its dependency on expensive fossil-fuel generation provided by IPPs. Diversification options include the installation of additional power generation capacity based on renewable energy sources, rehabilitation of existing hydro plants (e.g., Péligre already in process, additional plants included in the present IP), and possibly power generation from imported LNG. In addition, the SREP project will develop approaches suitable for this EDH transitional period. Grid connected renewables will be developed as public-private partnerships, with SREP mitigating the risk of the private sector – both through direct investments and/or as guarantees/risk mitigation instruments. The resulting renewable energy generation will be provided at much lower costs than the current costs of EDH generation (including IPPs), and will therefore be a part of a loss reduction strategy. However, demonstrated progress on addressing the EDH financial situation will be one of the requirements for the PPP investments to proceed.

Concerns about integration of intermittent generation capacity. There are concerns from the Government/EDH on the integration of large intermittent generation into an already very unreliable grid without causing additional reliability and quality issues. Transmission line capacities are constrained and it is unclear yet what spare capacity will be available once the full Péligre capacity will be on line. Dispatch is far from optimal in light of the severe generation shortage.	A study is currently ongoing to evaluate the capacity of EDH's grid and dispatch strategies for the integration of intermittent renewable energy. The study will provide information on the maximum capacity of wind and solar PV that the grid can safely absorb, on site restrictions and on additional network upgrades that may be needed. To mitigate this risk, all SREP investments in grid-connected renewables will remain well on the "safe", conservative side, starting with smaller investments in wind, biomass and/or solar power, while exploring the impacts on the grid and adjusting approaches/identifying complementary investments to prepare a larger injection of renewable energy to the grid in the future. This will not only address the perceived risk, but in addition allows to maximize total net benefits from RE growth.
Lack of clarity on legal and regulatory framework. There is no legal/regulatory framework for grid-connected renewables, such as feed-in tariffs (and rights) or similar certainty on tariff level; no standard PPA; no regulatory agency to provide regulatory protection to investors etc. For off-grid renewables, the legal and regulatory framework is not transparent either, which discourages private investments. The relationships and hierarchy among different legislations is unclear and affects in particular potential mini-grid investors who are reluctant to invest in stranded RE assets that could be expropriated or lose value. There is no clarity on whether mini-grid operators are free to set tariffs or whether they will be subject to any Government tariff or quality of service regulation. Finally, there are no provisions of what would happen with assets in case EDH grid arrives to the village. The banking community also highlighted the inability to take roof top solar PV as a collateral as it is considered as a fixing and becomes part of the building and collateral of the building financier automatically under the current legislation. This	SREP will help Government develop appropriate regulatory instruments to support both grid-connected and off-grid renewables. This will be done through the "Building enabling framework, capacity and skills for RE scale-up project" (Project Brief 5), as well as through the application, testing and fine-tuning the regulatory instruments in individual SREP-supported investment projects (Project Brief 1-4).

makes debt financing of solar PV extremely difficult	
Lack of access to capital. Access to capital for renewable projects remains an issue, particularly for smaller companies engaging in off-grid electrification. Consequently, projects have been relying mainly on donor and NGO grants, which are not sufficient for scaling up. The private sector requested the Government and the donor community to (1) facilitate soft loans for developing flagship projects on rural energy in Haiti, (2) provide improved access to commercial loans, and (3) encourage less risk-averse capital to invest in rural energy projects.	SREP, together with a parallel project co-financed by the Clean Technology Fund (CTF), will address the financing issues by mobilizing a mix of commercial financing and subsidies, progressively targeting involvement of local financial institutions in renewable energy lending.
Inadequate fiscal policy for renewables. The current fiscal policy disadvantages both grid and off-grid renewables against their fossil fuel alternatives. Renewable energy equipment is subject to both import duties and VAT tax, which can amount to over 30% of the product value. The negative impact on the relative competitiveness of renewables vis-à-vis fossil fuels presents an additional burden on the poor.	SREP, through its "Building enabling framework, capacity and skills for RE scale-up project" (Project Brief 5) will work with the Government on options for leveling the playing field between renewables and fossil fuels. For off-grid electrification, targeted, market-friendly, results-based subsidies will be considered to increase affordability of the off-grid services for the poor.
Information and capacity constraints. A lack of in-depth information on the detailed performance, risk determinants, and good practice of technical and financial engineering is one of the main drivers for the extremely high-risk premiums typical for nascent RE markets (GIZ 2014b). Participants in all Haiti SREP consultations agreed that information gaps exist on ongoing projects, markets, resources, administrative processes, potential partners and financiers, and should be made publicly available. As for the capacity, enhancing renewable energy curricula and improving hands-on experience in the field of RE of university graduates, as well as the creation of a pool of skilled technicians would be an important step strengthening the sustainability of rural energy projects, and to allow faster scale-up in the future (the limited number and growth of skilled	Given the prominence of information and capacity constraints and asymmetries cutting across all renewable energy segments, SREP will include a specific project to address key cross-cutting capacities and skills, as well as enabling environment for scaling-up renewable energy in Haiti. See Project Brief 5.

electricians has been identified as a major bottleneck to the market growth of distributed RE generation in several countries). The National Electrification Strategy, which also ranked high in consultations, would form a bridge between the "information gap reduction aspect" of this section, and the policy / enabling framework bullet listed above.

3 RENEWABLE ENERGY NATIONAL PLANNING AND ECONOMIC VIABILITY

As discussed in section 1.5, Haiti's main planning tool is the *National Energy Sector Development Plan* (*PNDSE*) for the period 2007-2017. However, the PNDSE is outdated and EDH is currently developing a new *Electricity Master Plan*, which should be available by late 2015. The PNDSE recommends an additional capacity of about 400MW, including 10% of renewable energy capacity. This low proportion of renewable energy integration is in part due to the unavailability of appropriate data on RE at that time. The new Electricity Master Plan, informed by the ongoing study on integrating intermittent renewables to the EDH grid, will provide new recommendations for an optimal mix of renewable energy over time, which is expected to target a higher share of RE.

At a higher level, Haiti's power sector planning is driven by the general development needs and objectives set in the *Strategic Plan for the Development of Haiti (*SPDH*)*, which sets the path for Haiti to become an emerging economy by 2030, and will be a key reference for the Electricity Master Plan. Reaching the SPDH goal of becoming emerging country by 2030 will require dual efforts:

(i) improving EDH performance and supporting **on-grid** generation capacity to enable EDH to provide reliable and affordable electricity services in urban areas and surroundings; and

(ii) supporting **off-grid** electrification efforts for households, businesses and institutions that are not served by EDH.

The Government considers SREP an important strategic tool to help it achieve these objectives.

Grid connected renewables provide an important alternative to Haiti's expensive and volatile oil-based generation. They provide an opportunity to address EDH's financial situation both directly and indirectly. Directly, because on-grid renewables are a lower cost generation option, allowing gradual displacement of the more expensive fossil fuel generation (Haiti's thermal generation costs are very high by international standards, as Haiti's RE Supply Curve in the next section illustrates). Indirectly, because the overall increase in generation capacity by way of added renewables (if planned and implemented correctly) will help improve service quality for the existing customers - and potentially allow the connection of new customers. This is an important complement to the reforms being carried out on the EDH commercial side (aimed at increased collections and reduced theft), which will be easier to implement if customers perceive parallel improvements in service availability, reliability and quality. SREP—through a combination of targeted investments and advisory activities—can help Haiti build RE experience, adjust and introduce regulatory and planning instruments, and build the necessary skills needed on all levels (from technicians to dispatch) for the necessary renewable energy scale up.

The Government is aware that even if power sector reform and EDH loss reduction programs are successfully implemented, EDH will need to focus first on improving supply in urban areas and (legally) connect those households which are in the vicinity of the existing grids. Therefore, it will take years before EDH will be able to start expanding deeper into rural areas. In order to achieve the 2030 universal access target, it is thus necessary to invest in parallel off-grid electrification options. Such investments are also strongly encouraged from an equity perspective: While nationwide, Haiti made progress in reducing poverty and extreme poverty, progress in rural areas has been stagnant. The continued influx of people to the metropolitan areas is not sustainable. Therefore, Government policies continue targeting investments and job creation in secondary cities and tertiary cities, as well as in rural areas, underpinning the ongoing decentralization process. Government strongly believes that SREP can play a supportive role in increasing access to decentralized sources of renewable energy, particularly in isolated rural areas.

For the above reasons, the Government is requesting SREP funds for a balanced program that will help it reconcile the need to simultaneously focus on (i) strengthening power sector capacity to support economic growth and (ii) expanding access to provide economic opportunities and improved living conditions in secondary/tertiary towns and rural areas.

3.1 GRID-CONNECTED RENEWABLES

The RE Supply curve for Haiti is shown in Figures 12 and 13 on the next page. It should be noted that (i) LCOE are for the low-case WACC typically applied for SREP IPs (as opposed to the (much higher) actual risk-adjusted returns early stage equity and debt providers would require when investing in Haiti RE today in absence of the SREP IP measures), and (ii) the capacity credits don't fully reflect all of the specific dispatch challenges EDH will face when integrating wind and/or solar >10 MWp on the short term.

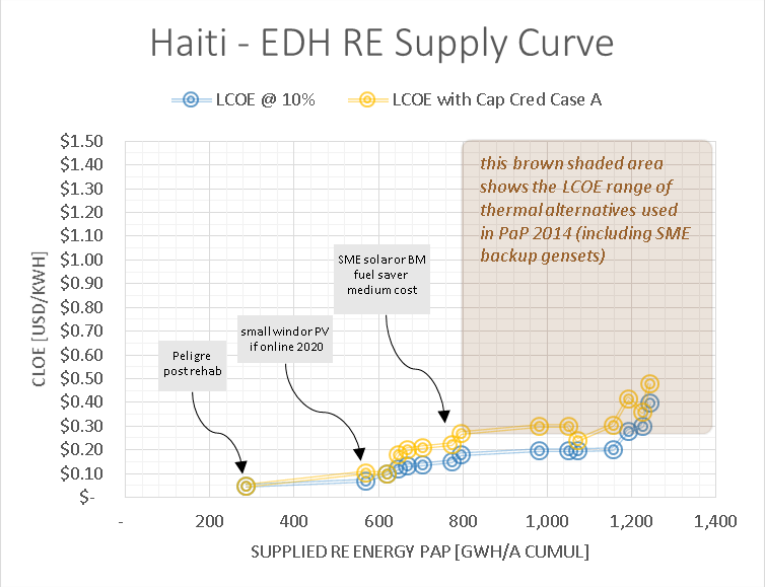
Planning the scale-up of private sector-led on-grid renewables in any given country is a challenge, because appropriate methods and instruments have started to emerge only recently.[32] As a result, renewables are sometimes regionally clustered in network "hot spots" (where they are needed less than in other nodes of the national grid), or unfavourable PPAs lead to inefficiencies.

In addition, existing tools and approaches cannot be simply transferred from pioneer markets (such as the EC or US) to sunbelt countries, because of several fundamental differences in power sector boundary conditions,[33] most of which apply to the case of Haiti and matter for SREP planning. They include (i) challenges (such as weaker grids and less actual spinning reserve), as well as (ii) advantages (better RE resources and the availability of hydro storage to significantly increase the direct benefits derived from thermal fuel

[32] GIZ 2013 & 2014a, IEA 2014, RMI 2014
[33] WEC 2014

saved by wind/solar injection). Some of the differences (iii) can go both ways - for instance, fragile grids can actually be stabilized by distributed RE injection (if it is planned well); and power sector growth not only poses challenges for RE dispatch, but at the same time, this growth can reduce the opposition by incumbent IPPs and utilities to RE (once they understand the potential of RE to increase their revenues). [34]

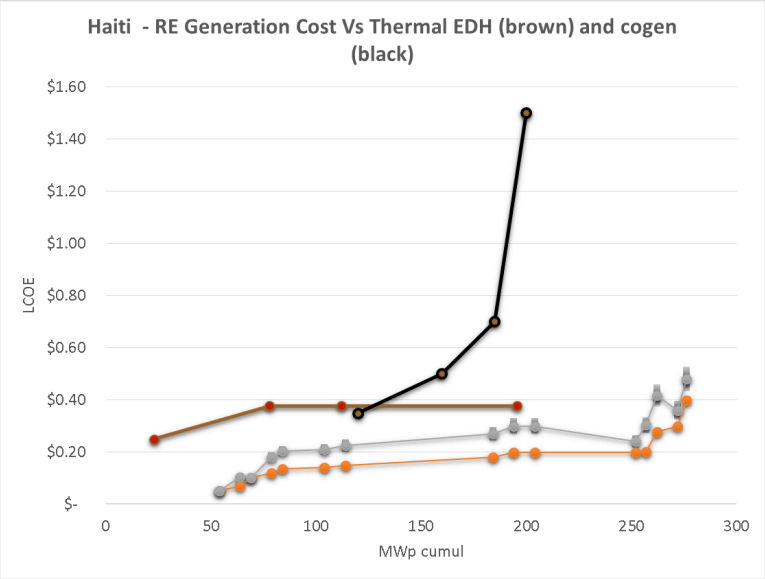
FIGURE 12. EDH RE SUPPLY CURVE



Source: iiDevelopment (2015)

[34] Due to the typical lead time it takes till quantitative RE optimization software services have been procured and implemented with solid data on network and generation, it is usually best to start with a pragmatic mix of methods and planning tools (such as the RE Supply Curve and score cards used by SREP), and add more advanced planning tools on the way, in a sequential approach (GIZ/ESMAP 2014).

FIGURE 13. RE GENERATION COST VS. THERMAL EDH AND COGEN



Source: iiDevelopment (2015)

SREP will support the Government's and key sector players' path along the learning curve of RE planning and dispatch by applying lessons from other countries as they emerge and optimizing the volume of on-grid RE interventions over time and space. A main effect of SREP on the local RE market segments will be to improve the post-SREP financial costs of RE, by way of reducing the risk-reflecting weighted average capital costs of equity and debt providers, as illustrated in GIZ 2014b for the case of PV in Germany, Brasil and Italy.

Annex IV provides more details on (i) the specific Ongrid RE Cases that have been selected for Haiti SREP (SREP Cases #9-12 in Chapter 4) and (ii) the issues and methods that have been considered in the comparison of the costs and benefits of RE capacity additions over time.

3.2 OFF-GRID RENEWABLES

For SREP offgrid RE planning, current energy supply and demand in areas far from the existing main grid have been analyzed,[35] and possible alternatives for different offgrid market segments have been defined. Then, the most promising business models of each segment have been analyzed regarding their scalability and transformational potential, based on all relevant existing offgrid business activities in Haiti (including NGOs and Coops), comparing them to international success stories and failures, and selecting a short

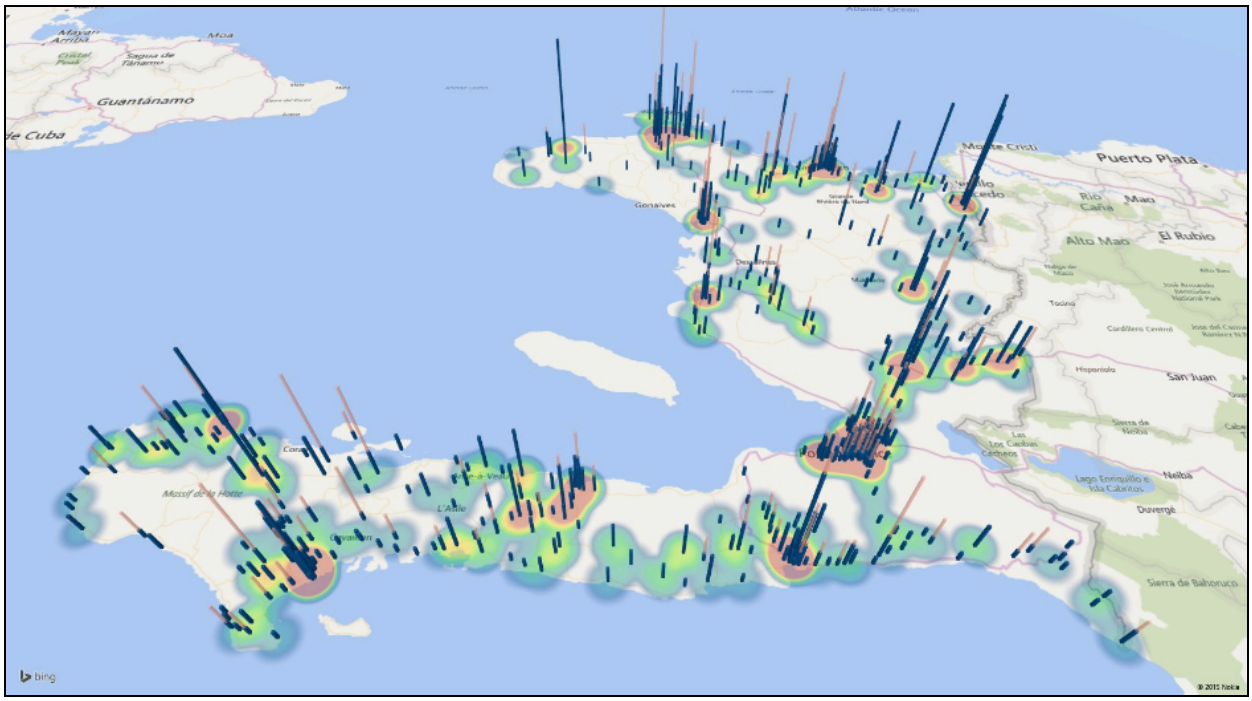
[35] The results of this study are available in a separate background document on Digicel/iiDevelopment 2014 energy survey analysis with 1400 respondents) and in an additional background documents on the detailed analysis of the costs (by way of cash-flow analysis) and benefits (by way of consumer surplus).

list of the best suited "SREP Cases" for in-depth financial and economic analysis (a short list of eight market segments, including both hybrid village grid cases and stand-alone users).

To do so, the economic and financial analysis looked at end user prices at which existing energy demand would match different RE offgrid supply options, based on WTP and welfare gains. This is illustrated in the map and graphs below, and details are given in Appendix 1.

Figure 14 (below) shows the results of the SREP WTP surveys, by mapping (i) current household access (to grid power and offgrid solar) to (ii) these households' present monthly expenditures for lighting, phone charging etc.

FIGURE 14. THE SPATIAL DISTRIBUTION OF SURVEY RESPONDENTS (DIGICEL 2014)[36]



Source: digicel & iiDevelopment 2015

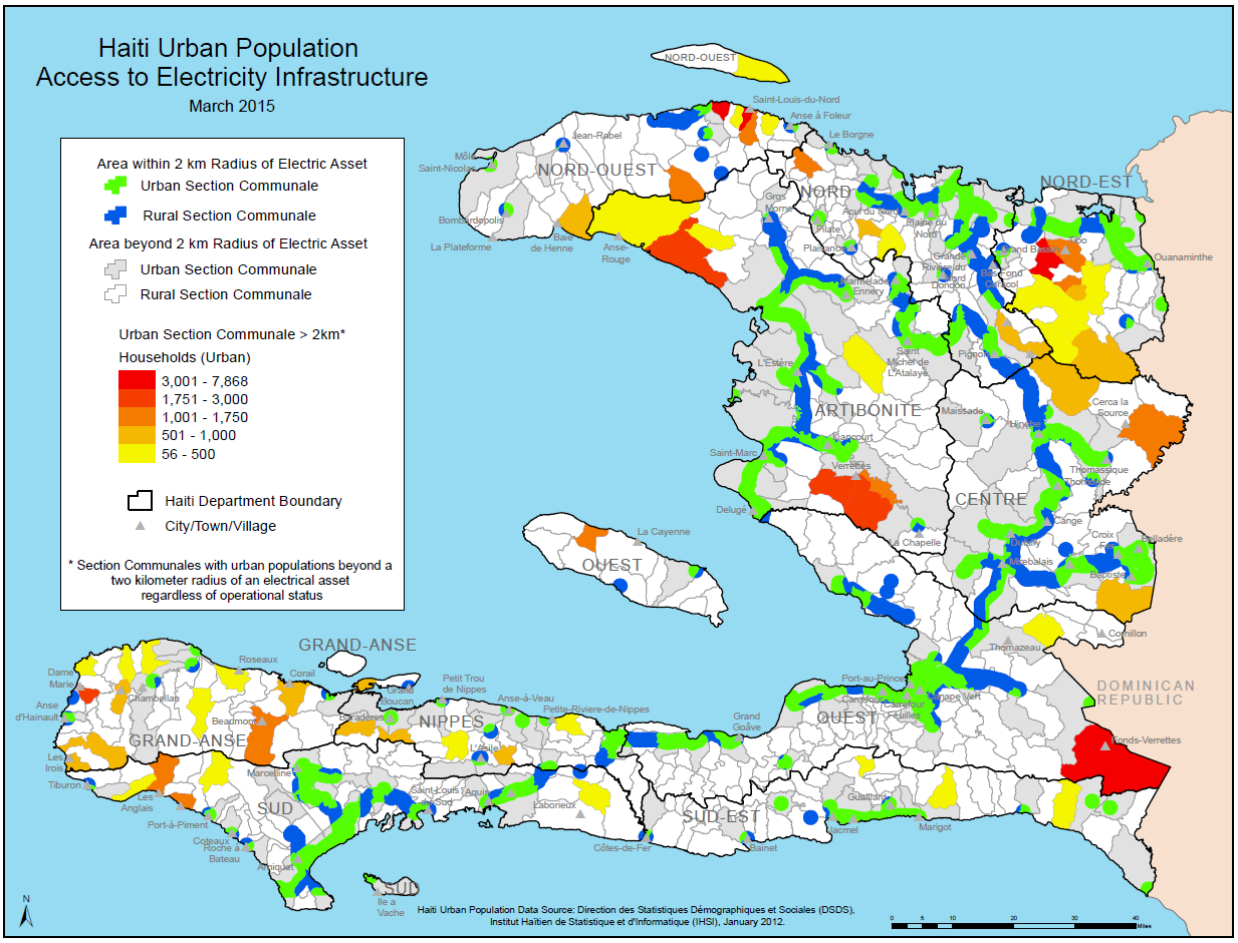
Figure 15 (next page) identifies population clusters that currently are more than 2 km away from the grid, and could represent a potential for village-based supply options, such as mini- and micro-grids.

The colored ranges (red to yellow according to population sizes) in this SREP preparation map by (Navigant et al 2015) correspond to the number of "*urban" or "village"* households

[36] The map shows survey results of the Dicicel/iiDevelopment market survey for (i) grid access (heat map: red = grid access); (ii) off-grid solar kits or lanterns (yellow spikes) and (iii) their current substitutable expenditures (on light, phone charging, radio dry cells, TV, etc. – blue spikes, with height of spike = monthly expenditures).

in urban sections[37] that are not within 2 km of an existing electrical asset (generators, LV transmission, substations). [38] The goal of this exercise and map development was to estimate the potential of greenfield village grid systems (as opposed to village grid retrofits and stand-alone systems) that would make sense for SREP under different scenarios.

FIGURE 15. SREP ASSESSMENT OF THE OFFGRID VILLAGE GRID POTENTIAL IN HAITI



Source: SREP Task Team – Navigant/IDB (2015)

Taking the integral of the unserved urban households from the map above leads to an estimate of about 65,000 "urban village" households that are distant from known electric infrastructure. Some of these will be preferentially served by stand-alone systems (SHS, kits, lanterns) because they aren't in an area of sufficient density, and/or they would only

[37] A section is "urban" if it has any urban population according to the Haiti Statistics Bureau, IHSI

[38] [38] This is only a rough cut due to the early planning stage: the results are far from definitive at this stage and will be refined during further SREP preparation. In addition, private sector firms will eventually be enabled to build their own estimates for market potential by technology and area, thanks to the "Living GIS" and webpage the SREP IP shall provide from the outset.

be willing to pay for very basic electricity services for which such stand-alone systems would be the most economic solution (possibly combined with a larger solar-diesel hybrid, but no LV grid, for any anchor client in the same small village who need AC power and/or larger peak capacity).[39]

In a next step, the effect of SREP support on lifting some or (i) all of the different village grid market segments (SREP cases # 6-8) and stand-alone segments (SREP cases # 1-5) up to a higher level of quality, sales and sustainability by way of suitable public private support instruments; and of (ii) the users to different Tier levels was assessed as per Global Tracking Framework 2015.

Typical cash-flows and pricing strategies of different Haiti RE off-grid provider models for the relevant segments and technologies (pico PV and small solar stand-alone to village power and large social and productive users) have been prepared and analyzed regarding their potential for (i) effect and subsidy needs till 2020, and (ii) probable market development post 2020 (after SREP exit) to gauge the transformative effect of possible SREP interventions.

The resulting SREP Offgrid Cases 1-8 are described in the Annex.

[39] As an example for using this map, if one assume that, say, 10% of them are in an area with sufficient density to be served by a small MG, that's 30,000 people (6500 households) served by MGs, which could be served by 65 small MGs, assuming 100 connections per Case 6: Small MG. It should be noted that the potential for larger minigrids (cases 7-8), which are more probable cases for SREP, was easier to establish as information on clients, existing infrastructure, etc. was easier to derive (for each site) from EDH data and other sources.

4 PRIORITIZATION OF STRATEGIC INVESTMENT AREAS

4.1 PRIORITIZATION OF POTENTIAL INVESTMENTS

Considering the very diverse technologies and business models that could be used to achieve the two Government SREP goals identified in the previous chapters, a comprehensive sector-wide analysis of all possible renewable energy investments has been carried out to define the SREP Investment Plan for Haiti. This comprehensive approach was used in order to avoid crowding out of emerging success cases by way of supporting others.

The prioritization process was carried out under the leadership of the Government through the SREP Task Force led by the Energy Cell of the Ministry of Public Works, Transports and Communications, with strong support of the MDBs. The process consisted of the following steps:

Step 1: The SREP Team (MDBs and Task Force) used the Comprehensive Framework for National RE Program Planning[40]for a systematic overview of (i) local examples for private sector business models and (ii) international examples for public interventions which might be relevant for SREP- Haiti ("RE Intervention Universe"). In consultation with key stakeholders, this framework was adapted to local conditions, and a large number of locally existing firms, business cases, public and NGO projects and investments in the pipeline have been assembled and analyzed ("Long List") – See Appendix 1 for the Long List of Business Cases.

Step 2: This Long List of business cases has then been analyzed in order to determine their suitability for Haitian conditions, fit with Government priorities, readiness for implementation and scale-up potential. This screening resulted in the identification of specific potential Haiti business models (and generalized business cases based on these) for all RE market segments that were identified as promising for SREP Haiti. As a result, a menu (or "Short List") of the most promising renewable energy investments by market segment (the "12 SREP business cases") has been compiled (see Appendix 1 and Table 7 for a list of these 12 segments/cases).

Step 3: Each business model was then analyzed regarding Economic and Financial feasibility and relative cost-effectiveness (for varying market share targets) to inform decision-making (see the previous chapter and Appendix 1). On this bases, potential business models were then ranked in several ways, with a variety of score card tools that allowed transparent discussions of trade-offs, risks and SREP potential. Table 6 and 7 below show some of the main results of this ranking process.

[40] based on Reiche, Rysankova, Fraatz 2014

Table 6 is a simple way to illustrate some of the key issues and trade-offs that have been considered in the analysis of possible market segment volumes, costs and benefits of the SREP Ongrid cases (9-12). The details on these trade-offs and additional parameters that have been analyzed are explained in more detail in Appendix 1. For each SREP Ongrid Case, Table 6 contrasts typical values for: (i) unleveraged project internal rates of return (for example, preliminary wind speed estimates that a 10 MWp wind generator at Lac Azuei or a biomass cogeneration IPP in Port-au-Prince would have lower higher returns than a 10 MWp PV plant); (ii) typical minimum returns a private investor would require in light of the current sub-sector context (for example, an investor of a solar fuel-saver scheme would price in less offtaker risk than a solar IPP); (iii) the saldo of these two (as a quick practitioner indicator of cases which might require de-risking for private sector to move in); (iv) the way CAPEX (capital expenditures, with output held constant, for comparability) change typically with growing cumulative share of each market segment (for instance, once the best wind or hydro sites have been comissioned, costs per MWh for additional capacity will rise – while Capex per MWh stay stable for PV for a practically unlimited cumulative capacity); (v) the way BENEFITS change with increased cumulative capacity in Haiti (for example, average fuel savings per MWh injected variable renewables from wind and PV usually increase from 0% Capacity Share to a certain plateau (GIZ2013 & 2014) and then start falling beyond a country-specific tipping point); and (vi) the way CAPEX change over time (all else held constant; for example, wind capex remained largely stable over the last years, while solar Capex keep falling fast).

Table 7 summarizes another set of illustrative scores that have been developed by one of the independent consultant teams working on preparation (Navigant et al 2015) for an interium version of the srep "short list", based on (i) their discussions with key stakeholders and (ii) their analysis of the typical costs, firm-level rates of return and maximum volume for the 12 segments (see Appendix for details). For example, under this partial ranking by this particular expert group that have been asked to prepare independent scores, which were then all considered in the subsequent steps described on the folloing pages (because score cards necessarily have a subjective element due to the (implicit or explicit) need to weight each subsidy performance indicator for a total score – as demonstrated in Teplitz et al. (2009) for different cases and priorities of energy access ODA), the cases “small public remote grid” and “large government-owned hydro” ranked lowest of the options scored in this specific case and point in time.

TABLE 6. SNAPSHOT OF ONGRID RE BUSINESS MODELS COMPARATIVE ANALYSIS

ONGRID BIZ MODELS					Summary of Ongrid RE Comparative Analysis with Tool C							
					I. Financial Feasibility: IRR Vs wacc					II. Scale: Optimizing RE Net Benefits over Time		
SREP CASE #	Customer segment	Scale	Product	Owner RE	RE Resource	IRR (%)	hurdle rate if PRIVATE OWNER	IRR minus hurdle rate	Owner Risk if Private (except case 9 = only public)	comments on risk	1. **CAPEX** change with increasing ENERGY **SHARE** @ same vintage (t held constant)	2. **BENEFIT** change with significantly increasing ENERGY **SHARE** @ same vintage (t held constant)	3. **CAPEX** change over **TIME** (share held constant, but plant comissioned later, at t1 instead of t0)
9	main grid	MW	electricity	Government	hydro	9%	15%	-6%		Public Sector has no offtaker risk. Private IPP would need de-risking			**no singificant Capex drop if built at t1 > t0.** However: (i) the more hydro in system, the more wind&pv becomes viable; (ii) Investor loses savings between t0 and t1.
10	main grid	MW	electricity	Seller	wind	15%	15%	0%		Public Sector has no offtaker risk. Private IPP would need de-risking			**slight Capex reduction:** (i) wind capex fall less than solar, (ii) BOS (t) and transaction costs (t) less of an issue for IPP than for behind-meter cases
11a	standalone/grid mix	kW	equipment	Customer or Lease/PPA	solar	14%	10%	4%		Lower offtaker risk, because part of generation is used for self supply			**fast Capex Reduction**: international CIF and BOS fall fast, only local transaction costs depend more on share (market stage) than time
11b	standalone/grid mix	kW	equipment	Customer or Lease/PPA	solar	16%	5%	11%		Zero offtaker risk, because RE capacity capped at solar noon demand in this biz case (simple no battery case)			**fast Capex Reduction**: international CIF and BOS fall fast, local transaction costs depend more on share (market stage) than time, post 2020 battery becomes attractive
12a	standalone/grid mix	MW	equipment	Customer or Lease/PPA	biomass	23%	15%	8%		Has both (i) biomass supply risk (strong if local unrest) and (ii) offtaker/ regulatory risk			can go both ways: capex may fall slightly for specialized hardware/suppliers, OpEx may increase or fall (BM supply)
12b	standalone/grid mix	MW	equipment	Customer or Lease/PPA	biomass	23%	12%	11%		Has (i) biomass supply risk, but (ii) zero offtaker risk, because BM used 100% for self supply			can go both ways: capex may fall slightly for specialized hardware/suppliers, OpEx may increase or fall (BM supply)

Label	RE Resource
Utility hydro	hydro
<10MW wind IPP or utility	wind
Behind-Meter: PV fuel saver + feed-in	solar
Self supply PV without feed-in	solar
Behind-meter: biomass fuel saver + feed-in	biomass
Self supply biomass without feed-in	biomass

	business/NGO	business/NGO	business/NGO	business/NGO	business/NGO	business/NGO

TABLE 7. SNAPSHOT OF POTENTIAL ONGRID & OFFGRD RE BUSINESS MODELS

SREP CASE #:	market segment	Scale	Owner RE	Seller (SPV Business Owner)	GENERIC BUSINESS MODEL	RE Resource	Example Cases	Filtering Discussion Tool B: Energy Access	Environmental Benefit	Scalability	Transformative	TOTAL SCORE (higher=better)
OFFGRID single user 1	stand alone	W	Household o Lease/PPA	business/NGO	SUPPLY RESIDENTIAL SOLAR PRODUCTS	solar	Enersa TOTAL Micama					2
OFFGRID single user 2	stand alone	kW	Enterprise or Lease/PP	business/NGO	SUPPLY PRODUCTIVE PV (PPV) SYSTEMS	solar	Drip Irrigation (LAC) Rural Stores Refrigeration (in LAC) Rural Community Tourism Enterprises					3
OFFGRID single user 3	stand alone	kW	Cooperative	business/NGO	SUPPLY COOPERATIVE PRODUCTIVE PV SYSTEMS	solar	Drip Irrigation Agriculture Coops (Rotary International/Haiti) Zanmi Agrikol Lashto Fish Farm (Croix-des-Bouquets) Micro-Enterprise Center (MEC no microgrid) SELF other countries					3
OFFGRID single user 4	stand alone	kW	Governmen	business/NG	SUPPLY COMMUNITY SOCIAL PV SYSTEMS	solar	L'Hôpital de Port-à-Piment School in Port-a-Piment (Electronic Learning Board)					2
OFFGRID village minigri 5	remote grid	kW	Seller	muni/coop	SMALL SCALE PUBLIC REMOTE GRID	solar	Companies starting in Africa: PowerHive, TTA, etc..					1
OFFGRID village minigri 6	remote grid	kW	Seller	business/NGO	SMALL SCALE ANCHOR TENANT GRID	solar solar biomass	Earthspark Int'l Les Anglais (DIGICEL TOWER) SELF Feyo Bien (With MEC) Limye Pa w Camp-Perrin (Anchor?)					3
OFFGRID village minigri 7	remote grid	MW	Seller	muni/coop	MEDIUM SCALE COOPERATIVE REMOTE GRID	hydro wind solar	Nepal community-run grid Alaska wind--diesel grids NRECA Port-à-Piment, Côteaux, Roche-à-Bateau					2
OFFGRID village minigri 8	remote grid	MW	TBD	business/NGO	LARGE SCALE [PRIVATE/PRIVATIZE/EdH] REGIONALGRID	hydro wind solar	Pichon/Belle Anse? Port de Paix? Proposed Caracol. Other countiries (Australia?).					2
ONGRID RE 9	main grid	MW	Governmen	govt	LARGE SCALE GOV'T DG	hydro	Saut Mathurine (rehab) Guayamouc (new)					1
ONGRID RE #	main grid	MW	Seller	business/NG	LARGE SCALE PRIVATE IPP	wind solar	Lac Azuei/Étang Sautmâtre may be part of virtual utility pv + wind					2
ONGRID RE #	stand alone/ma grid hybrid	kW	Customer or Lease/PPA	business/NGO	BEHIND-THE-METER SOLAR: fuel saver or mix with feed-in	solar	Hôpital Universitaire de Mirebalais L'Hôpital Bernard Mevs (Port au Prince)					2
ONGRID RE #	stand alone/main g hybrid	MW	Customer or Lease/PPA	business/NGO	BEHIND-THE-METER BIOMASS: a. fuel saver or b. mix with feed-in	biomass	Darbonne Sugar Mill (Léogâne) Unikode Distllery Barbancourt Distillery (La Plaine du Cul-de-Sac)					2

COLOR CODE: High / Medium / Low

Resulting recommendations for grid connected renewables:

Based on a comparative assessments of economic and financial viability, associated risks and transformative potential, the SREP IP recommends the following plan of action for on-grid renewables:

At this early stage of on-grid RE development, all analyzed SREP on-grid key Cases(Cases 9-12) have significant potential for scale-up in Haiti conditions, once the necessary enabling conditions, including regulatory framework, adequate feed-in tariff etc. will have been put in place. The effort it takes to reach that stage depends on the market segment.

Both the economics and the desired "transformative" effect of each RE Case depend on the targeted market share, so that an optimal SREP target volume must be estimated for each case, and also for the total sum of implemented cases (for instance, the total of ongrid RE volume, in parallel to the optimal range for each individual ongrid RE segment; See Appendix 1 for detailed approach and analysis).[41]

Based on the initial analysis of intermittent on-grid renewables for the Port-au-Prince metropolitan grid, it appears that an SREP investment in about 10-20 MWp capacity before 2020 would allow an optimal combination of (a) net benefits from capacity added with SREP funding and (b) net benefits from post-SREP long-term scale-up ("transformational effect").

This is due to multiple trade-offs, including (i) the current stage of the underdeveloped grid and dispatch capability; (ii) the interdependencies of wind and PV with seasonal hydro and demand, and their effect on fuel savings and line losses; (iii) the differences in the speed of capex reduction between wind and PV (Table 6 above and the Appendix); (iv) the current lack of information on the exact net benefits of the best wind site close by (which might result in unnecessary wellfare losses in case of premature peak capacity commissioning); as well as (v) the hefty risk premium private sector players would currently add in light of the (pre SREP) sector boundary conditions (which will have been improved at SREP exit).

[41] Economic and Financial Analysis indicate maximum (on-grid and off-grid) SREP funding volume ranges for each RE market segment beyond which (i) the EIRR falls below hurdle rates (that is, (a) the country hurdle rate (then that project segment becomes economically unviable beyond the maximum volume) and/or (b) the EIRR of other project alternatives (then they would be ranked higher for SREP selection)) and/or (ii) the financial closure is not likely to be reached within acceptable and efficient subsidy limits (say, because user segments would be targeted who's budget doesn't allow a very high service level). Typical examples for such falling EIRRs are the grid connected renewable cases discussed here, as costs (Capex, LCOE and net integration costs) and benefits (fuel saved and line savings or losses) depend strongly on market share (funding volumes). Therefore, SREP selection scores refer not only to a RE market segment as such, but implicitly also to a corresponding range of SREP funding (and related output indicators) targeted ton that market segment which we consider (i) "optimal" and (ii) "safe" volumes in a broad, non-mathematical sense.

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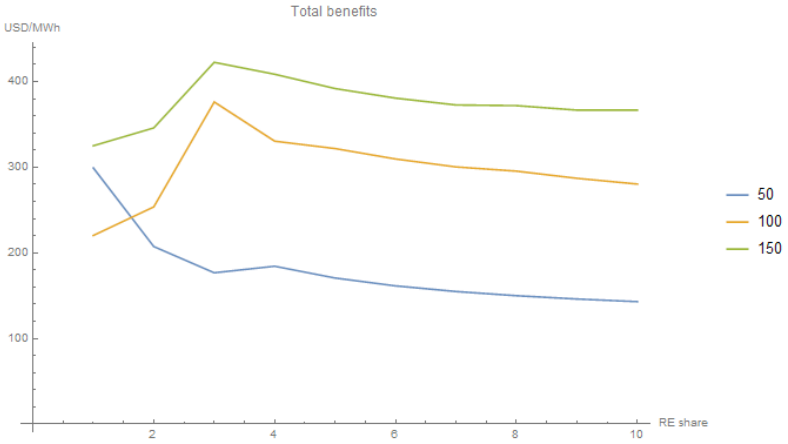
FIGURE 16. INITIAL SIMULATIONS OF THE AVERAGE ANNUAL FUEL SAVINGS (Y AXIS, IN US$ M) OF INJECTING GROWING AMOUNTS OF VARIABLE RE (X AXIS, 2% ENERGY SHARE = 5-10 MWP (DEPENDING ON WIND SHARE AND CAPACITY FACTOR) INTO EDH'S MAIN GRID.



Source: iiDevelopment (2015)

Given that the country still needs to develop the regulatory and "market enabler" instruments for an efficient RE scale up, the recommendation is to start with moderate additions of up to 20 MWp of combined variable renewable energy capacity under SREP, to jump-start the development of Haiti's experience with diverse grid-connected REs. All analyzed resource options are feasible in principle for the Port-au-Prince metropolitan area, with wind and solar PV being primary candidates due to the wind's good LCOE expected for Lac Azuei on the one hand, and solar PV's modular character and site flexibility on the other hand (which allows to develop smaller "line loss reduction" distributed projects right at those parts of EDH's grid that can best accommodate it).

It is recommended that the actual business model(s) (that is, IPP, PPP, utility-owned with or without an O&M contract) is considered based on the feasiblity at the time of the actual project development, namely the degree of Government and EDH success in improving EDH financial viability to the level of making private sector investments possible. However, as of today, a PPP option appears to be most attractive at least for the first 10 MWp or so, as it (i) augments the impact of limited financial resources by leveraging public funding (resulting in a larger generation capacity installed than a pure public sector option); while (ii) reducing the risks for private sector (reduced exposure and risk mitigating instruments) and for the government (lower tariff payment obligations) than in a purely private-sector IPP approach.

Due to EDH's lack of financial sustainability, net metering for distributed generation is currently not considered an option. In the medium term, however, it is recommended to continue building on the existing growing self-supply market, in particularly the promising leasing model, in which RE companies lease PV equipment to urban business and residential customers to displace their current diesel generation. Development of this

market will create a more thriving solar PV industry, which can benefit both the scale-up of grid-connected and off-grid renewables. Once conditions are in place, net metering arrangements could be put in place to maximize benefits of this installed infrastructure for both the businesses and EDH.

Resulting recommendations for off-grid renewables:

The initial geo-spatial and load analysis of the unelectrified households suggests that there is scope for several off-grid technologies and business models to co-exist. In addition, there is a similar argument as for on-grid regarding the case for minimum and maximum ranges of optimal SREP support per market segment (Annex 1 and background document to it). Therefore, the fastest scale-up (both through SREP and post SREP exit) is likely to be achieved by creating a largely "technology neutral and business case neutral" enabling framework for offgrid RE (including access to finance/equity facility and/or results-based financing) with the objective to benefit ("boost") a full range of different RE supply options – from individual systems to village grids of various sizes. Initial market assessment has identified the following potential (preliminary data, more detailed analysis required as a part of the actual project preparation):

TABLE 8. OFF-GRID ELECTRIFICATION POTENTIAL

Off-grid RE type	Theoretical Max Potential of Segment (population)	Recommended SREP Target (population)
RE retrofitting, upgrading and expansion of the larger rural remote grids (mostly EDH remote grids, such as Port-de-Paix):	1,500,000	45-150K (3-10%)
Small and medium-sized village grids (retrofit + greenfield):	300,000	30k (10%)
Individual system clients (HH, Social Users and SME):	>5,000,000	500k-1M (10-20%)

Source: Navigant and iiDevelopment for SREP IP

For the village grid segment (cases 6-8), the most cost-effective intervention and the largest market potential in terms of clients reached is for RE retrofitting of the larger remote grids (case 7+8). However, given that EDH operates the majority of these, the feasibility of the approach is constrained by EDH's financial situation. Therefore, the recommendation is to pilot one or two such interventions in one or two of the EDH grids, and develop parallel interventions to scale up village grids for smaller rural towns (retrofitting of existing municipal grids, plus possibly green-field) in parrellel to acceleration of market development for individual systems (cases 1-5). Private operators of case 6-8 may well also become active in market segments 1-5.

Step 4: The top scored SREP Cases have then been compiled into a range of possible "public-private" SREP Projects (or **SREP interventions** supporting the scale-up of these business cases / the development of these market segments) in order to assess (and rank) in detail: (i) feasibility at project level (implementable at high probability and manageable transaction costs); (ii) synergies and economies of scale (e.g. various potential off-grid electrification business models would be included in one "umbrella" off-grid electrification project); (iii) overall effect of different "bundles" of market segment interventions on the overall energy market in Haiti (with the goal to *optimize* the total effect, efficiency, SREP scale-up potential and transformational impact (expected development of RE market segments and overall market post SREP exit) – for instance of all ongrid target market shares in their cumulative effect, during and post SREP as described in Teplitz et al. (2009)); as well as, (iv) the specific process rules, safeguards and priorities of SREP, Government and MDBs. The resulting projects / SREP components were again jointly ranked to establish a final order of priority. Table 9 shows the results of this prioritization by the SREP Task Force, taking into account the feedback received from stakeholders (scored from 0 to 4, 4 being the best score):

TABLE 9. RANK FOR FINAL SELECTION OF SREP-HAITI PROJECTS

Final Selection of SREP Projects	Transformative impact	Development impact	Economic & Financial Viability	Leveraging additional	Leveraging private sector resources	Implementation capacity (GoH)	Viability for MDB Financing	Sum
1. Integrating RE in the main grid	4	4	3	2	3	3	2	**21**
2. RE-based expansion of Port de Paix remote grid	2	3	2	2	3	3	2	**17**
3. Off-grid electricity services for productive, social and household uses	4	4	3	4	3	4	3	**25**
4. Rehabilitation of small hydro plants	2	3	2	2	1	3	2	**15**

Step 5: The public-private projects were consulted and prioritized with key stakeholders, who requested the addition of a cross-cutting component for building capacity and improving the enabling environment for scaling-up renewable energy in Haiti. Thus, the final proposed SREP investment program consists of five "**SREP Projects**" (Table 10):

TABLE 10. FIVE PROPOSED SREP-HAITI INVESTMENT PROGRAM PROJECTS

SREP Project	Priority level
1. Integrating RE in the main grid	**High** priority – important transformational potential in terms of experience and capacities for integrating renewables in EDH grid, which will inject much needed RE generation capacity to the EDH grid and help unlock future investments in RE. Need to ensure adequate maintenance if owned by EDH.
2. RE-based expansion of Port-de-Paix grid	**Medium/high** priority – less replication potential due to limited size of isolated grids, but can be replicated in other five isolated grids; provides a good learning potential (cooperation with academia etc.) and has a strong justification from a development impact perspective (implemented in the poorest and most isolated department, which, however, has significant development potential for which lack of electricity is a constraining factor).
3. Off-grid electricity services for productive, social and household uses	**High** priority – transformation of rural areas where electrification rates have been stagnant in the past 30 years; potential to support agriculture productivity improvements and other productive uses; complements a parallel engagement under IDA and CTF
4. Rehabilitation of small hydro plants	**Medium/high** priority –cost-effective intervention but limited replication/scale up impact. Need to ensure adequate maintenance if owned by EDH
5. Enabling environment, capacities, skills	**High** priority- Cross-cutting – essential complement of projects 1, 2, and 3 and for the scaling-up beyond the SREP projects

Stakeholder consultations were carried throughout the whole prioritization process. The consultation process and results are captured in Annex III.

5 RESPONSIVENESS TO SREP CRITERIA

The SREP Investment Plan developed for Haiti is responsive to all of the SREP criteria. Table 11 summarizes how the off- and on-grid renewable energy projects responds to each specific criteria.

TABLE 11. SUMMARY OF PROJECTS' RESPONSIVENESS TO SREP CRITERIA

Criteria	OFF-GRID Renewable Energy	ON-GRID Renewable Energy for Grid-Connected Infrastructure
Increased installed capacity from renewable energy sources.	It will result directly in investments of net present value >$100 million in about 10 MWp (possible range: 10-18MWp) of increased decentralized renewable energy capacity and solar stand-alone systems. It will build the capacity and project pipeline that will lead to achieving the national off-grid electrification goal.	It will result directly in in 10-20 MWp of grid-connected renewable energy capacity (depends strongly on wind share and absorption capacity, as well as the final deal structure) of installed generation capacity of grid-connected renewables. It will build enabling framework and the capacity for further RE scale-up
Increased access to energy through renewable energy sources.	It will provide electricity access to at least 1 million residents (expected range of beneficiaries = 1-1.5 M including Port-de-Paix	It will provide improved electricity access (higher tiers per SE4ALL multi-tier framework to about 1M EdH-using citizens
Low emissions development.	Renewable-energy mini grids and small stand-alone solar systems and products emit no CO_2; mini grids that use backup diesel for some of generation emit relatively small amounts compared to baseline.	Renewable-energy (solar, wind, hydro) designed into the existing grid-connected infrastructure emit no CO_2. By starting building experience with grid-connected renewables and building supportive enabling framework, SREP will help Haiti to set the path toward the low carbon development future.
Affordability and competitiveness of renewable sources.	The economic cost of supply for mini-grids is significantly less than for diesel generation; and the economic avoided cost of lighting is significantly less for picoPV than for kerosene. But given rural consumers' limited ability to pay and that lower-income consumers must be reached to deepen access to the rural population,	Renewable Energy is shown to be cost competitive to existing PaP generation in this document, by way of RE Supply Curve and advanced modeling of operational benefits from saved fuel.

	targeted incentives will be needed.	
Productive use of energy.	Mini grids directly support electricity supply to industry and commercial enterprises. Stand-alone systems support productive energy use, directly by enabling cottage industries and small retail ventures to increase their productivity and indirectly from the benefits that accrue from children's improved education due to better lighting and access to communication, improved health, and enhanced security. The SREP project will further support productive uses in agriculture by cooperating with the Ministry of Agriculture project for supporting agricultural productivity and agri-businesses.	On-grid renewables will increase the quantity and quality of PaP electricity supply in light of the difficult baseline, and thus help to meet some of the suppressed demand, which is currently limiting productivity, as explained in this document
Economic, social, and environmental development impact.	Displacement of diesel and kerosene reduces local pollution and risk of fire from open-wick lamps. Greater economic opportunity results from electricity access. Local communities can retain money in the community that previously would have been used to purchase fuel.	In addition to the obvious positive economic impacts (above and Annex), local and global in environmental impacts of on-grid RE feed-are expected to be positive due to the displaced thermal fuel and the relatively small size of the installed wind, PV and hydro plants in the uncritical PaP Lac Azuei areas.
Economic and financial viability.	Economic and Financial Viability of the off-grid component has been confirmed by applying consumer surplus calculation based on an estimated, income-corrected demand curve using data of Digicel 2014 and ECVMAS 2012. Renewable energy sources are least cost compared to fossil-fuel alternatives, and projects have positive and robust economic rates of return. Financial rates of return are satisfactory, though some grant support for initial investment is needed due to rural residents' lower ability to pay, especially since 50 percent access must be reached.	Economic and Financial Viability has been confirmed by applying standard Economic and Financial Analysis for on-grid RE benefits and costs (see Annex).
Leveraging of	Infrastructure is needed to rapidly	A leverage of about 1:3 - 1:4

additional resources.	scale up investments to achieve the national electrification goal. SREP resources also leverage investment financing from other sources (private sector, other MDB, households, leveraged at about 1:4 – 1:5 – see financing plan).	(SREP to private+MDBs) is expected for the on-grid component, but will depend strongly on the final deal structures possible, as explained in main IP text.
Gender equity.	Women and children are direct and significant beneficiaries as they will gain access to cleaner energy services in homes that offer far superior services, improved access to essential health and educational services, greater economic opportunities, and lower costs of accessing better energy services. Where feasible, women will be involved in supply chains – e.g. building on the successful example of micro-finance for women group (Fonkoze/MicamaSoley) .	Improved power availability will benefit both men and women. Development of a new renewable energy industry will create new opportunities for women employment and businesses. SREP capacity building project will specifically target women to help them take advantage of the new opportunities
Co-benefits of renewable energy scale-up.	Scaled-up renewable energy reduces local air pollution and avoids risk of fire from fuel spillage. Electricity is an important input in poverty alleviation efforts and rural development.	Local diesel fuel use will be reduced, so that handling issues will be reduced, too. Greater reliance eon locally available renewable energy will also support energy security.

6 SREP FOR HAITI: PROGRAM DESCRIPTION

6.1 PROGRAM OBJECTIVES AND EXPECTED OUTCOMES

The SREP Investment Plan for Haiti provides a balanced allocation of resources between two competing sectoral priorities – (i) urgent need to **reduce costs and improve quality, reliability and sustainability of service** (particularly in urban areas), and (ii) the urgent need to **increase electricity access** (particularly in rural areas). In both cases, the (i) improved and (ii) increased electricity access by way of RE scale-up will lead to productivity improvements and fuel economic and social development.

Consequently, the proposed SREP program in Haiti is expected to **expand** and **improve** access to electricity services by way of renewable energy scale-up. SREP will lead to both new electricity connections (Projects 2 and 3) and improvements in availability, reliability and quality of service for existing customers (Projects 1, 2 and 4). While these are not new connections, many of the existing customers currently receive less than 4 hours of power supply a day (corresponding to Tier0 of the SE4ALL multi-tier framework) – the impact of the improved service may therefore be as striking as for the customers who have received electricity for the first time. The impact of these investments will be tracked using the SE4ALL multi-tier framework, which will track both new connections and improvements across tiers, including through household surveys, with a baseline planned for 2015 (see Chapter 10for the details). In addition, particular attention will be paid to tracking the impact on productive uses. The household surveys will also allow for gender-disaggregated data and track specific impacts on women.

Additional key result indicators will include (i) increase in renewable energy capacity (MW) and generation (MWh), (ii) GHG emission reductions and avoidance, (iii) enabling regulatory framework enacted, (iv) expanded skill base for further renewable energy scale up, (v) increase in number of renewable energy enterprises, of which female headed, and (vi) renewable energy jobs created; (vii) knowledge transfer/increased capacity of the Haitian technicians .

6.2 PROGRAM RATIONALE AND DESIGN

The SREP Investment Plan for Haiti is conceived as a *comprehensive* program, with the explicit objective to initiate *transformation* from (A) Haiti's current underdeveloped, unreliable and expensive fossil fuel-centered electricity generation mix to (B) a modern and sustainable energy system which will rely on diverse sources of power, able to provide reliable and affordable electricity services to an increasing share of the population.

The underdeveloped state of the energy sector is both a challenge and an opportunity. It is a challenge because the electricity sector has still a long way to go until it will be able to

power the Government's ambition of becoming an emerging economy with a universal access to electricity by 2030. This transformation will not happen through one program but will require a long-term consistent support. Diversifying fossil fuel-base energy with renewable energy will be a very important, but not the only element in this journey. The ultimate success is closely linked to the progress in the implementation of structural changes in the organization and management of the electricity sector – starting with the recent Government plan (agreed with the IMF and supported by the WB PRELEN project) as outlined in Chapter 1.

On the other hand, the underdeveloped state of the sector is also an opportunity to influence and guide its development towards a cleaner and more sustainable path right from the start—and thus to leapfrog development by adopting state of the art knowhow and technologies. The relatively late move of Government towards integrating RE actively into its national energy mix (both on-grid and off-grid) will also allow to leapfrog some of the less developed (i) public sector RE planning methods and (ii) private sector RE business models that have been tested in other emerging markets over the last decade, which allows to reap "second mover advantages" by transferring the lessons learned in these international early stage efforts. One emerging lesson[42] is that past national RE efforts have often forgotten to optimize national level benefits of diverse RE options due to a somewhat single-minded focus on the SPV-level cost of individual RE projects: a more balanced look at both costs and benefits – as described in Chapter 3—will allow for a much higher net benefits of national RE pathways.

The SREP program is designed specifically to address these challenges and opportunities, intending to:

- Identify immediate, cost-effective, readily implementable opportunities for renewable energy investments with the best success probability, replication and scale up potential.

- Demonstrate how renewable energy can fill the gaps in the development of all electricity systems levels, by explicitly working on all these levels in parallel: from (i) the EDH main grid, to (ii) EDH isolated grids, (iii) existing (mostly non-operational) rural municipal grids, (iv) smaller green-field off-grid investments for productive, social and household uses or smaller villages without anchor clients, to (v) the smallest "PicoPV systems" sold via innovative business models. This allows to reduce transaction costs and showcase a synergetic, integrated, national renewable energy development. To minimize the risks involved with projects that work on all fronts at the same time, SREP is bundling several smaller interventions to larger projects, focusing primarily on creating a framework that can support diverse technologies and business models, while leaving the decisions on the most

[42] GIZ 2013, IEA 2014, Reiche et al 2015

appropriate technologies and business models to the market – thereby reducing transaction costs.

- Start small, but think big by reducing barriers to renewable energy investments. The barriers to the development of renewable energy, as identified in Chapter 2 are daunting. Successful transformation from fossil fuels to renewables will require a steep learning curve both for the Government and for the private sector, and a great degree of experimentation and fine-tuning of what works. To allow this learning and adjustments, the IP recommends starting with multiple smaller investments which will allow learning by doing and pave the way for successful larger investments in the future (as opposed to placing all resources into one large project, which may result in greater immediate renewable energy capacity but would have more limited learning potential, greater risks for both Government and the private sector and more uncertainties about its replication).

- Complement SREP investment with other energy sector interventions. The WB is currently assisting the Government through MTPTC and EDH in overall sector development and reforms, capacity building, rehabilitation of existing generation, transmission and distribution assets and actions to improve EDH commercial performance and reduce losses. See Annex 3 for details of the additional interventions. SREP is an integral part of this broader energy sector support program.

- Complement investments with a strong TA and capacity building program going beyond the needs of individual projects in order to build a nation-wide frameworks, capacities and skills to support more ambitious and sustainable renewable energy scale up (during and after the SREP time frame). This vision is embedded in the inclusion of a self-standing project focusing on improving policy and regulatory frameworks and building a strong skill base for renewable energy encompassing both academic and technical/vocational training.

- Build on and coordinate closely with other donors. SREP will coordinate closely with all stakeholders interested in supporting renewable energy, such as UNEP, Norway, USAID, and Pan-American Development Foundation. See Annex III for details. SREP will focus on filling the gaps that these organizations are not covering. For example, many of these organizations provide grant funding for innovative off-grid energy start-ups. The companies that started with these funds, however, often find difficulties to expand further – a gap that SREP aims to fill.

6.3 PROPOSED SREP IP COMPONENTS

The SREP Investment Plan for Haiti will include the following **five components:**

1. Renewable energy for the Port-au-Prince metropolitan area

The project will deliver 10-20 MW of renewable energy (depends on technhology (mix), final deal strustures and result of ongoing wind studies)into the EDH main grid serving Port-au-Prince and surrounding areas. The current installed capacity in the main grid is 240 MW, of which, however, only about 100 MW is available (15% hydro and 85% thermal) against an estimated peak demand of over 500 MW. The grid serves about 160,000 (legal) customers (and many more "irregular" customers), who all however receive only intermittent service. The average supply time is 16 hours, but this average hides differences across geographic areas and types of clients. Many household receive less than 2 hour service a day.

The objective of the proposed SREP project will be to build Government and private sector experience with developing and implementing grid-connected renewable energy projects through supporting investments in the grid-connected renewable energy generation.

This would be done through supporting the country's first grid-connected variable renewable energy project(s) (that is, one large project, or several parallel or consecutive RE projects) in order to test and fine-tune the approaches proposed by GOH and facilitate learning. The experience would be used to develop a suitable policy and regulatory framework to encourage larger investments (scale-up!). The proposed approach will be preferably a public-private partnership (PPP), encouraging private sector investments (including operations and maintenance), with SREP financing focused on reducing the total investment costs and the risk exposure for the private sector. The projects will be selected following competitive procedures. The PPP option will be conditioned on the demonstrated commitment to improve EDH finances. If a PPP option is not viable at the time when the project is developed, a public sector alternative could be considered. However, in that case, it will involve at minimum a private sector contract for operation and maintenance, following the established international examples of such O&M contracts for wind.

The project implementation is linked with the rehabilitation of the transmission line from Peligre to Port-au-Prince. As a part of project co-financing, the transmission line will be upgraded to allow for additional renewable energy capacity, therefore accommodating additional power output from a wind farm and/or solar power. Incrased hydropower generation from the rehabilitation Peligre dam will also facilitate the integration of the intermittent renewable energy (as described in GIZ 2013), but the proposed total capacity

of intermittant RE remains well below the safe limit. Various renewable energy technologies will be considered, with wind and solar PV being primary candidates due to wind's high economic attractiveness at the best sites and due to the solar PV modular character and site flexibility, which makes it easier to develop smaller projects.

2. Renewable energy-based expansion of Port-de-Paix remote grid


Photo credit: UNEP

Apart from the main grid serving Port-au-Prince, EDH also operates 11 isolated grids, ranging from 300 kW to 25 MW, with power mostly supplied intermittently by diesel units and some hydro power, both with O&M problems, constraining a possibility to extend access to more households, even though it is estimated that over 300,000 households could be reached by rehabilitating and expanding these grids. The Port-de-Paix grid is located in the North-West region, the most isolated region with highest proportion of poor and extremely poor in Haiti. It has an operational capacity of 2.2 MW, serving some 3,600 customers. Service is in general available only 5-12 hours a day, partly dependent on availability of the diesel fuel, a transport of which is a challenge particularly in the rainy season due to the region's isolation and lack of adequate transport infrastructue.

The region has proven wind and solar resources. The purpose of the project would be to expand capacity of the Port-de-Paix grid with renewable energy (most likely solar/wind based on a detailed project design) to improve quality of service for existing customers and to facilitate expansion of the isolated system to additional customers. This project will serve as a pilot case for potential replication of a similar arrangement in other EDH isolated grids. Learning from a previous wind project which was installed in Port-de-Paix by EDH in 1978 with assistance of the German cooperation—and is no longer operational due to the lack of operations skills and maintenance by EDH local staff—the proposed SREP project will be implemented as a public-private partnership, with private sector responsible for installation, operations and maintenance, and for covering at least a part of the investment costs.

The objective of the project would be to demonstrate improvements and expansion in energy access in Port-de-Paix's isolated grid through its hybridization with renewable energy. This project would serve as a demonstration project for other isolated grids that due to their remoteness cannot be connected with the main grid. The project will be developed with participation of the private sector. At minimum, the private sector will be contracted for EPC delivery and operation and maintenance. The feasibility of a PPP approach (with private sector investing directly in the project), will be explored during final project design .

3. Off-grid electricity for productive, social and household uses

Photo credit: UNEP

Investments in rural electrification in Haiti have remained scarce overall in the last 30 years, resulting in a rural electrification rate kept extremely low, as shown in chapters 1-3. at around 5%. With EDH absent throughout most of the rural areas, local governments and users have been left on their own to find solutions to their electricity needs. Up until recently, individual diesel systems and kerosene were the only available lighting/power solutions for most people, businesses and institutions in rural areas. More recently, renewable energy technologies, especially solar PV, have taken off as a new alternative for off-grid energy access. Solar PV is emerging as an alternative to diesel or kerosene in both urban and rural areas. In urban areas, mainly as an alternative to diesel self-supply that many EDH customers (mainly businesses) need to recurr to due to unreliability of EDH service and resulting damages to their productive and economic activities. In rural areas, households now have an option to replace their kerosene consumption with solar PV products, and renewable energy solutions can also be developed for productive and social uses.

The proposed project will build on the existing promising experiences and business models and establish enabling and financing frameworks to facilitate their replication and scale-up – from solar lanterns, through village grids to renewable energy to improve productivity. The project will also link with Government agri-business and competitiveness programs – to support productivity improvements through displacing expensive diesel generators with renewables.

The project will be co-financed with the existing IDA Rehabilitating Infrasructure and Access project and a parallel CTF-funded Modern Energy Services for All Project, which is being developed in parallel. See Annex V for the CTF concept and its complementarity to SREP.

4. Rehabilitation of existing small hydro plants


Photo credit: UNEP

EDH owns and operates six small and mini hydro plants (with a capacity below 2.5 MW each). Only one of them, however, is fully operational; all others do not produce at their potential capacity due to an urgent need for repairs and rehabilitation.

Rehabilitation of the small/mini hydro plants is a cost-effective way of expanding renewable energy capacity, allowing EDH to reduce expensive fossil fuel generation. In addition, increasing the share of hydro resources in the overall generation mix will facilitate further investments in intermittent renewables such as wind and solar. EDH has commissioned a study evaluating the potential for the rehabilitation of the small hydro plants, which has identified the investment plan for rehabilitating the six small hydro plants which could add up to 20 GWh/a of renewable generation at a total costs of around US$10 million. The project can be developed in phases. EDH has identified three priority investments: Drouet: (2.5 MW), Gaillard (0.5 MW) and Caracol (0.8 MW) at an estimated costs of about $6 million

Given EDH's maintenance deficiencies in the past, the project will pay specific focus on ensuring that credible arrangements are being put in place to ensure future maintenance of the rehabilitated facilities, such as through setting up a maintenance fund with an obligatory EDH contributions, outsourcing operation and maintenance to private sector or concessioning the hydroplants to the private sector.

In addition to the existing small hydro, various studies are underway to assess in more detail the potential for new mini- and micro-hydro plants. The proposed project will also consider a PPP arrangement for these new plants.

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5. Building enabling environments, capacities and skills for renewable energy scale up.


Photo credit: UNEP

All renewable energy investments currently suffer from the lack of transparent and consistent regulatory framework, fiscal policies favoring fossil fuels, and capacity and skill constraints at both professional and technical levels throughout the supply chain. Renewable energy scale-up therefore requires comprehensive, systematic and consistent efforts to eliminate these barriers at the national level for all types of renewable energy investments. For that reason the SREP Investment Plan includes a specific project for these cross-cutting issues, as opposed to including a TA/capacity building component in each project, which would be the more usual approach, but which could lead to fragmentation of efforts and potential inconsistencies. The project will cover a broad range of enabling activities, but the key focus will be on two areas, which the stakeholder consultations revealed as the main bottlenecks, (i) lack of enabling regulatory and fiscal frameworks, and (ii) lack of local capacities and skills for the implementation of renewable energy projects. The implementation will be closely linked to the execution of the four investment components described above, which will provide a real-life "RE market development" laboratory for testing and fine-tuning of the regulatory instruments and for learning (e.g. involving universities in the implementation of some renewable energy investments). The capacity building activities will include a gender dimension. It is expected that the effect of this project in terms of removing information asymmetries and other market inefficiencies will help to "lift" several RE market segments to a new, more efficient level, which will significantly bring down the risk-adjusted financing costs of new RE projects, as described in GIZ 2014b for PV markets in three countries.

6.4 PROGRAM CO-BENEFITS

The direct impact of the SREP Investment Plan for Haiti will be to engage the country in a broad development of renewable energy in order to increase energy access, as well as reduce costs and improve quality, reliavbility, and sustainability of energy services, particulary in urban areas. The SREP will have a direct, positive impact on the living conditions of the population and the productivity of its economic activities, as well as ensuring avoidance of GHG emissions.

In a development paradigm in which social and environmental benefits are inextricably linked, the SREP program is expected to yield the following co-benefits:

- Reduced dependence on fossil fuels, leading to
    - avoiding the growth of GHG emissions due to increased use of fossil fuels;

    - supporting progress towards country's energy autonomy and security;
    - in the long term, lowering energy bills, by reducing the cost of energy generation;
- Reducing local pollution;
- Creation of new economic activities and jobs related to new technologies with private-sector participation;
- Greater private-sector participation. SREP will strengthen the participation of private-sector operators in renewable energy production through (i) initiatives to build their technical and organizational capacity in the energy sector and (ii) better legal and regulatory arrangements that engage the private sector in a meaningful way; and
- Reduced levels of poverty and improved quality of life of rural population. In recent years, the fight against poverty has been an important part of Government action. In the quest to improve Haiti's living conditions, the Government recognizes improved access to and greater use of electricity as a key enabling condition;
- Improved socioeconomic status of women. SREP initiatives will contribute to enhancing women's quality of life by reducing the time they allocate to household chores, improving their access to modern energy for income-generating activities, and increasing their access to modern forms of communication. In rural communities, the availability of electric lighting and other energy services can lead to better education, health, and public security, especially for women and children. Once a community has electricity, a wide range of income-generating activities opens up for women (e.g., ice-making and food-processing businesses, small retail shops, and restaurants).

7 FINANCING PLAN

TABLE 12. SREP FINANCING, CO-FINANCING AND PRIVATE SECTOR FINANCING LEVERAGE

SREP IP Projects 1-5:	SREP financing	Total Public co-financing	Private sector financing leveraged
1. On-Grid RE for the Port-au-Prince metropolitan area	10	Tbd**	Tbd**
2. RE for Port de Paix remote grid*	0-4	0-7	Tbd
3. Offgrid electricity for productive, social and household uses	15	36.5	>45
4. Rehabilitation small hydro*	0-4	0-12	0
5. Building enabling framework, capacities and skills for RE scale-up	1	2.5	0
Total	**30**	**Tbd**	**Tbd**

* SREP Project 2 and 4 (Port-de-Paix and hydro rehabilitation) will be determined during final preparation which of these two will be funded to which extent.

** Leverage for on-grid RE in which private sector project sponsors would feed into EDH grid will depend on the specific SREP Case (#9-12) and may reach from about 1:1 (typical wind on-grid PPP with moderate risk appetite investors) to 1:5 (fuel saver cases) in Haiti pre 2020. Project sponsor wacc in case of international bidders will depend strongly on the debt terms they can secure on the global market.

8 INSTITUTIONAL FRAMEWORK FOR IMPLEMENTATION

The implementaiton of the proposed SREP-funded projects will be overseen and coordinated by the Ministry of Public Works, Transport, Energy and Communications (MTPTC) through its Energy Cell, with support from the SREP Task Force – it is expected that the same Task Force established for the preparation of the Investment Plan will retain an advisory role during its implementation. Haiti SREP task force consists of Ministry of Environment, Ministry of Economy and Finance, Ministry of Agriculture, Natural Resources and Rural Development, Ministry of Planning and External Cooperation, EDH, CIAT, Bureau of Mines and Energy. MTPTC has ample experience with implementation of donor programs, and is currently also managing the World Bank's Rebuilding Infrastructure and Access Program. Individual SREP projects will have individual implementation arrangements attuned to each project's characteristics and needs:

1. Renewable Energy for the Metropolitan Area

The project will be managed by MTPTC through its Energy Cell and EDH (exact arrangements to be defined), which will be in charge of implementing the project preparation studies and carrying out the competitive processe(s) for selecting the private sector firm(s) for the PPP contract.

2. Renewable energy for remote grids – Port-de-Paix demonstration project

The project will be managed by MTPTC through its Energy Cell in cooperation with EDH, which will be in charge of implementing the project preparation studies and carrying out the competitive process for selection of the private sector operator, and channelling of subsidies to the project. EDH wll implement r the upgrading and expansion of the Port-de-Paix isolated grid (Component 3).

3. Off-grid electrification for productive, social and household uses

The project will be managed by MTPTC through its Energy Cell with the support of the Bureau of Mines and Energy, except the CTF-funded access to finance facility, which will be implemented through a competitively selected financial intermediary, and the private sector support facility, which will be directly managed by IFC.

4. Small hydro rehabilitation

The project will be managed by EDH, the owner of small hydropower assets.

5. Building enabling environment, capacities and skills for renewable energy scale-up

The project will be managed by MTPTC through its Energy Cell, which will cooperate closely with the universities with renewable energy programs, such as the State University of Haiti (UEH) and Quisqueya University (UniQ), and the Gender and Energy Interagency Commission.

9 ENVIRONMENTAL AND SOCIAL ASPECTS

The lead national SREP coordinating entity, MTPTC (Energy Cell), has undertaken lending and technical assistance projects with the World Bank and IDB. As such, they have policies and procedures in place to ensure compliance with the Government, the World Bank and IDB social and environmental safeguards. In addition, IFC Performance Standards and its policies on social and environmental sustainability will be appropriately applied. Specific arrangements are as follows:

Environmental and Social Management Framework (ESMF). Since specific locations of investments will be determined during project design, an Environmental and Social Management Framework will be prepared that defines the environmental and social (E&S) planning, review, and clearing processes that follow national and MDB guidelines. The Ministry of Environment will play a fundamental role in designing this framework.

Resettlement Policy Framework (RPF). This framework will establish the modalities for conducting resettlement action plans (RAPs) and outline components that must be integrated, such as legal frameworks, eligibility criteria, methodology for asset valuations, and mechanisms for stakeholder consultations.

Strenghtening the Safeguards Compliance Capacity under SREP will be of utmost importance and will require continued joint effort between Government, World Bank, IFC, and IDB.

Environmental and Social Assessments. Each SREP project will be subject to comprehensive E&S assessments, which will include detailed studies aimed at uncovering the particular E&S impacts of a project or its subprojects. The studies include an Environmental and Social Impact Assessment (ESIA), an Environmental and Social Management Plan (ESMP), and a full or abbreviated RAP.[43] Adequate and relevant stakeholder consultations must be undertaken and guide the development of the E&S studies. Additional specialized E&S management plans and/or initiatives may be required to better address the impacts associated with a given projects or subproject. Preparation of detailed E&S studies must adhere to Haitian laws and regulations, as well as the E&S policies, guidelines, and standards of the MDBs.

Responsibilities. Project implementing agencies and where applicable sub-project implementers (e.g. SREP supported RE IPPs or mini-grid operators) are responsible for compliance with national law and regulations and the E&S policies, guidelines, and standards of the MDBs. These operators are also responsible for preparing the required detailed E&S studies (e.g., ESIA, ESMP, and RAP), obtaining clearances, implementing all required mitigation and monitoring measures, providing adequate budgets to sustain these activities, and complying with any directives issued by the relevant parties.

[43] The type of RAP will depend on the number of persons affected by resettlement effects experienced as a result of the project.

The detailed E&S studies prepared by sub-project implementers must be submitted to both the Ministry of Environment and the MDBs for review and approval. The Ministry's approval is based on Haitian laws and regulations, while that of the MDBs is based on their respective E&S policies, guidelines, and standards. The Ministry will be responsible for the review and clearance of ESIAs and ESMPs for subprojects. It provides a one-stop clearance process by involving all other key governmental agencies in the approval process.

The MTPTC with its Energy Cell have overall responsibility for implementing the ESMPs, RPFs, and any specialized E&S management plans and/or initiatives developed for the subprojects. MTPTC will not issue licenses/permits to sub-project implementers (if such licenses/permits are required)until the environmental entity or other relevant authorities issue E&S clearances.

Stakeholder Consultations. The ESMF contains detailed checklists and generic mitigation measures to ensure that potential impacts are addressed in E&S assessments and subproject management plans. In preparing the required detailed E&S studies (e.g., ESIA, ESMP, and RAP), the subproject implementers must adhere to the requirements for ensuring that participatory stakeholder consultations have taken place, as captured in the E&S policies, guidelines, and standards of the MDBs. Project-affected people and other critical stakeholders must be informed and consulted about the nature, timing, and scope of the relevant project impacts and mitigation measures. Participatory approaches must be utilized in organizing and conducting the consultations. Gender considerations must also be factored in.

Capacity Building. The Government in collaboration with its MDB partners has carried out numerous workshops and other capacity-building activities for key stakeholders through the PRELEN Project, through IDB projects and in the framework of the preparation of the SREP Investment Plan. Capacity building activities under PRELEN include the hiring of a consultant to support the MTPTC and EDH in the implementation of safeguards policies (during Project preparation), and technical assistance. The SREP Interventions will build on that and other MDBs' capacity-targeted activities. It is thus expected that these improved capacities will then facilitate the implementation of safeguards instruments under the SREP.

Environment, Health, and Safety Management System. Project and subproject implementers will design, construct, and operate the projects and implement an environment, health, and safety (EHS) management system.

Public Disclosure. Project and subproject implementation will require communication and consultation with both the Haitian stakeholders impacted directly and indirectly by the subproject and other stakeholders within and beyond the project zone of influence. Disclosure of the detailed E&S studies (i.e., ESIA, ESMP, and RAP) must be done in compliance with the public-disclosure requirements of the IDB and the World Bank Group. Relevant documentation will be made available on the websites of the Government and the MDBs and through additional means.

10 MONITORING AND EVALUATION AND KNOWLEDGE MANAGEMENT

This chapter describes the areas in which the key tools of monitoring and evaluation (M&E) and knowledge management will be strengthened as part of implementing the SREP Investment Plan for Haiti. The chapter also introduces the SREP M&E framework, which will be coordinated by the MTPTC Energy Cell.

10.1 STRENGTHENING MONITORING AND EVALUATION

The Energy Cell within the Ministry of Public Works, Transportation and Communications (MTPTC) will define and implement the SREP M&E system aimed at collecting, analysing, processing, and reporting on key information related to program activities, as well as progress in reaching SREP impacts and outcomes and lessons learned. The SREP program will contribute to ongoing efforts to establish an energy sector-wide M&E system (see Box 3) to ensure that the sector-wide M&E framework in Haiti (i) includes SREP indicators to facilitate reporting, (ii) improves indicators related to renewable energy, and (iii) puts a data collection system in place to obtain baseline information.

BOX 3. BUILDING M&E CAPACITY FOR THE KEY SECTORIAL AGENCIES S

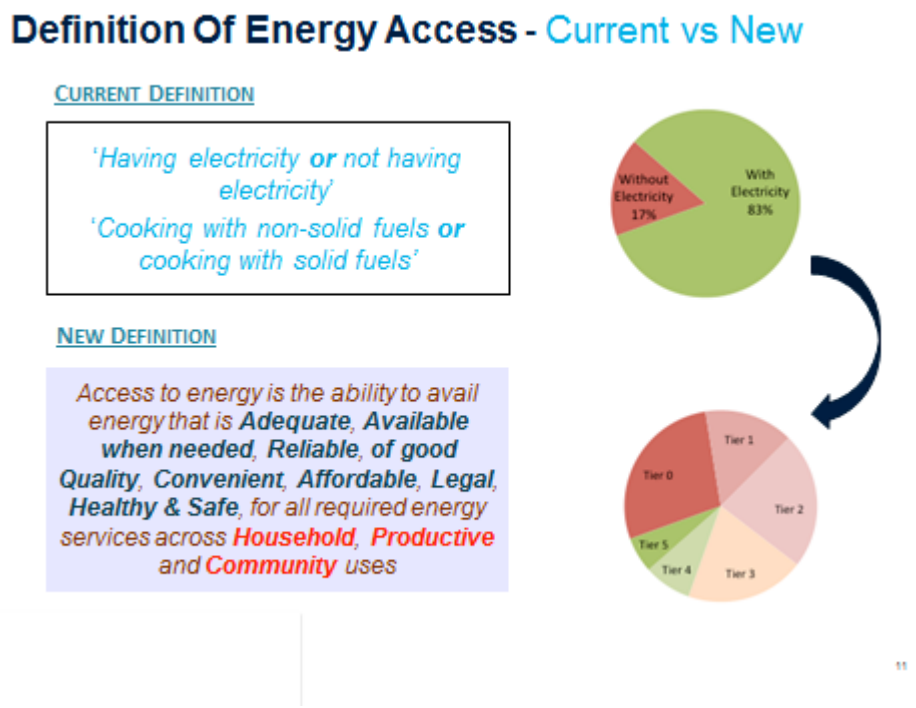
World Bank, through the PRELEN project, is currently providing technical assistance to the sector-wide M&E system that lacks human and technical resources. This support is targeting both MTPTC and EDH, main elements of this M&E system. Technical assistance is being provided to MTPTC and EDH on how to develop an effective M&E Framework. Under PRELEN, MTPTC has overall responsibility for the M&E of project activities. In this context, it prepares the project's M&E reports which include: (i) quarterly reports on the performance of the Project, based on the M&E framework established during Project preparation; (ii) quarterly Interim Financial Reports (IFRs); and (iii) annual independent financial audits of the Project and of EDH. Technical Assistance further helps the MTPTC set up its own monitoring framework. EDH also, in the framework of its corporate responsibilities, reports on its performance on a regular basis and provides the Project Coordination Unit (PCU) with the relevant information

10.2 SE4ALL MULTI-TIER FRAMEWORK FOR MEASURING ENERGY ACCESS

In addition to the general SREP M&E approach, the Haiti SREP Program will apply the Sustainable Energy for All (SE4ALL) Multi-Tier Framework (MTF) introduced in the Global Tracking Framework of 2013 and updated in 2015 (Figure 17). MTF replaces the traditional binary measure of energy access (with or without access) with a five-tier measurement methodology, which also assesses other attributes of the energy service, such as quantity, quality, affordability, and duration of supply. The MTF therefore allows then assessingthe assessment of not only whether households/enterprises/ institutions have electricity connections, but also whether the electricity service is adequate to meet their demand. The framework therefore can thus differentiate between a minimum level of service (such as provided by a small solar kit – Tier 1) and final aspiration, which is 24h unlimited reliable and affordable power supply (Tier 5),

acknowledging also that a grid connection does not guarantee the highest tier (e.g. intermittency and unreliability of supply would downgrade Tier 5 connection to lower tiers). The multi-tier approach thereby allows tracking of new access, but as well as also improvements in access levels across tiers.

FIGURE 17. DEFINITION OF ENERGY ACCESS AND MULTI-TIER FRAMEWORK



10.3 RESULTS FRAMEWORK

The Table below summarizes the SREP M&E results framework for Haiti.

TABLE 13. SREP RESULTS FRAMEWORK

Result	Indicators	Baseline	Minimum Targets by 2020	Minimum Targets by 2030	Means of Verification
Support for low-carbon development pathways by reducing energy poverty and/or increasing energy security	National measure of energy poverty.	MEPI = tbd	tbd	tbd	MEPI = This will be calculated based on the M&E component
	Electricity output from ongrid and offgrid renewables in GWh per year (excluding baseline hydro)	2	42	150	MWp installed and feeding into grids + offgrid sales reports; dispatch of vRE in PaP
	Increased **annual** public and private investments (US$) in total targeted subsector(s) per country	ca. 1 M	20 M	60 M	, Annual reports Government, EdH, RE IPPs and offgrid sales companies as per supply-chain analysis
Increased supply of renewable energy	Increased **annual** electricity output (GWh) as a direct result of SREP offgrid and ongrid interventions	n.a.	20	tbd	see 2 rows above
Increased access to modern energy services	Increased number of women, men, businesses and community services benefiting from improved access to electricity due to SREP interventions	n.a.	1M		M&E, sales reports of companies
New and additional resources for renewable energy projects	Leverage factor: share of financing from other sources compared with SREP funding (notation: SREP:Others)	n.a.	1:3 – 1:4		Donor reports; private sector financial statements; sales reports;PPAs signed…

10.4 STRENGTHENING KNOWLEDGE MANAGEMENT AND LESSONS SHARING

The outcome of consultations with stakeholders from academia (August 2014, November 2014, February 2015); as well as civil society and end-user beneficiaries (February 2015), revealed the need for focusing SREP attention on building capacity and awareness of renewable energy technologies, including the creation of a pool of skilled technicians.

The lack of appropriately skilled labor is constantly identified as a major barrier for scaling up renewable energy. [44] Government agencies, private enterprises, multilateral institutions, and NGOs widely recognize the shortage of skilled technicians for installation, operation and maintenance of renewable and decentralized energy systems as one of the major barriers. For the particular case of Haiti, the recent World Bank Systematic Country Diagnostic (February 2015) outlines the correlation between high level of education and skills and higher labor income. It further explains that skills and experiences, together with access to services such as electricity, contribute to a higher productivity in the country. In the absence of adequate skills, the private sector will most likely be unable to increase its productivity (see Box 4 below).

BOX 4. WORLD BANK'S SYSTEMATIC COUNTRY DIAGNOSTIC (FEB 2015)

Surveys also point to the lack of qualified manpower. One major constraint faced by enterprises in Haiti is the difficulty to find technicians that are well qualified, particularly in new technologies. This forces the country to position itself as a low cost producer for goods and services requiring little skills. An opaque labor market may be at fault, with no institutional mechanism to enable the exchange of information between labor demand and supply.

A more rigorous analysis confirms that more experience and skills, as well as access to inputs, are associated with better performance. An analysis of correlates of successful self-employed performance was carried out, using three measures: revenues per worker (in log), revenues per worker in the top 30 of the distribution, profits per worker in the top 30 of the distribution. With the caveat that this exercise indicates a conditional correlation rather than a causal relation, the analysis helps nevertheless identify the characteristics and inputs that could be significantly more relevant to improve understanding of what will it take to elevate productivity and generate jobs in the self-employed and small business sector. The results suggest that experience, skills, and access to inputs, such as electricity and water, are associated with higher returns.

Policies to boost households' income – wherever they work – are essential to sustaining and accelerating welfare gains. In urban areas, achieving this objective will have to involve the creation of economic opportunities and better jobs. A higher level of education and skills, for example, is correlated with higher labor income. In rural areas, the stagnation of both extreme poverty and income inequality observed between 2000 and 2012 reflects the increasing reliance on the low-productivity agricultural sector. Because 80 percent of the extreme poor live in rural areas, it will be necessary to develop this sector by means of policies that support income diversification. Such a diversification could contribute at spreading risk, strengthening food security, and preserving biodiversity.

[44] From Gap to Opportunity: Business Models for Scaling Up Energy Access, IFC, 2012 / Developing Effective Networks for Energy Access, USAID, 2013 / Stimulating quality investment in SE4ALL, IIED, 2013 / Public-Private Roundtables at the Fourth Clean Energy Ministerial, CEM, 2013 / IFC-WB London Investor's Conference on Private Sector Led Off-Grid Electrification: Executive Summary, The World Bank Group, 2013

Furthermore, both in urban and rural areas, it is necessary to promote expanded access to inputs (e.g. seeds, electricity, finance, water) and to product markets (e.g. transport), as well as improve the business environment in order to increase the profitability of employment. Greater economic opportunities and better jobs, especially in urban areas, would contribute in reducing crime and violence, further improving the business climate.

Another important barrier is the lack of awareness of renewable energy technology. A World Bank mission visited numerous departments in Haiti in February 2015 with the purpose to gather an understanding about end-user beneficiary needs and perspectives. The mission identified widespread lack of awareness of and co-benefits resulting from deploying renewable energy technologies in Haiti.

The SREP-funded *Building Enabling Environment, Capacities and Skills for Renewable Energy Scale-up Project* will focus on building capacities and skills, working closely with academia. Where feasible, the remaining SREP-funded projects will integrate learning and capacity building activities, and where relevant and feasible involve universities in implementation.

11 RISK ASSESSMENT

The overall implementation risk of the SREP-Haiti Investment Plan (IP) is assessed as Moderate to High – mostly due to overall country political and governance risks. Table 14 presents the main identified risks and mitigation measures used to ensure successful implementation of the program. Appropriate corrective and supportive measures will be put in place during the formulation and implementation of the IP in light of the lessons that will have been drawn from the activities. Guidance from members of the SREP Steering Committee will be actively and regularly sought to ensure that good practices are always adopted.

TABLE 14. MAIN IDENTIFIED RISKS AND MITIGATION MEASURES USED TO ENSURE SUCCESSFUL IMPLEMENTATION OF SREP-HAITI

Risk type	Description	Mitigation measure	Residual risk
Technical	Solar PV and other renewable-energy, mini-grid technologies and grid-connected RE technologies (solar, wind, hydro) may not work as intended.	Grid-connected solar, wind and hydro technologies are mature, with decades of experience worldwide. Detailed feasibility studies and mini-grid and off-grid projects currently under way will provide additional site-specific information and valuable lessons learned for fine-tuning designs. For off-grid renewables, comprehensive TA and capacity building to project developers will be offered.	Low
	Grid-connected intermittent renewables cannot be connected to the grid due to grid's low capacity and reliability.	WB is supporting a study that analyzes optimal ways of integrating renewable energy into EDH grid. Findings of the study will inform both how much intermittent renewables the grid can absorb, which sites are most suitable for injecting the power to the grid, and what kind of grid improvements are needed to ensure grid reliability. The SREP program will be developed through learning by doing approach. It is envisaged that SREP investments will be used for several smaller, sequential renewable energy investments in order to minimize the risks of grid absorption of larger scale intermittent renewables and to promote learning by both the Government and the	Low

		private sector.	
	Maintenance and operation failures.	EDH has had challenges with the maintenance of assets. Therefore, the proposed SREP investments will establish specific mechanisms for supporting maintenance and overall sustainability of investments. These include: Reliance on private sector for both investing and operating SREP renewable energy projects (both grid and off-grid), with PPPs structured to provide both incentives and contractual obligations to private sector to sustainably operate and maintain the assets. Trained managers and operators will be required at all facilities. In off-grid projects, long-term maintenance contracts will be required. For individual systems, provision of after sale services will be a condition for support. Training of technicians will be expanded.	High
	River/stream flow data quality and adequacy are uncertain. Hydrology affected by climate change. Biomass fuel availability can become limited and prices rise after investments are made. Wind resource data quality and adequacy are uncertain.	Resource availability will be confirmed during feasibility studies, including sensitivity analysis for hydrology changes Risk of price rise in biomass fuel will be mitigated by project developers having long-term supply contracts for a portion of their fuel needs, as well as directly controlling access to a portion of requirements through their own fuelwood plantations.	Moderate
Financial	Mini-grid and solar off-grid customers have limited ability to pay or will not pay.	Willingness-to-pay and market studies have been carried out in the framework of the preparation of the IP. The surveys confirmed a fairly high willingness to pay for electricity (about US$30 per month on average, but with significant differences across regions and types of customers). To accommodate different willingness to pay, SREP will	Moderate

		support a wide range of technologies and business models, which will cater to different market segments with varying willingness to pay – from solar lanterns, through pay as you go solar kits/home systems up to village mini/micro-grids. The initial experience of off-grid energy companies in Haiti is positive, showing that rural customers are willing to pay for reliable electricity, particularly if they can control their expenses, such as through pre-paid meters.	
	EDH payment default risk or payment delays	The Government, along with the MDBs and development partners, is keenly aware of this temporary difficulty and is working closely with EDH to overcome its problems through improving its financial position, see Chapter 1 for more detail of the IMF-supported loss reduction program in Haiti. SREP will develop risk mitigation instruments to support private sector investment, mitigating the EDH off-taker risk	High
	Associated CTF credit line will not disburse due to lenders lack of interest/knowledge in off-grid businesses	CTF access to finance facility is being designed in close consultations with the Haiti banking sector. There is an interest of several financial intermediaries (FIs) to support off-grid SMEs but successful implementation of the access to finance facility will require a greater degree of de-risking for the FIs. It is therefore anticipated that for the first round of lending, most of the risk will be carried by the Government. SREP risk mitigation facility will be developed to progressively seek greater participation of FIs in off-grid electrification lending Training to FIs on pipeline development and due diligence for appraising renewable energy projects will be provided.	Moderate
	Project developers have limited financial management capability.	Transaction advisory services and capacity building are provided to overcome these risks.	Moderate

	The Haitian Gourde will depreciate.	Investors already take into account some degree of currency depreciation risk. The SREP-Haiti will consider offering guarantees to cover such risks	Moderate
	Government failed to secure anticipated funding for the proposed projects.	Co-financing from the MDBs is about to be secured, and other partners and the private sector have already shown interest in co-financing. If the necessary co-financing resources are not secured during the project preparation phase, the projects could be phased, with the first phase benefitting from the secured funding and the second one for scaling up once additional funding is secured.	Moderate
Institutional	Poor governance; one of the lowest transparency indices in the world.	SREP-Haiti program will be designed to promote transparency—e.g. development of a transparent regulatory framework, sub-projects will be competitively selected – including the grid-connected renewables, the CTF access to finance facility will be managed by a competitively selected financial intermediary and loans will be awarded according to transparent rules published in the Operating Guidelines. In addition, all projects will need to adhere to MDB procurement and financial management rules.	High
	Regulatory and contractual mechanisms are not adhered to or are delayed.	Currently, the regulatory framework for both grid-connected and off-grid renewables is weak and inconsistent. There is no regulatory agency. The value added of SREP will be in developing, testing and fine-tuning regulatory instruments and building capacities for their implementation.	High
	Limited human capacity for project development and implementation.	Energy cell is staffed with competent professionals, including renewable energy and rural energy specialists. Further recruitment is in process. SREP program will include a specific project focusing on building local capacities of Government, private sector, academia and technicians to facilitate renewable energy scale-up	Moderate to High
	Clearance and approval are	Energy Cell will work with the project developers to avoid bottlenecks	Moderate to

	delayed.		High
	Power-planning capacity gives inadequate consideration to renewable energy development.	The SREP will support EDH in improving planning processes to incorporate generation from renewable energy, both intermittent and dispatchable technologies. New expansion planning tools will be introduced and capacities of power planners will be strengthened.	Moderate
Environmental	Projects have unacceptable environmental impacts.	All projects must comply with environmental assessments as part of MDE oversight and clearance procedures. MDE and MTPTC (via Energy Cell) will monitor according to Haiti's legislation and MDB requirements.	Moderate
Political	Instability surrounding the 2016 Presidential election. Social unrest in localities having electricity supply issues.	The extensive "consensus building" process as part of SREP preparation and implementation will build a broad-based support for the project, and will rely on the dialogue and network developed under the off-grid activities of the IDA project.	Moderate to High
Social	Projects have unacceptable social impacts.	Intensive stakeholder consultations were carried out during SREP preparation and will continue when projects are implemented. Specific project-level, social-safeguards assessment will be undertaken according to the BME and the newly established Gender and Energy Interagency Commission, and compensation or other mitigation actions will be taken in accordance with the framework and Government of Haiti and MDB guidelines. By providing affordable electricity to more people, the program will promote greater economic growth and equity, including targeted investment activities in rural areas. A focus on productive energy uses and employment creation is incorporated into the program design and will target vulnerable groups (women and youth). Design of financial mechanisms under the SREP will take affordability and willingness to pay into account, supported by information, education, and	Low

		communication campaigns.	
Project Design	CTF – access to finance facility funds could remain unused due to a lack of interest and knowledge of private sector providers (including NGOs and cooperatives) and financial intermediary / MFIs.	The existence of a pipeline of scalable projects. The interest in FIs in accessing the funds. The ongoing consultations with key stakeholders about on-lending terms and risk-sharing. Arrangements to ensure terms respond to their needs. Provision of technical assistance to stakeholders – including private sector and FIs.	Low to Moderate