Climate Investment Funds

SREP/SC.13/5
April 20, 2015

Meeting of the SREP Sub-Committee
Washington D.C.
Wednesday, May 13, 2015

Agenda Item 5

SREP Investment Plan for Haiti

PROPOSED DECISION

The SREP Sub-Committee, having reviewed document SREP/SC.13/5, *SREP Investment Plan for Haiti*,

a) endorses the investment plan as a basis for the further development of the projects and programs foreseen in the plan and takes note of the request for USD 30 million in SREP funding. The Sub-Committee requests the Government of Haiti, in the further development of the proposed projects and programs, to take into account comments made at the meeting and any additional written comments submitted by Sub-Committee members by May 29, 2015, and to respond in writing to questions raised during the meeting and in subsequent written comments;

b) reconfirms its decision on the allocation of resources, adopted at its meeting in November 2010, that all allocation amounts are indicative for planning purposes and that approval of funding will be on the basis of high quality investment plans and projects;

c) takes note of the estimated budget of USD 428,000 for MDB project preparation and supervision services for the project entitled, *Renewable Energy for the Metropolitan Area* (IBRD), and approves USD 128,000 as a first tranche of funding for such services;

d) takes note of the estimated budget of USD 428,000 for MDB project preparation and supervision services for the project entitled, *Renewable Energy and Access for All* (IBRD), and approves USD 128,000 as a first tranche of funding for such services;

e) further takes note of the estimated budget of USD 440,000 for MDB project preparation and supervision services for the project entitled, *Off-grid Electricity Services for Productive, Social and Household Uses Project* (IFC).

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Le. 15 APR 2015

Mafalda Duarte
Climate Investment Funds, Program Manager
CIF Administrative Unit
1818 H Street NW
Washington, D.C. 20433
www.climateinvestmentfunds.org

Dear Mrs Duarte,

It is with great pleasure and honor that I am submitting to the consideration of the Climate Investment Funds the Investment Plan for Scaling-up Renewable Energy in Haiti. The Government of Haiti highly appreciates the support provided by the Climate Investment Fund and the Multilateral Development Banks in the development of the SREP Investment Plan for Haiti. I hope that the SREP sub-committee will endorse the Investment Plan to provide Haiti with the opportunity to efficiently implement it and increase energy access in the country.

The Government is committed to make Haiti an emerging economy within the next decade and a half, as outlined in the *2030 Strategic Plan for the Development of Haiti.* The exploitation of the country's vast repository of renewable energy sources is a crucial step in attaining this goal. SREP provides an extraordinary opportunity to jump-start Haiti's renewable energy portfolio, enabling the country to narrow the enormous gap between energy availability and demand, reduce its dependence on oil, create heightened energy security, and provide affordable electricity for all. SREP will also foster the emersion of new economic opportunities and increase the involvement of private sector in renewable energy. All these are necessary forerunners to creating the

economic conditions that will improve Haitians' standard of living and bolster their economic fortunes.

The SREP Haiti Investment Plan was spearheaded by a diverse governmental Task Force and represents the collective consciousness and will of the entire country. Haiti was fortunate to benefit from consultations with civil society and academia, as well as the expertise of our multilateral development partners, whose decades of experience around the world in similar projects have helped create an ambitious yet realizable program for the country's alternative energy future.

The Investment Plan addresses two key challenges: the need to improve services for residential and business customers on the country's public utility grid, and expand access to those households, businesses and institutions that cannot yet be reached by the national utility, Électricité d'Haïti (EDH). Renewable energy can both improve service offered by the public grid, and provide alternative, affordable means of energy access for those whom the public grid cannot reach.

The Haitian Government looks forward to the support of SREP for this Investment Plan, and to working with CIF and development partners to successfully implement project and programs pertaining to each component of the plan.

Yours Sincerely,

Jacques ROUSSEAU, ING
Minister of Public Works, Transportation and Communications
Government of Haiti

SCALING-UP RENEWABLE ENERGY PROGRAM (SREP)

INVESTMENT PLAN FOR HAITI

Climate Investment Funds

SCALING-UP RENEWABLE ENERGY PROGRAM (SREP)

SREP Investment Plan for Haiti

APRIL 15, 2015

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ACRONYMS AND ABBREVIATIONS

BME	Bureau des Mines et de l'Energie (Bureau of Mines and Energy)
CIAT	Comité Interministériel d'Aménagement du Territoire (Interministerial Committee for Regional Development)
CTF	Clean Technology Fund
E&S	Environmental and Social
ECVMAS	Enquête sur les Conditions de Vie des Ménages après le Séisme (Post-Earthquake Household Living Conditions Survey)
EDH	Électricité d'Haïti
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FI	Financial Intermediary
GDP	Gross Domestic Product
IDA	International Development Association
IDB	Inter-American Development Bank
IEA	International Energy Agency
IFC	International Finance Corporation
IP	Investment Plan
IPP	Independent Power Producers
kW	Kilowatt
kWh	Kilowatt-hour
LAC	Latin America and the Caribbean
LNG	Liquefied Natural Gas
M&E	Monitoring & Evaluation
MDB	Multilateral Development Bank
MCI	Ministère du Commerce et de l'Industrie (Ministry of Commerce and Industry)
MDE	Ministère de l'Environnement (Ministry of Environment)
MEF	Ministère de l'Économie et des Finances (Ministry of Economy and Finance)
MTPTC	Ministère des Travaux Publics, Transports et Communications (Ministry of Public Works, Transportation and Communications)
MV	Medium Voltage
MW	Megawatt
MWp	Megawatt-Peak
NGO	Nongovernmental Organization
O&M	Operation and Maintenance
PPA	Power Purchase Agreement
PRELEN	Rebuilding Energy Infrastructure and Access Project
PREPSEL	Projet de Réduction de Pertes dans le Secteur Electrique
PV	Photovoltaic
RAP	Resettlement Action Plan
RE	Renewable Energy
SE4All	Sustainable Energy for All
SME	Small and Medium Enterprise
SPDH	Strategic Plan for the Development of Haiti
SREP	Scaling-up Renewable Energy Program
TA	Technical Assistance
toe	Tons of Oil Equivalent

UN	United Nations
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
vRE	Variable Renewable Energy
WTP	Willingness to Pay

FOREWORD

The Republic of Haiti is endowed with vast and various renewable energy potential resources. Exploiting this vast repository of alternative energy sources is a crucial step in the government's goal of becoming an emerging economy within the next decade and a half, as outlined in our 2030 Strategic Plan for the Development of Haiti.

The Scaling-Up Renewable Energy in Low Income Countries Program (SREP) provides an extraordinary opportunity to jump-start Haiti's renewable energy portfolio, enabling the country to narrow the enormous gap between energy availability and demand, reduce its dependence on oil, create heightened energy security, and provide affordable electricity for all. SREP will also foster the emersion of new economic opportunities and increase the involvement of private sector in renewable energy. All these are necessary forerunners to creating the economic conditions that will improve Haitians' standard of living and bolster their economic fortunes. Climate change has only added to the importance of our renewable energy resources and the urgency with which they must be utilized.

The SREP Haiti Investment Plan was spearheaded by a diverse governmental Task Force led by the Ministry of Public Works, Transportation and Communications (MTPTC). But it is more appropriate to call this a plan that represents the collective consciousness and will of the entire country. Haiti was fortunate to benefit from consultations with civil society and academia, as well as the expertise of our multilateral development partners, whose decades of experience around the world in similar projects have helped create an ambitious yet realizable program for the country's alternative energy future.

Haiti has two challenges: the need to improve services for our residential and business customers on the country's public utility grid, and expand access to those households, businesses and institutions that cannot yet be reached by the national utility, Électricité d'Haïti (EDH). Renewable energy can both improve service offered by the public grid, and provide alternative, affordable means of energy access for those whom the public grid cannot reach.

On behalf of the government and the people of Haiti, I am submitting Haiti's SREP Investment Plan for endorsement by the SREP subcommittee. I greatly appreciate the work of the Task Force and every other stakeholder that has contributed to the realization of this plan — a milestone in Haiti's march towards an energy future that meets the needs of all of its citizens.

Jacques Rousseau
Minister of Public Works, Transportation and Communications
Government of Haiti
March 15, 2015

EXECUTIVE SUMMARY

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In June 2014, the Republic of Haiti was selected as one of the new countries eligible to benefit from the Scaling Up Renewable Energy in Low Income Countries Program (SREP). SREP operates under the Strategic Climate Fund, part of the Climate Investment Funds, and aims to demonstrate the economic, social, and environmental viability of a low-carbon development pathway by creating new economic opportunities and increasing energy access through renewable energy (RE) sources.

The SREP Haiti Investment Plan presents the country's approach to catalyzing RE development in order to fill the huge electricity demand gap reliably and cost-effectively—and to sustainably transform the country's oil-dependent energy mix. Harnessing the country's RE potential will enhance energy security and generate new economic opportunities through cheaper energy use for men and women. It will also mobilize and leverage private capacity in enterprises and lead Haiti toward becoming an emerging economy—a government objective for 2030. The Investment Plan was developed under the leadership of the government through a comprehensive and consultative process.

The rationale for supporting Haiti through SREP stems from the government's difficulty in tackling on its own the energy challenges it faces and their serious long-term consequences for the economy, livelihoods, and environment. Haiti suffers from high rates of energy poverty, and the current fossil-fuel based power system is unable to meet the rapidly increasing energy demand. But its untapped RE resources are abundant, and the government's commitment to harness these resources to promote economic development and the well-being of all citizens is strong. And the private sector's investment in both on-grid and off-grid RE is growing, particularly if the enabling environment can be strengthened. SREP support can therefore help Government address the key sector challenges and leverage new opportunities. The timeliness of this support is underlined by recent government efforts to address the widening energy needs by improving the quality of electricity services in cities and expanding access to basic energy services in rural areas.

The Investment Plan was prepared by a multi-entity governmental Task Force led by the Ministry of Public Works, Transportation, and Communications (MTPTC). Multilateral development banks operating in Haiti have supported the Task Force during the design of the Investment Plan, including consultations with other government agencies, the private sector, academia, and civil society. This inclusive and country-led RE development program is consistent with the government's long-term strategy for Haiti's development, as envisioned in the 2030 Strategic Plan for the Development of Haiti. That plan proposes a results-oriented, programmatic approach to scaling up RE and enhancing access to energy in urban and rural areas.

The proposed approach guarantees engagement of the public sector and encourages that of the private sector to catalyze sustainable development of RE infrastructure and markets.

Key Energy Sector Challenges

Haiti faces several daunting energy challenges:

- *Extremely limited access to reliable energy services.* National energy consumption is dominated by biomass (75%), largely charcoal, which is unsustainably harvested and

inefficiently used. Electricity is available to only 30% of the population. In rural areas, with electrification at 5%, households rely mainly on kerosene lamps and on candles for lighting. Service is only intermittent, averaging 16 hours a day nationally, but many households receive fewer than four hours of daily power supply. The unreliability and low quality of on-grid electricity has prompted the wealthiest households and businesses to have storage capacity or to self-generate: the installed capacity of small and medium diesel generator sets is estimated at more than 200 megawatts (MW)—exceeding the total available on-grid capacity.

- *Aging and damaged infrastructure.* The main provider of electricity is the state-owned utility, Électricité d'Haïti (EDH), which serves about 250,000 customers. Its assets are aging—on average the networks are 30 years old and power plants are 25 years old—and in urgent need of repairs, rehabilitation, and upgrades. The devastating earthquake of 2010 and hurricanes of 2008 badly damaged the energy infrastructure, slowing further the rehabilitation progress
- *Rapidly increasing energy demand*. Power demand has surged in recent years, tracking economic growth and reconstruction. But the structural lack of capacity has increased the volume of unmet demand. Current electricity peak demand is estimated at over 500 MW and is rising fast, while available generation capacity peaks at 180 MW, barely reached due to the system's fragility.
- *High dependence on fossil fuel–based electricity generation.* EDH generates around 15% of the country's energy, with the rest coming from independent power producers and the Tripartite Cooperation between the governments of Haiti, Venezuela, and Cuba. Most power—81%—comes from thermal generation (diesel and fuel oil), and 19% from hydropower. This oil-based generation is costly: EDH average generation costs are 32–39 US cents per kilowatt-hour. Self-generation is even more expensive than on-grid generation. The high energy costs directly undermine economic development by increasing the prices of goods and services and by reducing Haiti's industrial competitiveness.
- *Large government subsidies.* In addition to high costs of generation, EDH has high technical and commercial losses due to aging infrastructure, illegal connections, and weak payment collection. Sustaining even the current service requires huge subsidies, equivalent to US$200 million a year—4% of the national budget.
- *Urban–rural disparities.* Haiti has reduced poverty in the last decade but almost exclusively by improving opportunities in urban areas. To reduce urban–rural disparities, policies should target investments and job creation in secondary and tertiary cities and in rural areas, which will require improving access to reliable and affordable energy.
- *Gender inequity.* Women and girls are particularly vulnerable to energy deprivation because it reinforces the obstacles they face in accumulating and using assets, particularly their human capital. Even if equally qualified and employed, women in the labor market earn much less than men.

Constraints to Renewable Energy Development

Haiti has excellent but largely untapped RE potential, including hydro, wind, solar, and biomass. Hydropower makes up the greatest share of RE power production, but micro- and

mini-hydropower exploitation remains well below potential. Wind energy has yet to be exploited, and solar energy has been harnessed only on a very small scale, mainly off-grid. A handful of biomass-powered projects are being developed.

RE has a major role in reaching the 2030 ambition for green jobs and sustainable growth, but it must overcome the following constraints:

- *Legal and regulatory*. While the basic legal conditions allow the private sector to invest in grid-connected and off-grid renewables, the legal and regulatory framework is obsolete, inconsistent, and incomplete, resulting in regulatory decisions often made case by case. The consequent lack of predictability deters RE investments, and companies that have invested find it hard to attract financing for scaling up. The government wants to clarify the framework for on- and off-grid renewables to reduce investors' risk perceptions and attract new investment.
- *Institutional.* No specific agency is responsible for the promotion of renewable energy and energy access*.* Recently, MTPTC, responsible for energy oversight, has created an "Energy Cell," which is now also in charge of promoting RE development and expanding energy access. While this unit is still very recent and its capacity is still being built, it has been the driving force behind Haiti's SREP Implementation Plan, and in the medium run, it is to be transformed into a Directorate of Energy in MTPTC.
- *Economic and financial*. Most RE projects have high capital costs, and the financing terms in Haiti (lack of long-term debt financing and high interest) discourage private investment. Equity financing is also very rare. RE projects also face risks of currency depreciation, as well as resource and off-take risks. With grid renewables, the off-take risk is the biggest, and the main reason that no power purchase agreement has yet been signed. To unlock private investment, the government wants to develop a public–private partnership (PPP) model that would reduce risks to the private sector, while benefiting EDH with lower-cost generation choices. In parallel, the government is addressing EDH's financial situation through a comprehensive loss-reduction and commercial recovery program—supported by the World Bank and Inter-American Development Bank and monitored by the International Monetary Fund—through a recently negotiated three-year program for Haiti.
- *Technical.* The small size and fragility of EDH transmission and distribution networks restrict the amount of variable RE the grid can absorb without worsening electricity services. While SREP's proposed investments of 10–20 MW are within the grid absorption capacity, future (post-SREP) RE investments could face integration hurdles. The government, EDH, and the World Bank are carrying out a study to assess grid absorption capacity and recommend grid investments to increase the share of variable RE that can be integrated with EDH's main power system.
- *Social.* Haiti has a history of social turmoil, which can affect RE, particularly if its potential benefits are not shared widely. Although the penetration of RE is already high in the country (mostly solar lanterns and other solar-powered appliances), field consultations for the Investment Plan revealed misconceptions, inadequate information, and lack of consumer awareness of the potential benefits of RE. These benefits must be clearly communicated.

- *Capacities and skills.* The lack of skilled labor has frequently been identified as a major barrier for scaling up RE inside and outside government. The skills gap is apparent at professional level (engineers and other specialists with RE expertise) and technical level (skilled technicians for assembling and maintaining systems). Consultations confirmed that there are information gaps for projects and potential partners, and that public information on them could help develop RE markets.

Opportunities for Leveraging the Private Sector

Despite the barriers, SREP can leverage the promising private interest in RE. The most active market is for off-grid power, due to lower (private) off-take risks, compared to the EDH off-take risk, but on-grid renewables are garnering attention.

Off the grid, private companies in the urban market offer solar photovoltaic (PV) solutions for hybrid diesel self-generation by businesses and individuals. In the rural base-of-pyramid RE market, enterprises and nongovernmental organizations offer an increasing menu of off-grid energy solutions, including micro-grids, solar lanterns, and pay-as-you-go solar kits.

The on-grid market is stimulating investor attention because of the RE potential, now quantified in studies, and because of the high power-generation costs, which make RE technology competitive. That creates an opportunity for both the government/EDH and the private sector. Several companies, including reputable international investors, are already conducting on-site feasibility studies and discussing with government the potential investment modalities such as PPPs.

Opportunities for Scaling Up Renewable Energy

The underdeveloped state of electricity is both an opportunity and a challenge. It provides a chance to guide sector development toward a cleaner, cheaper, and more sustainable path from the start, and thus to leapfrog old technologies and to reap a "second mover advantage" by applying lessons from other countries' business models and planning tools.

But the sector still has far to go if it is to achieve universal electricity access by 2030. This transformation will happen not through one investment plan but only with phased, coordinated, and long-term support. Diversifying the fossil-fuel generation mix to RE will be a very important, but not the only element. Success depends on improving performance, organization, and management of the electricity sector, as gradual gains in investments and policy reform go hand in hand. RE investments in the EDH grid require improved EDH finances, while cheaper RE in the grid will help curtail EDH losses and improve service quality—enabling further policy reform.

The SREP Investment Plan for Haiti has been designed with these opportunities and challenges in mind. Its focus is on a mix of several small investment projects (the five SREP components), which allow learning by doing and real-time fine-tuning based on experiences and realities on the ground, while being large enough to trigger transformational changes. SREP Haiti will build directly on current private activity and interest in each market. It will bring a qualitative change in each segment by removing key barriers and offering a demonstration impact. And it will support synergies across markets and enable scaling up after SREP.

Combining economic and financial analysis with consultations, the Investment Plan identified potential investments likely to maximize national economic benefits in the short and long term (including post-project scale effects), given current opportunities, constraints, and risks. The results were discussed with a broad range of stakeholders to ensure that SREP Haiti IP reflects the country's development needs, national priorities, and realities and expectations on the ground.

This back and forth identified opportunities for on-grid and off-grid RE in the short term.

On-grid RE. At this early stage of on-grid RE development in Haiti, all on-grid technologies (hydro, biomass, wind, and solar) have large potential for scale-up. Solar PV and wind power are the most likely candidates for SREP investment—for three main reasons. First, the scalability and the potential demonstration impact of both are high. Second, wind power's economic attractiveness is strong at the most promising sites near the major 115 kilovolt transmission line (soon to be upgraded), connecting the largest hydropower plant with the capital. Third, solar PV's modular character allows for smaller project investments without losing economies of scale, and its relative "site indifference" creates potential for locating plants in places with the best grid-absorption conditions.

For these intermittent on-grid renewables, an optimal range of immediate investments for combining optimal net benefits from SREP funding and post-SREP long-term scale-up is 10–20 MW. This range reflects the current state of the underdeveloped grid and dispatch capability. It also reflects the interdependencies of wind and PV with seasonal hydro and with demand, and the effect on fuel savings and line losses. And it reflects the typical early-stage uncertainties on wind data, detailed operational benefits, fully loaded costs, private sector margins, and net benefits. SREP will help clarify these areas for post-SREP scale-up.

Off-grid RE—urban markets. SREP has an opportunity to leverage the emerging solar PV market in urban areas. Several companies now sell or lease solar PV systems to businesses that have intentionally isolated themselves from EDH and self-generate with diesel generator sets. Solar PV can lower their energy costs and improve their competitiveness, while building RE generation capacity that can ultimately be harnessed for the EDH grid.

Off-grid RE—rural markets. The geo-spatial analysis, alongside stakeholder and field consultations, suggests that to maximize the benefits of rural electrification, there is scope for several technologies and business models to coexist—in that they operate in different market segments simultaneously and create competitive pressures benefiting end users. The geo-spatial analysis indicates that the largest access gains in the village off-grid segment could be made from EDH remote grids, including hybridizing its diesel generation with RE. But such investments are inherently complex and risky because they depend on EDH's ability to improve its commercial performance. So, SREP focuses initially on only one or two pilots in this segment, and focus resources on private sector driven business models. In this non-EDH off-grid market segment, the fastest scale-up is likely with an enabling environment—including a regulatory and financing framework—that is technology-neutral and business case–neutral. The objective is to boost promising business models grounded in Haiti's conditions, ranging from individual systems to village grids.

SREP Program Description

Program development objective. SREP Haiti is expected to achieve the following key outcomes:

- Expanded and improved access to electricity
- Increased RE capacity (MW) and generation (megawatt-hours)
- Reduced and avoided greenhouse gas emissions
- An enabling regulatory framework
- An expanded RE skill base, including increased capacity of technicians
- Increased number of RE enterprises
- RE jobs
- Knowledge transfer
- Opportunities for female entrepreneurs and workers.

SREP Haiti's Investment Plan consists of five components targeting the most promising investment opportunities (table 1) in the continuum of grid-connected and off-grid RE.

Table 1. Five components in SREP Haiti's Investment Plan

<table>
<tr><th></th><th>Urban</th><th>Rural</th><th>Crosscutting</th></tr>
<tr><td>Feeding into the EDH grids</td><td>Component 1: RE for the Port-au-Prince metropolitan area</td><td>Component 2: RE-based expansion of Port-de-Paix remote grid
Component 4: Rehabilitation of small hydro plants</td><td rowspan="2">Component 5: Building an enabling environment, capacities, and skills for RE scale-up.</td></tr>
<tr><td>Off EDH grids</td><td colspan="2">Component 3: Off-grid electricity for productive, social, and household uses</td></tr>
</table>

Component 1: Renewable energy for the Port-au-Prince metropolitan area. The objective is to build government and private sector experience by developing and implementing grid-connected RE. This would be done through supporting the country's first grid-connected variable RE project or projects, wind or solar PV, totaling 10–20 megawatt-peak (MWp) feeding into EDH's main grid serving the Port-au-Prince metropolitan area. The approach will be a PPP, encouraging private investments and adequate operation and maintenance. The exact arrangements, to be defined at project implementation, will depend on progress in the EDH loss-reduction program. If a PPP approach is not feasible or would lead to terms unfavorable to the government, a public sector option—an EPC (engineering, procurement and construction) contract plus an operation and maintenance contract to the private sector—could be considered. The final technology and deal structure will be decided when SREP implementation starts, based on a more detailed analysis in the new Electricity Master Plan (to be released this year) and information on variable RE grid absorption, relative benefits in situ, private sector interest, and EDH performance at that time. The experience will be used to develop frameworks and instruments to encourage larger RE investments and scale-up.

Component 2: Renewable energy-based expansion of Port-de-Paix remote grid. EDH also operates 11 isolated grids of 300 kilowatts to 25 MW, with most power supplied

intermittently by diesel units. Low quality of supply constrains productive use and extension of access to more households. It is estimated that more than 300,000 households could be reached by expanding these grids. The component's purpose is to demonstrate an integrated approach of hybridizing these (largely) diesel-powered grids with RE, rehabilitating and expanding the grid infrastructure to allow further customer connections, while improving commercial performance through installing meters. The component, targeting the most remote EDH grid in Port-de-Paix in the North-West region, is expected to result in 1–2 MW renewable generation capacity (most likely wind–solar hybrid) and expansion to at least 14,000 customers.

Component 3: Off-grid electricity for productive, social, and household uses. With only one-third of the population electrified, innovative business models have recently emerged to offer RE services to off-grid households, businesses, and institutions in urban and rural areas not served by EDH. The purpose of this component is to scale up access to modern electricity services, aimed at supporting promising models in urban and rural settings, including solar PV leasing to hybridize diesel generation for industrial and business clients, village RE–diesel hybrid grids; service provision through pay-as-you-go individual solar kits/home systems; and solar lantern sales The component is expected to result in 10 MWp of new RE capacity and well above 200,000 newly electrified households, businesses, and institutions.

Component 4: Rehabilitation of small hydro plants. EDH owns and operates six small and mini-hydro plants (each with capacity below 2.5 MW). Only one is fully operational, and the others do not produce at potential capacity due to an urgent need for repairs and rehabilitation. The component's purpose is to restore EDH's small and mini- hydro plants to their full capacity of 7.5 MW, as a cost-effective way of expanding RE capacity to reduce dependency on diesel generation. In addition, increasing the share of hydro resources in the overall generation mix can facilitate investments in intermittent renewables, such as wind and solar. (This component is part of SREP but is not included in the $30 million requested SREP budget. The government intends to seek funding from additional sources, such as the Green Climate Fund.) *Component 5: Building an enabling environment, capacities, and skills for renewable energy scale-up.* Beyond the lack of a modern regulatory framework, all RE investments suffer from fiscal policies favoring fossil fuels and from skill constraints. This component tackles these crosscutting issues, rather than having a technical assistance or capacity-building subcomponent in each component—the more usual approach but one that could fragment efforts. Covering a broad range, the component's key focus will be the enabling framework and local skills for RE projects. Implementation will be tied closely to that of the other four components.

Funding Sources and Rationale for SREP Financing

The total estimated budget for SREP Haiti is US$149.5 million—with a SREP contribution of US$30 million for Components 1, 2, 3, and 5 (table 2). (Component 4 will seek financing from other sources.) The program is seeking co-financing from participating multilateral development banks and other development partners, including US$30.5 million from the World Bank for all five components and US$10 million from the International Finance Corporation (IFC) to support Component 3. Finally, SREP Haiti is expecting to mobilize US$93 million from the private sector (including IFC). The overall SREP leveraging factor is

estimated to be 1:4 to 1:5 largely depending on the final design and deal structure of Component 1.

Table 2. SREP Indicative Financing Plan

SREP Component	SREP funding			Public co-financing			Private leveraging		Total leveraging
	WB	IFC	Total SREP	WB-IDA[d]	WB-CTF[e]	Other public[f]	IFC	Other private	Public + private
1. RE for the metropolitan area	8-10	0-2[b]	10	6				16[g]	22
2. RE for Port-de-Paix remote grid	2-4[a]		2-4	10				2	12
3. Off-grid electricity	8-9	7-9[c]	15-17	8	11.5		15	60	94.5
4. Small hydropower rehab			0	4		14		tbd	18
5. Enabling framework, capacity and skills	1		1	2.5	0.5				3
Total	21-23	7-9	30	30.5	12	14	15	78	149.5

a. The exact amount needed from SREP will be determined through a detailed feasibility study.
b. IFC participation in the Component 1 is dependent on viable conditions in place for the PPP option. If a PPP option is not viable, IFC resources may shift to expand Component 3.
c. The initial allocation for the sub-component is US$ 7 million. However, IFC SREP contribution could be expanded to US$9 million if the sub-component progress is satisfactory and if IFC contribution under Component 1 does not materialize.
d. World Bank co-financing is from the existing IDA-financed PRELEN, which is prioritizing SREP-prioritized investments.
e. Project under development, Concept note approved in February 2015
f. Financing being sought from other sources, such as the Green Climate Fund
g. Minimum leveraging estimate. Final leverage for on-grid RE, where private sector project sponsors would feed into EDH the grid will depend on the specific SREP Case (9–12) and may vary from about 1:1 (SREP to private investment for typical wind on-grid case with moderate risk-appetite investors) to 1:5 (for small distributed generation analogous to the "fuel saver" case in Chapter 2). Deal structures with international bidders will depend on the off-take risk at project development and on the debt terms they can secure in the global market.

The above SREP financing amounts are sought to support catalytic investments in RE, to encourage private investment. This will be done through reducing the key regulatory, financial and capacity barriers, developing and demonstrating public-private partnership models and risk mitigation instruments, and supporting the emerging promising business models in both urban and rural markets. Given the early stage of the RE industry in Haiti, SREP's focus will be on demonstrating viable approaches and jump-starting the most promising market segments while creating the conditions for future replication and scale-up.

Concluding Remarks

Haiti's electricity sector stands at a cross-roads between a business-as-usual scenario—which means increasing reliance on fossil fuels and their volatile prices—and an alternative scenario setting the sector on a sustainable path.

The government views SREP Haiti as a unique opportunity to switch from business as usual to a highly promising sustainable path. It is conscious of the detrimental impact that business as usual would have on the economy and on the well-being of its citizens, and is committed to providing all the enabling conditions for supporting the new scenario. It has already put into effect a comprehensive program to reduce EDH technical and commercial losses, and will continue supporting improvements in EDH performance. And it is committed to supporting the private sector in investing in on- and off-grid RE alternatives.

1

COUNTRY CONTEXT: ENERGY STATUS AND POLICIES

1 COUNTRY CONTEXT: ENERGY STATUS AND POLICIES

1.1 HAITI'S DEVELOPMENT STATUS

Haiti accounts for one-third of the land area of Hispaniola Island in the Caribbean, neighboring the Dominican Republic and covering 27,750 km^2. The population was estimated at 10.9 million people in 2003,[1] which makes Haiti one of the most densely populated countries in the Latin America and Caribbean (LAC) region. A further 2.5 million Haitians are estimated to live abroad. The Haitian diaspora is an important source of remittances, which amount to well over US$1.8 billion annually[2] or equivalent to around one-third of gross national product (GNP), and exceeding all international assistance after the earthquake of January 12, 2010.

Figure 1. Haiti's 10 administrative departments

The country is administratively organized into 10 departments (figure 1). More than a third of the population lives in the Western department (Ouest), which contains the metropolitan area of the capital, Port-au-Prince. Haiti has seen steady urbanization over the last 30 years, with the share of the rural population declining from 75.5% in 1983 to 55.6% in 2003, and further projected to fall to 48.1% by the end of 2015.[3]

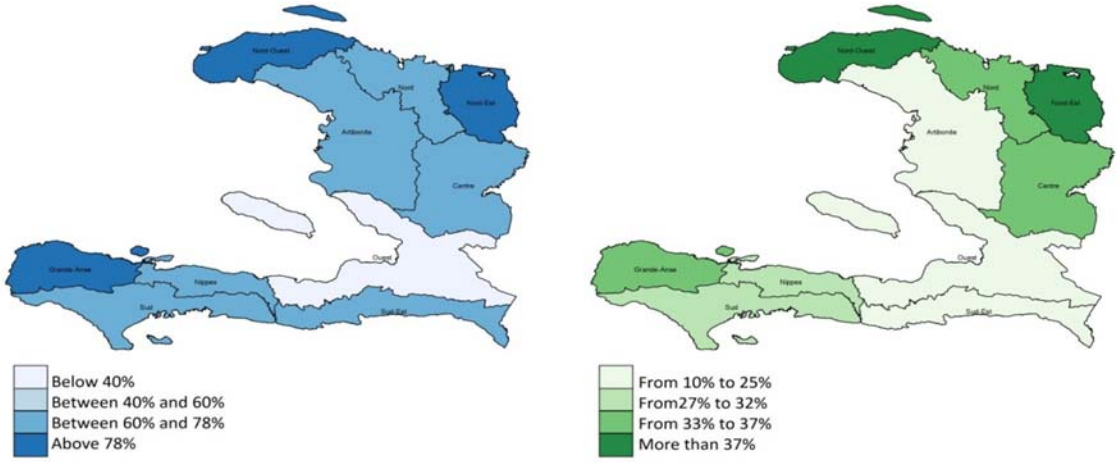
Source: Vidiani.com: Maps of the World.

Gross domestic product (GDP) per capita was US$846 in 2014[4]—far below the LAC average of US$9,536.[5] According to the latest household survey (Enquête sur les Conditions de Vie des Ménages après le Séisme, ECVMAS) in 2012, 6 million out of 10.4 million of the population was poor, living under the national poverty line of US$2 a day, and almost a quarter of the population was extremely poor, living below US$1 a day. Haiti ranks 161st on the 2014 Human Development Index. 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 in January 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 government buildings disappeared. The country is only now beginning to recover from the disaster.

The poverty disparity between urban and rural areas is widening. Thirty-eight percent of the population in rural areas is still unable to satisfy its nutritional needs and almost 70% of rural households are considered chronically poor—both below the poverty line and lacking access to basic goods and services, making it especially hard for them to emerge from poverty. Eighty percent of those classified as extremely poor live in rural areas.

Poverty also varies geographically. The poorest departments are farthest from the capital and the most isolated—North-West (Nord-ouest), North-East (Nord-est), and South (Sud) (figure 2). In addition, Haiti is the most unequal country in the LAC region. The richest quintile gets over 64% of total income, the poorest quintile less than 1%. In 2012, the Gini coefficient was 0.61, the highest in the region.

Figure 2. Poverty (blue) and extreme poverty (green) by department



Sources: ECVMAS 2012; World Bank.

In an attempt to decrease rural–urban disparities, the government started decentralizing in 1987. Since 2006, the law on decentralization has allowed municipal governments (among others) to generate, distribute, and commercialize energy at municipal level, as well as manage municipal energy infrastructure.[6]

Although a framework for decentralization exists, in practice access to public services and public goods is mainly in the largest metropolitan areas. The capital's metropolitan area is rapidly growing, and at nearly 3 million people—with an infrastructure dating back to the late 1970s—the urban center is unable to function efficiently, while negative externalities also hinder growth. Therefore, government policies continue targeting investments and job creation in secondary cities. Access to reliable and affordable energy in these secondary cities, as well as and tertiary cities and rural areas, is a lynchpin of decentralization. The government firmly believes that the Scaling-up Renewable Energy Program (SREP) can play a supportive role in increasing access to decentralized sources of power, particularly in isolated rural areas.

1.2 Energy Consumption

Only about a third of Haitian's population has access to electricity. In rural areas, electricity is rare (5%) and Haitian households rely primarily on kerosene lamps, and sometimes candles, although penetration of solar lanterns is increasing. Improving access to reliable

modern electricity services, particularly in rural areas, is therefore one of the key government priorities.

Electricity demand has been rapidly growing in recent years, tracking economic growth.[7] But the structural lack of power supply capacity has increased the volume of unmet demand, as well as autonomous generation, for personal, business, and community use. Current peak demand is estimated at over 500 megawatts (MW) and is projected to reach over 750 MW by 2020. It is therefore essential that generation, transmission, and distribution capacity increases correspondingly, so that economic growth is not constrained.

Haiti's energy sector is characterized by intensive use of biomass fuel (mostly fuelwood and charcoal), imported fossil fuels, and a largely untapped renewable energy (RE) potential. Total primary energy consumption 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 4 million toe in 2012, including 20% net imports of conventional energy. The country's total petroleum-product imports amounted to US$755 million in 2012.[8] The same year, biomass (wood and charcoal primarily, but also sugarcane/bagasse waste in much less volume) represented around 75% of total energy consumption, petroleum products 23%, and hydropower 3%. The residential and commercial sectors account for most energy use.

Charcoal, from rapidly declining tree resources, is the single largest source of household energy in urban areas (91% of households use charcoal). In rural areas, woodfuel (twigs) dominates as the primary fuel for household cooking. Inefficient cooking practices, coupled with high population density and severe poverty, are putting an enormous burden on Haiti's natural resources.[9]

Reducing charcoal consumption is an important government goal, and several efforts are being financed by development partners including the United States Agency for International Development (USAID) and the United Nations Environment Programme (UNEP) focused on increasing adoption of efficient cookstoves. RE plays a prominent role in the government's plan to expand generation capacity, and the government considers SREP the key tool for bringing in the required transformative change to attract RE investments.

1.3 Electricity Generation, Transmission, and Distribution

The main provider of electricity services in Haiti is the national, government-owned utility Electricity of Haiti (Électricité d'Haïti; EDH).

Generation and transmission

EDH generates some 15% of the energy produced in Haiti, with the rest coming from independent power producers (IPPs) and the Tripartite Cooperation mechanism (Haiti–Venezuela–Cuba).[10] Current electricity infrastructure is aging and has been poorly maintained. Installed generation capacity is about 320 MW (table 3), of which only 176 MW is available[11]—insufficient to meet estimated peak load demand of more than 500 MW, resulting in frequent load-shedding and service interruptions.[12] Most of the power (81%) is

supplied through oil-based thermal generation (diesel and fuel oil), with hydropower contributing 19%.

The largest hydro plant is Péligre (54 MW), under rehabilitation with its transmission line to the metropolitan area. EDH owns eight other smaller hydro plants, but only one is operating at full capacity. Hydropower is the only grid-connected RE source.

The majority of power is supplied by three IPPs, which provide 130 MW operating capacity—of which about 100 MW is for the metropolitan area. All IPPs produce power from thermal sources (diesel and heavy fuel) via power purchase agreements (PPA) with EDH. These fossil-fuel generation plants are expensive for EDH, straining its financial situation; EDH's current average generation costs are US$ cents 32–39/kWh. Integrating RE into the power supply mix can significantly reduce EDH generation costs.

Table 3. EDH grids—capacity and customers

Grid	Installed capacity (kW)	Available capacity (kW)	Active customers (number)
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
Total	317,885	150,500	246,674

Source: EDH, 2015.

Distribution

EDH operates one main interconnected grid covering the metropolitan area and 11 isolated grids, serving about 250,000 "active" customers).[13] Most of these customers are on the main grid covering Port-au-Prince and surrounding areas, where 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, but with operation and maintenance (O&M) problems.

EDH faces considerable technical, managerial, and financial challenges. Technical and nontechnical losses are 65%, a large part due to illegal grid connections. Further, the collection rate is only two–thirds—meaning that EDH recovers only 22% (one-third of two-thirds) of the value of the 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 in paying for fuels, basic maintenance, and other operating costs, and depends on government subsidies to bridge the gap.

Current electricity tariffs were established in 2009. As part of the Electricity Master Plan that it is drafting (and that should be ready by late this year), EDH is conducting an investment plan and analyzing tariff reform. The average residential tariff (US$0.21/kWh) is below the LAC region average, but the average tariff for the industrial and commercial customers (US$0.30/kWh) is at the higher end of the regional range. Connection fees, differentiated by user type, are about US$65 for residential customers, and more for industrial and commercial customers.

The average daily electricity service of only 16 hours and the relatively high tariff for commercial and industrial users compels most industries to self-generate, reducing their competitiveness. It is estimated that the cumulative capacity of individual diesel generator sets in the country is more than 200 MW (more than the available power of 150 MW supplied through EDH). Solar photovoltaic (PV) power has recently started to emerge as an alternative for self-supply, on which SREP can build with a view to scaling up.

1.4 ELECTRICITY SECTOR INSTITUTIONAL FRAMEWORK

The main ministries and agencies involved in the energy sector are:

The Ministry of Public Works, Transportation and Communications (Ministère des Travaux Publics, Transports et Communications; MTPTC)—the lead government agency for the energy sector. Official oversight of energy access activities is handled by the offices of MTPTC through the Energy Cell, created in late 2012.

The Bureau of Mines and Energy (Bureau des Mines et de l'Energie; BME)—established in 1986. It operates under the supervision of MTPTC, with a mission to promote research as well as efficient exploitation and use of mineral and energy resources.

EDH—a state-owned corporation. It is the country's utility company primarily responsible for electricity generation, transmission, and retail distribution.

Other government ministries and agencies include:

The Ministry of Environment (Ministère de l'Environnement; MDE)—mainly responsible for environmental protection. As a crosscutting institution, it also has a key role in promoting sustainable energy through, for example, reducing charcoal consumption, increasing household energy with improved cookstoves, diversifying energy resources toward RE, and increasing rural energy access.

The Ministry of Commerce and Industry (Ministère du Commerce et de l'Industrie; MCI)—responsible for developing businesses to expand jobs. It is also aware of energy needs and has been involved in drafting energy-related laws, as for example the law on liquefied petroleum gas (LPG) that will help improve household energy for cooking. The ministry is also involved in franchising of free zones, which need electricity for most of their industries.

The Ministry of Economy and Finance (Ministère de l'Économie et des Finances; MEF)—responsible for budget support. It oversees the budgets of other ministries, agencies, and EDH, and is charged with supervising other ministries' agreements with development partners.

Interministerial Committee for Regional Development (Comité Interministériel d'Aménagement du Territoire; CIAT)—chaired by the prime minister. Its 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. It aims to streamline investments by simplifying bureaucratic procedures and providing economic and business information to potential investors.

There is no regulatory agency. EDH is overseen by MTPTC and MEF, which provides subsidies to cover EDH losses.

The 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 1.6.

1.5 Role of the Private Sector

The private sector—in Haiti, mainly small and medium enterprises (SMEs)—has become a key contributor to economic growth in numerous sectors. It has around 900,000 micro, small, and medium enterprises: 60,000 are SMEs—small firms with 10–49 employees or medium firms with 50–250 staff. The private sector is dominated by manufacturing (particularly textiles and garments) and agriculture.[14]

Independent power producers

Most power is produced by IPPs, including Sogener, E-Power, and HaytracIn with a combined production of 130 MW of operating power from thermal sources (diesel and heavy fuel).

The private sector has explored opportunities for grid-connected RE (mainly solar and wind) with various developers, including reputable investors from abroad, and has conducted detailed studies. It is beginning to discuss potential projects with the government. No PPA for RE has yet been signed, however.

Renewable energy distributed generation, including the private sector, cooperatives, and nongovernmental organizations

Most private RE activities concentrate on the off-grid market, which largely consists of two types of customers: *business and industrial,* particularly in urban areas, which intentionally decided to isolate themselves from the EDH grid and self-generate (because of

unreliability); and *households, businesses, and institutions* in unelectrified areas, mainly in rural towns and villages.

An industry has developed for both streams. Several companies offer solar PV alternatives to businesses to displace or complement their diesel generation, but installed PV rooftop capacity is still very small (estimated at around 4 MW, primarily for health services).[15] Some private companies, nongovernmental organizations (NGOs), and the first rural energy cooperative (established by the National Rural Electric Cooperative Association of the United States in 2014) provide off-grid electricity in rural areas, through village grids or individual systems. (Annex IV describes the main business models to serve base-of-pyramid consumers.) Several local companies also specialize in supplying, and in one case manufacturing, street lights.

A supply chain analysis[16] has identified 27 companies operating in Haiti's solar business and 10 supplying generator sets.

Several private sector players are in the process of creating Haiti's first Renewable Energy Association, which would allow the private RE sector to speak with one voice. Private interests and current initiatives in RE will be reinforced with the support of SREP and will be fundamental in meeting SREP results.

Financiers

Haiti's financial system has 8 commercial banks,[17] more than 220 credit cooperatives, and 21 microfinance institutions. More than two-thirds of commercial bank branches are in the Port-au-Prince metropolitan area, and only five of the eight banks operate outside the city. Rural areas are served primarily by credit cooperatives—90% of these cooperatives operate there.

Microfinance institutions fill the gap left by commercial banks and credit cooperatives, in March 2008 lending to around 150,000 people, or three times the number of commercial bank borrowers. The average microfinance loan size outstanding was US$540 or less.[18]

Commercial funding for RE is still rare in Haiti. A project financed by the Clean Technology Fund (CTF)—the Modern Energy for All Project—is being prepared, which intends to establish an access to finance facility to be managed by a competitively selected financial intermediary. The project's design envisages a credit line to private providers of RE services and products (including to NGOs, cooperatives, rural retailers, and microfinance institutions) for investing in off-grid RE projects. The Modern Energy for All Project is expected to build a robust energy project pipeline and increase interest in and capacity of Haiti's financing institutions (annex V).

1.6 Energy Policy and Strategic Framework

The government's 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 envisages strengthening the private sector and providing basic services (including electricity) to the populace. The Martelly[19] administration has identified energy as one of its five priorities—the "five E's" (with education, employment, the environment,

and the rule of law).[20] 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 to: ensure sufficient supply to meet demand and support economic growth; promote energy savings and efficiency; promote development of indigenous renewable sources of energy; pursue exploration of fossil fuel sources in Haiti; and create a regulatory framework to encourage development of supply while protecting the environment.

The National Energy Sector Development Plan for 2007–17 recommends improvement and development measures but is now outdated, as it was completed before the 2010 earthquake, which fundamentally changed the energy sector's development needs. EDH is therefore developing a new Electricity Master Plan, which should be out late this year, and which will build on the economic and financial analysis of various renewables carried out for the SREP Investment Plan (Chapter 3). The earthquake hugely compounded the problems faced by the energy sector by worsening EDH's financial situation and by undermining institutional and managerial capacities. It also damaged or destroyed much electricity infrastructure, increasing the emphasis on rehabilitating assets.

Since the earthquake, the government has focused on rebuilding the essential energy infrastructure and making sure that critical loads were supplied. This reconstruction, now largely complete, allows the government to move toward its longer-term priorities in the SPDH.

Reaching the SPDH goal of becoming an emerging economy by 2030 will require twin-track electrification efforts: improving EDH performance and supporting on-grid generation capacity to enable the utility to provide reliable and affordable services in urban areas and their surroundings; and supporting off-grid electrification in rural areas that will not be served by EDH.

Power sector reform and measures to improve EDH's financial performance are therefore critical. The government's approach to address EDH's precarious financial situation consists of three parallel tracks:

1. *Reduce EDH losses* by targeted investments in rehabilitating existing transmission and distribution lines—carried out with the current support from the World Bank and the Inter-American Development Bank (IDB)—and a comprehensive plan to reduce commercial losses, starting with improving collections through installing new meters. The government has developed a loss-reduction program, which is being adopted as a key element of a new International Monetary Fund (IMF) program, currently being negotiated. The Rebuilding Energy Infrastructure and Access Project for Haiti (PRELEN), financed by the International Development Association (IDA), is providing technical support and financing for the Government's program for reducing EDH losses (box 1).
2. *Increase availability and reduce costs of power supply*, decreasing EDH dependency on the expensive fossil-fuel power from IPPs. Options include rehabilitating existing hydro plants, boosting LNG imports for power generation, and raising the RE share in the generation mix. The government sees SREP as a catalyst for this ambition.
3. *Prepare the ground for broader legal, institutional, and regulatory reforms*, which would clarify the legal framework, open the electricity sector to competition, incentivize

private investments, and establish a regulatory agency. The absence of a clear regulatory environment is one of the main bottlenecks to developing the energy sector in general and scaling up RE activities in particular. The current legal framework, based on 1989's Organic Law of Electricity is very outdated, and discourages private investment. The resulting lack of competition is hurting consumers and constraining further development. The government is carrying out studies to help it structure these broader reforms.

Box 1. The government program for reducing EDH losses

Supported by bilateral and multilateral agencies, the government is committed to address the key threats to the sector's financial viability—mainly technical and commercial losses. In 2014, the prime minister formed an Energy Commission in which strategic partners gathered to discuss and coordinate the necessary steps toward EDH's performance recovery and sustainable development.

In January this year, EDH outlined an ambitious loss-reduction program, which has been validated by MTPTC and MEF ministers, and signed an implementation plan to coordinate monitoring of this recovery program. Program's short-term objectives are for EDH to save more than US$70 million annually (around 40% of annual budget transfers to the utility), through:

- optimizing fuel and electricity purchases (which offer the biggest savings potential for EDH costs); and
- sharply improving all parts of the commercial value chain (installing new meters, adopting automatic billing and bill recovery) with the aim of cutting commercial losses by around 10% in one year (from 63.8% in October 2014 to 57.4% 12 months later).

The 2014–2015 EDH recovery program also has the support of the IMF, as it will help rapidly reduce budget transfers to the electricity sector. In March this year, the IMF stated its intention to add implementation of the EDH loss reduction program to its structural measures in its forthcoming three-year program for Haiti, currently at advanced state of negotiations.

PRELEN is providing technical support and financing for implementing all activities related to this program (and to EDH as needed) of US$77 million, mainly for enhancing utility performance in seven areas: strengthening EDH management capacity; providing technical assistance (TA) to support EDH on technical, commercial, financial, and sector planning matters; carrying out a 2030 master plan for EDH to assess electricity demand and defining priority investments to meet it; extending EDH's billing system to the provinces; installing a remote-metering system for large industrial and commercial clients; providing TA to help EDH in carrying out external financial audits; and rehabilitating EDH's distribution networks and installing metering equipment in selected areas.

Several development partners are supporting loss-reduction efforts through complementary investments in rehabilitating critical infrastructure to enhance the overall impact: in 2012, USAID financed rehabilitation of seven substations in Port-au-Prince (US$12 million), followed by that of seven power distribution circuits in the same area, financed by IDB and the World Bank (US$3 million and US$4 million) in 2013 and 2014. This year, the World Bank is analyzing the feasibility of modernizing EDH's national dispatch center, a US$4 million investment that could potentially generate US$0.5 million in monthly savings to the utility. Lastly, IDB is rehabilitating EDH's largest power generation asset, the Péligre hydropower plant and the transmission line from Péligre to Port-au-Prince. The progressive upgrade of Péligre from 35 MW to 54 MW will ultimately provide 30% extra, cheap hydropower to the Haitian grids, thus lowering the average cost of generation.

1.7 THE RURAL ELECTRIFICATION CHALLENGE

Status and expenditure patterns

The official electrification rate according to EDH is 30%, but estimates vary due to unreliable statistics.[21] 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, low electricity access, and low incomes. The distribution of electricity access is also highly unequal: electricity access in Port-au-Prince is relatively high if irregular connections are accounted for, while access in rural areas remains extremely low (5% by official estimates).

Households in Haiti spend on average about US$30 a month on electricity or electricity substitutes. However, rural/urban and departmental averages vary greatly (table 5 and figure 3 in the next section), and the poorest half of the population spends much less than this average.[22]

Renewable energy solutions to electricity needs

With EDH absent in most rural areas, local governments and users have been largely left to find their own solutions. Up to very recently, individual diesel systems (for alternating current equipment) and kerosene and candles (for lighting) were the only options for most rural people, with diesel generator sets used by many businesses. As most households own cell phones, they also spend a lot on recharging at commercial charging stations. More than 36 smaller towns have diesel-powered mini-grids built by municipal governments, but only a few of those are still regularly operating, and where they are, service is typically for only a few hours in the evening.

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

The penetration of solar lanterns and small kits among households in rural areas is high internationally (16–17%),[23] but varies widely across the country. The share of households with a solar lantern or small system ranges from 9% in the Central Department to 37% in the South-East (table 4). (See the Appendix for details.)

Table 4. Penetration of renewable energy technologies by department and by rural/urban split

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. With much of the electricity infrastructure destroyed, solar lanterns have been brought into the country as part of post-earthquake assistance. These lanterns, originally used by displaced people in camps, have eventually found their way into 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 300,000 solar lanterns/kits in use in Haiti,[24] but only about half of them are quality-certified products, most distributed by local SMEs and NGOs.[25]

Post-earthquake support has also triggered investments in street lighting. Originally started as a reconstruction effort, the investments in street lighting have eventually been expanded to rural areas—supported by the government mainly through the "Ban m limye, Ban m lavi" ("Give me light, give me life") program. The 10 departments have about 13,500 solar street lights in 140 municipalities.

The involvement of the diaspora, NGOs, and the private sector since the earthquake has led to innovative approaches to sustainable energy off grid. (Annex IV provides examples of these home-grown models, ranging from microfinance for solar lanterns, to leverage of mobile payment platforms for off-grid energy, to deployment of smart village micro-grids.) Many of these initiatives have key attributes for replicability and scalability under SREP.

1.8 ENERGY AS AN ENGINE OF RURAL DEVELOPMENT AND GENDER EQUITY

Energy and development

The 2015 Haiti poverty assessment by the World Bank[26] states that, despite a decline in monetary and multidimensional poverty rates since 2000, poverty still remains high by regional standards. Access to basic services is generally low, characterized by glaring inequalities. The 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, in fact, increasing.

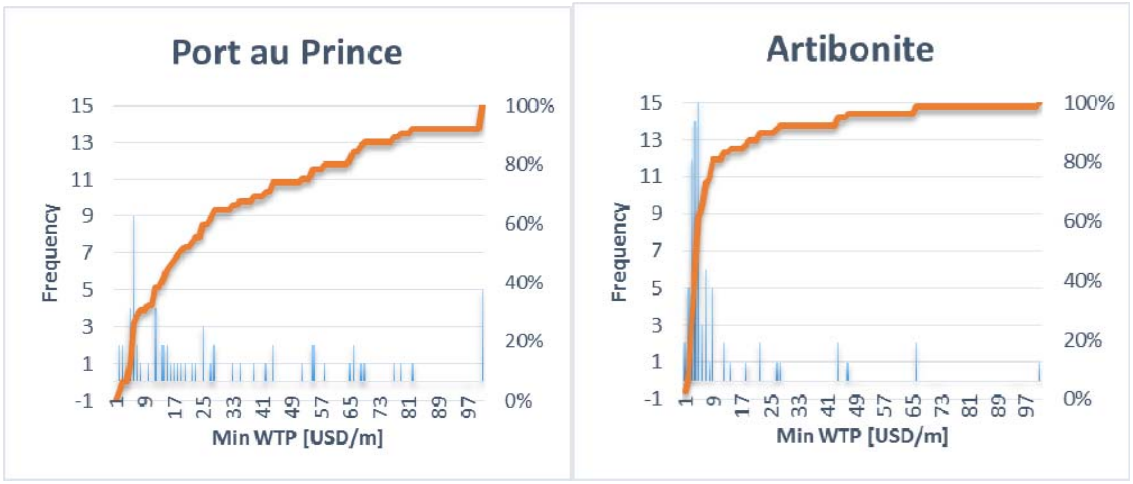
Households pay much for electricity and its substitutes—according to background surveys for the SREP Investment Plan, more than half pay over US$20 a month, varying by department and rural/urban split (table 5). In Artibonite, for example, about 80% of the population spends less than US$8 a month, while in Port-au-Prince, only 10% pay less than that (figure 3). [27]

Table 5. Current substitutable energy expenditures = minimum WTP (average monthly 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).

Figure 3. Current substitutable energy expenditures = minimum WTP (average monthly in Artibonite and Port-au-Prince)



Source: Digicel/iiDevelopment Survey (2014).

The government recognizes the tight link between access to modern energy and development, which drives its modern-energy efforts. The 2015 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 constraints on access to inputs. This includes augmenting credit and skills, with special attention to women, who are particularly disadvantaged in labor markets.

Gender

Women and girls are particularly vulnerable to energy deprivation because it reinforces the obstacles they face in accumulating and using assets, particularly their human capital. And despite progress in education, adult women are still less well educated than adult men. Women in the Haitian labor market are far less likely to be employed and earn much less than men, even if equally qualified Creating economic opportunities for women is one of the important measures to address the immediate and long-term needs of women and girls.

Similarly, low female participation in the public sphere is widespread. For example, in the 49th legislature from 2010 to 2014, only 4% of all parliamentary seats were occupied by women, well below the regional average of 26% and placing Haiti 136 out of 142 countries. Nationally in April 2014, eight of 23 ministers (i.e. more than 30%) and three of 20 secretaries of state were women. Locally, women accounted for only 12% of all mayors.[28]

The government has created a Gender Equality Office in Parliament and amended the Constitution to stipulate a quota of at least 30% women in all public offices. But there is no enforcement mechanism, and implementation remains low at all levels of formal political life.

To support the government's efforts at strengthening women's roles, governmental and nongovernmental stakeholders have launched gender initiatives. In energy, a Gender and Energy Interagency Commission was created in August 2014 by the Bureau of the Minister Delegate to the Prime Minister in charge of Energy Security and by BME, with support of the Latin American Energy Organization (Organizacion Lationamericana de Energia; OLADE). This commission, now under BME leadership, aims to promote gender equality in energy for sustainable development. It intends to build alliances across the country's institutions to coordinate efforts and ensure changes. It also brings together representatives of the Ministry of Economy and Finance, the Ministry of Women's Affairs and Women's rights (Ministère à La Condition Feminine et aux Droits de la Femme; MCFDF), and the State University of Haiti. OLADE is supporting capacity-building to provide commission members with training and expertise.

On the ground, several initiatives demonstrate that integrating women in the supply chain not only enhances women's livelihoods, but can also improve the off-grid energy business and sustainability—Boxes 2 and 3.

Box 2. Promoting female entrepreneurs: MicamaSoley

SAFICO, a Haitian manufacturing and trading company, has created a "social" division, MicamaSoley, offering products to improve the lives of rural dwellers, such as solar-powered lanterns, cell-phone chargers, and water filters. MicamaSoley leverages distribution networks through a partnership with Fonkoze, Haiti's largest microfinance institution, and the NGO CARE. SAFICO/MicamaSoley has sold more than 54,000 solar lanterns and systems, mainly via women and women's groups.

Fonkoze serves some 60,000 poor and ultra-poor women in rural areas, with 46 branches throughout the country.[29] These female credit customers—most of them market women—are organized in about 2,000 credit centers. Each center elects a female chief to liaise with Fonkoze and to oversee customers, who in turn oversee a group of 10 or so women who are receiving

microloans.

MicamaSoley's distribution model through Fonkoze targets these chiefs, who are introduced to different products and who receive one solar lantern to take home and try with no obligation. A few weeks later, chiefs can either buy the lantern or give it back. Those who buy can then purchase more lanterns at wholesale prices to sell at retail price to members of their credit centers or to the general public. 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 lanterns.

MicamaSoley'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 seen around the world under various names, like *sol* (in Haiti), *susu*, *tandas*, *hui*, etc. With support from CARE, VSLAs (of 20–30 women) meet weekly and save small amounts of money, which are then made available to members as loans when needed, plus interest. When CARE identifies a natural leader in a VSLA, they offer training to become a village agent. Collaboration with MicamaSoley has helped these women access new revenues by becoming resellers of solar lanterns. MicamaSoley has trained over 100 (mostly female) village agents and sold over 4,000 solar lanterns through this channel.

Box 3. Promoting female entrepreneurs: EarthSpark

EarthSpark, a non-profit body working as an incubator for clean energy enterprises, is leading an innovative approach to deliver sustainable off-grid energy services. With the government, local officials, and UNEP, EarthSpark has launched a micro-grid in the town of Les Anglais, Haiti, which provides affordable, reliable, and environmentally sensitive electricity services through EKo Pwòp—EarthSpark's micro-utility enterprise. Launched in November 2012, the EKo Pwòp grid has been providing continuous electricity to 52 households and will be scaled up to 430 customers = the construction is completed and the expanded grid is being tested, expected in full operation in May 2015. EarthSpark is also supporting sales of solar lanterns through its Enèji Pwòp branch.

Through both sides of its work—retailing small, clean energy products and developing a micro-grid—EarthSpark has mainstreamed gender considerations into its business. It has prioritized reaching out to women for training as clean energy entrepreneurs, as customers, and as micro-grid-employees, entrepreneurs, and customers. All grid "ambassadors" (promoters of the grid) are women, and once the grid expands, at least half the energy vendors in the town will be female. These vendors will generate new income by selling energy credits similar to the way that mobile phone credits are sold. Anecdotally, having all-female teams climbing ladders and managing micro-grid planning has challenged gender stereotypes in Les Anglais, but there is much more to be done on this front. So far, all grid linemen and electricians are men, and EarthSpark is seeking to support technical apprenticeships for females in the field.

Through a partnership with Kiva.org, EarthSpark has helped provide access to financing for both Enèji Pwòp retailers needing startup capital for their clean energy businesses and to households in Les Anglais needing a loan to cover connection fees to the micro-grid. Kiva has made 490 loans through EarthSpark, 57% of which were to women. As the next step, EarthSpark is planning to offer a loan product just for women connected to the grid to start or expand agriculture-processing and food-preparation businesses.

SREP will benefit from these experiences and will work closely with the Gender and Energy Interagency Commission to mainstream gender considerations in individual project

interventions. The RE capacity-building platform developed under SREP can become an important tool for closing the opportunity gap between men and women in Haiti.

2

RENEWABLE ENERGY SECTOR CONTEXT

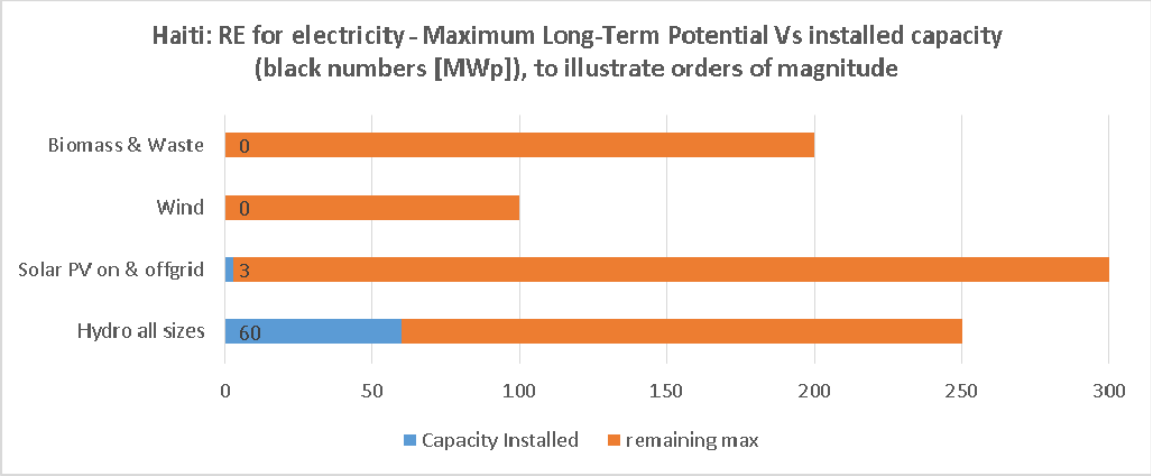
2 RENEWABLE ENERGY SECTOR CONTEXT

2.1 RENEWABLES IN HAITI'S ENERGY SECTOR

Haiti needs to at least triple its generation capacity by 2020 to satisfy rising demand.[30] It also needs to diversify its power sources and move away from the expensive use of fossil-fuel sources.[31] Under the Electricity Master Plan it is expected that RE will feature prominently in the least-cost expansion path. Needless to say, greater use of RE would also help Haiti set the sector on a low-carbon path.

Haiti has excellent, but largely untapped, RE potential, including hydro, biomass, wind, and solar, as confirmed by recent and current studies (figure 4).

Figure 4. Haiti's renewable energy potential



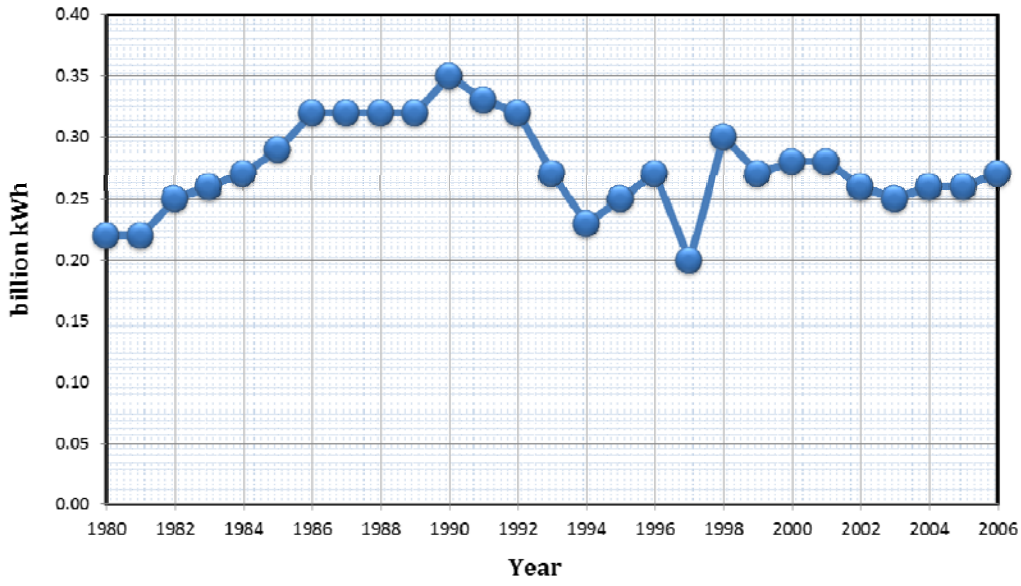
Source: SREP Task Force (see Chapter 8 for composition).

Despite such abundance, progress in harnessing it has been slow. Large-hydropower (if considered RE) makes up the greatest share of RE power production in the country, while micro- and mini-hydropower remains largely unexploited. Some biomass-powered projects are being developed but are not yet complete. Wind energy has not yet been tapped,[32] and solar energy has been exploited only on a small scale, with solar lanterns and as a self-supply option for businesses to displace diesel and for rural off-grid electrification.

Hydropower

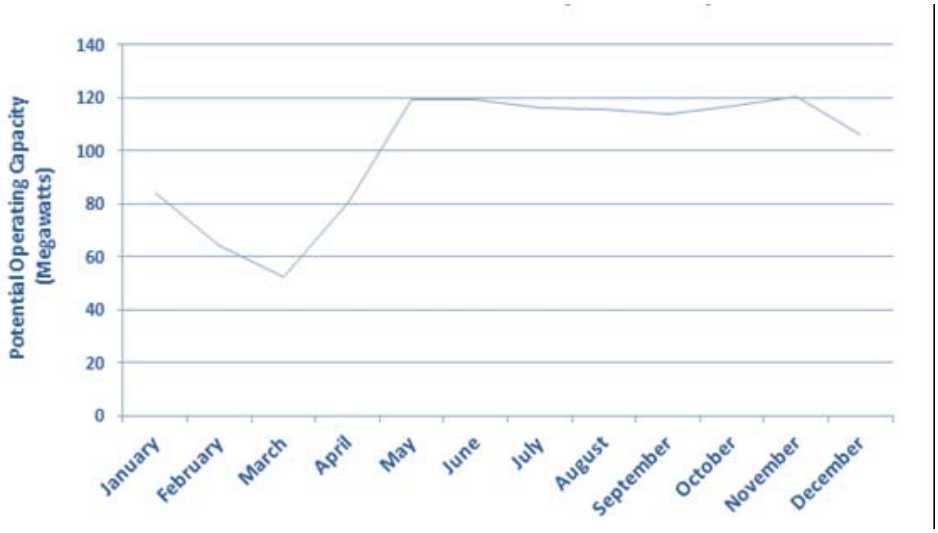
Installed hydropower capacity is slightly over 60 MW. Seven hydropower sites are operating; the largest, as said, is Péligre with 54 MW capacity (and is being rehabilitated). EDH also owns six mini- and small-hydro plants (under 2.5 MW each), with a combined capacity of 7.5 MW, but only five of them are operating and even those are below maximum output due to repair needs. Figure 5 shows Haiti's annual hydropower output from 1980 to 2006; Figure 6 illustrates its strong seasonality.

Figure 5. Haiti's annual hydropower production



Source: IEA.[33]

Figure 6. Seasonal variability of hydropower



Source: Worldwatch (2014).

Hydropower potential for Haiti is estimated at over 200 MW[34] (across all hydro segments). Potential for medium hydropower is about 130 MW (at three sites). This includes a 32 MW hydroelectric dam upstream of Péligre dam in Artibonite, which is under discussion for development with Sinohydro (China), per an agreement signed in February this year. Potential for small hydro, which remains largely untapped, is estimated at more than 100 MW,[35] in line with Worldwatch Institute's 2014 analysis (table 6). EDH has listed potential mini-hydro sites of 0.1–2.6 MW, with falls of 50–400 meters and a combined capacity of 23 MW.

Table 6. Estimates for remaining "additional" pico- to small hydropower potential by department

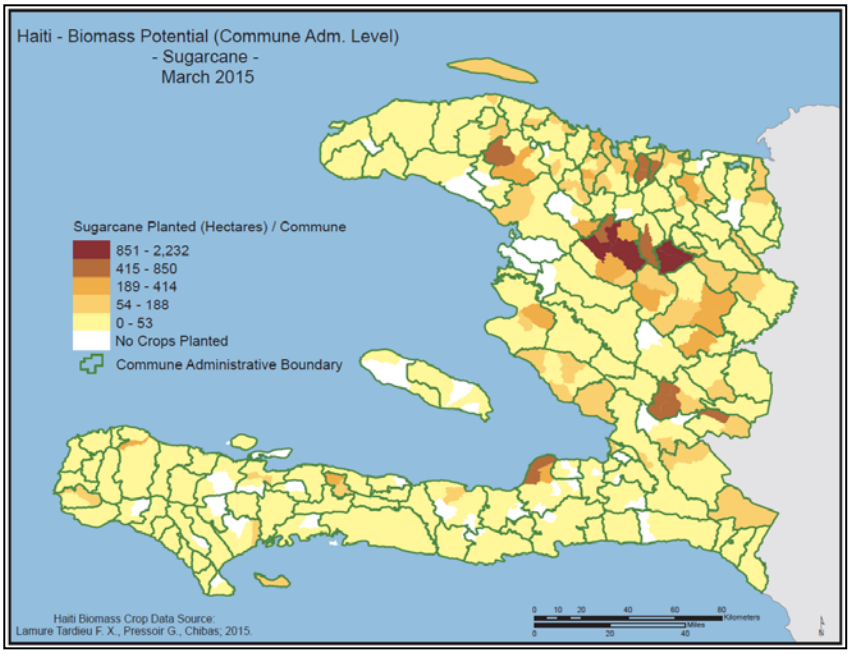
Region	Potential Capacity (MW)	Annual Energy Output (GWh)
Ouest	36.6	320.7
Sud-Est	17.9	157.2
Grande-Anse	14.4	126.0
Nippes	10.3	89.9
Centre	7.3	64.3
Sud	6.2	54.0
Artibonite	3.6	31.9
Nord-Ouest	2.9	25.5
Nord	2.0	17.7
Nord-Est	1.1	9.3
Total	**102.3**	**896.5**

Source: Worldwatch (2014) based on Soleo (2012).

Biomass

Charcoal and firewood are the main source of thermal energy with more than 70% of total energy supply; however, not all of it is renewable as it contributes to deforestation. Biomass, if used direct for electricity production, could generate up to 300 MW. . 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 balance is from sugarcane (13%), rice (4%), and coconut and coffee (less than 1% each) (figure 7).[36]

Figure 7. Haiti sugarcane biomass potential



Biomass projects have been looking into using feedstock like jatropha, sugarcane, eucalyptus, and oil palm for conversion to biofuel. Based on current production of biofuel crops, the country may be able to generate up to 154 million liters of ethanol (again assuming that all the currently available feedstock is converted to power).

Source: Lamure Tardieu F. X., Pressoir G., Chibas; 2015.

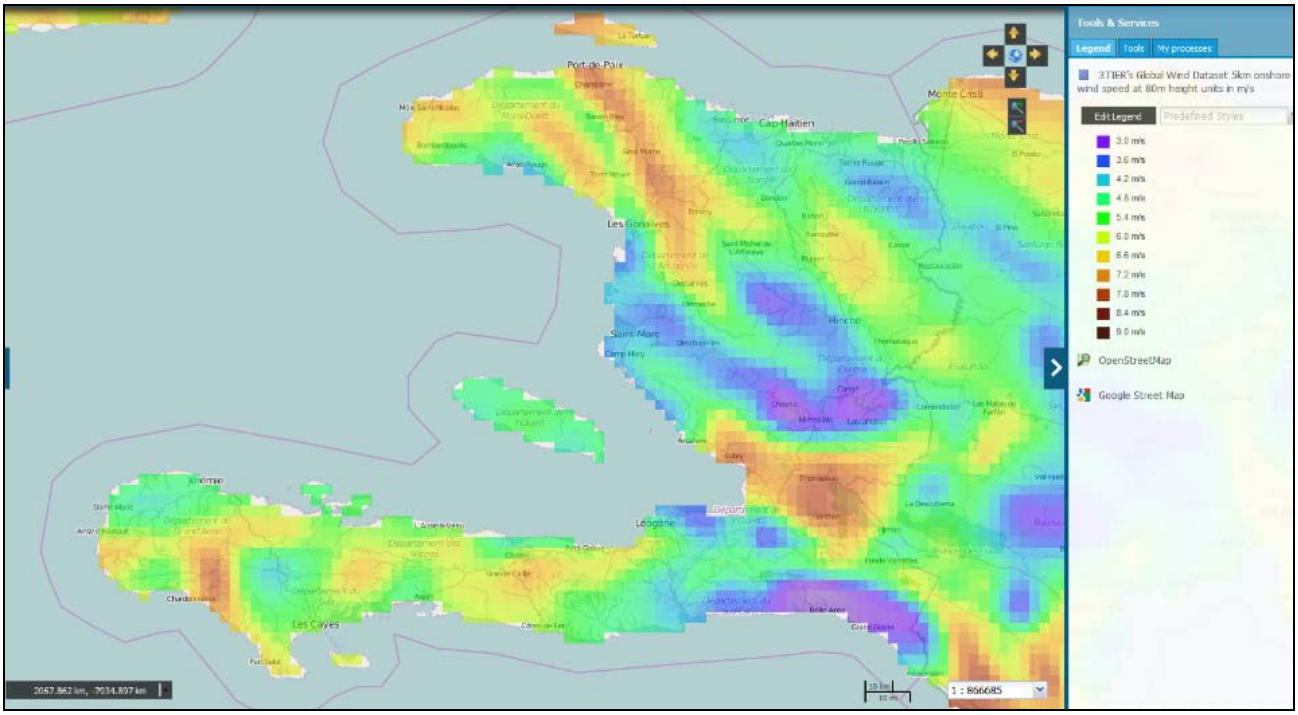
The majority of this ethanol is from sugar (56%) and corn (44%), while a small amount (less than 1%) comes from sorghum.[36]

Haiti may also be able to generate up to 30 million liters of biodiesel (making the same assumption), almost all from coconut (70%), then sesame (27%) and cottonseed (3%). Although gaining attention as a potential biofuel, jatropha needs more study of its potential investment returns.[37]

Wind

Haiti has no grid-connected operating wind generator, although wind is among the country's promising renewable resources with a potential estimated capacity of at least 70–80 MW.[38] Apart from publicly available wind-potential maps (e.g. IRENA, Figure 8), site-specific speed measurements and feasibility studies for significant projects (10 MW and above) are being conducted by individual, private project promoters and investors. The final results of these studies should be known toward the end of this year. The involvement of multiple local and international investors in wind projects points to market readiness on the supply side. The government, supported by the European Union, has also conducted a study at three sites (see the websites of the BME and MTPTC).[39]

Figure 8. Map of wind potential



Source: IRENA Global Atlas. 3Tier wind layer.[40]

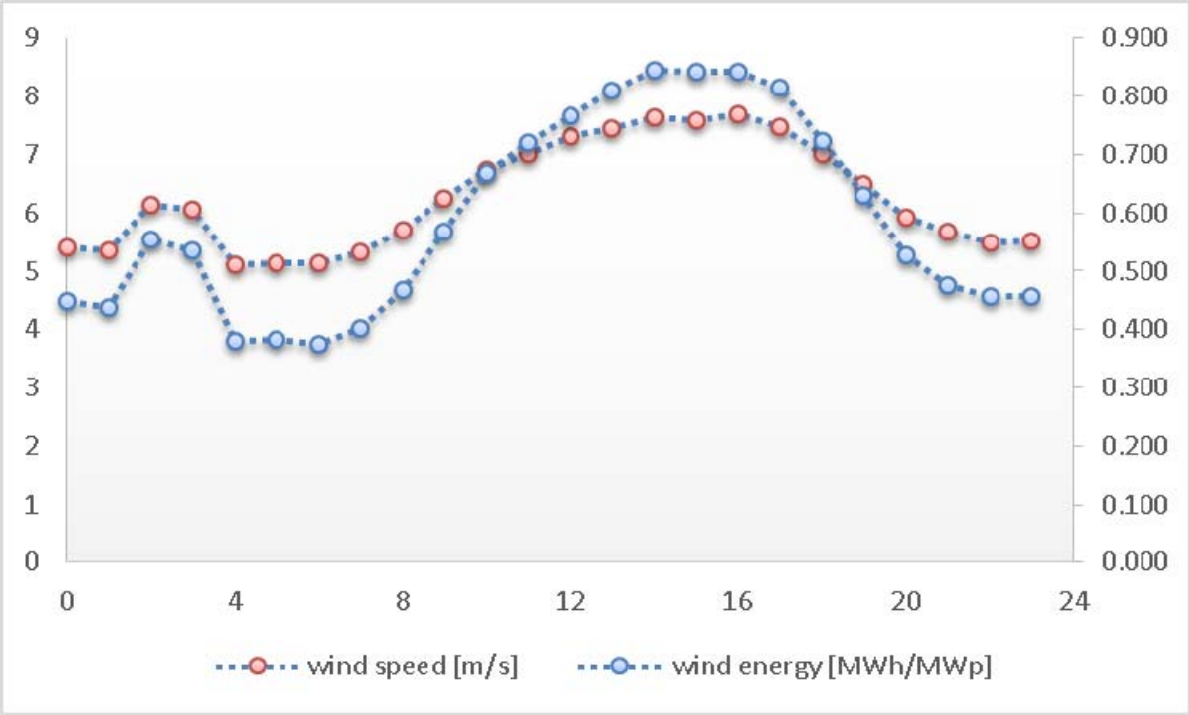
As illustrated by Figure 8, particularly promising areas for wind sites include:[41]

- The *central wind corridor* crossing Lac Azueï in the Western Department northeast of Port-au-Prince. It is in Plaine du Cul de Sac between two big mountain chains (La Selle and Chaine des Matheux). As wind-speed estimates vary widely for this area, 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).[42]

As wind energy is highly volatile, detailed measurements at appropriate heights (ideally 80–100 meters) are needed not only for actual project siting and design, but also to gauge the diurnal patterns (estimates vary) as this will have a direct impact on the fuel-savings benefits and dispatchability of the injected wind power (figure 9).

Figure 9. Typical diurnal wind energy profile



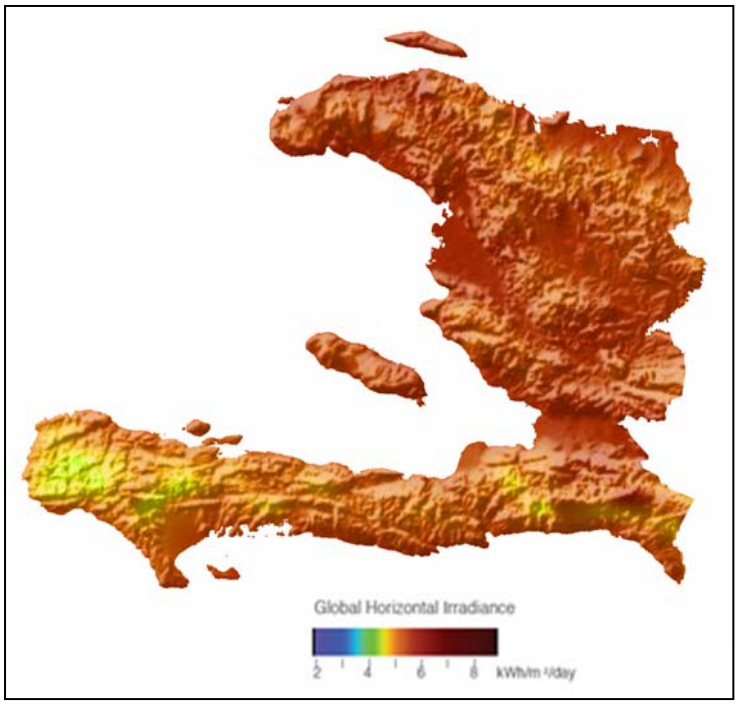
Source: iiDevelopment (2015) (including use of METEONORM 7 © software).

Note: X = hour of day and Y = average wind energy (more pronounced than wind speed variability, due to cubic relation between energy and wind speed).

Solar

Haiti has excellent solar energy resources (figure 10), with high-level irradiation across all departments and months of the year. But this potential remains largely untapped, both solar PV (for electricity) and solar thermal uses (for water heating and small productive applications).

Figure 10. Solar energy resource map



Source: Government of Haiti Energy Cell. 3Tier solar layer.[1]

The country has no significant grid-connected solar PV generation, but it does have recent experience in deploying off-grid solar PV systems in two distinct, nascent market segments.

In one, PV companies start serving the urban business market[43] via an emerging leasing model (PV companies providing long-term lease of the PV equipment, for which users pay a fee). This market is serving 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"). The typical PV capacity per site ranging from the tens of kilo- to megawatt-peak (MWp) scale (e.g. a recently concluded investment of 1 MWp of solar power for Marriott hotel).

In the other segment, PV companies serve off-grid markets (see Section 1.7) via picoPV systems, solar PV for schools, and solar street lights (with 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 in place, especially for the distributed SME "fuel saver" market segment. One local company 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 relative to national demand, as well as scalability to MWp, Haiti's technical PV potential is virtually unlimited. The economically viable PV potential keeps increasing due to rapidly falling capital expenditure (capex) costs, so that the benefits of deferring PV investment need to be weighed against forgone fuel savings during such a delay in investment (see the economic and financial analysis in Chapter 3). However, PV is already least cost for most off-grid users in economic terms (but not necessarily in financial terms, as steep risk-premiums result in extreme discount rates), and below the Port-au-Prince

benchmark thermal levelized cost of electricity (again, only in economic terms). That said, the practical PV potential has previously been estimated at around 200 MWp in urban areas and over 1,600 MWp throughout the country.[44]

2.2 Barriers to Developing Renewables and Measures to Mitigate Them

Transforming Haiti's energy sector through large deployment of RE faces numerous institutional, regulatory, and legal challenges; information, knowledge, and capacity constraints; and economic and financial uncertainties. These main barriers, as well as mitigation measures (table 7), were identified through consultations with stakeholders (annex III).

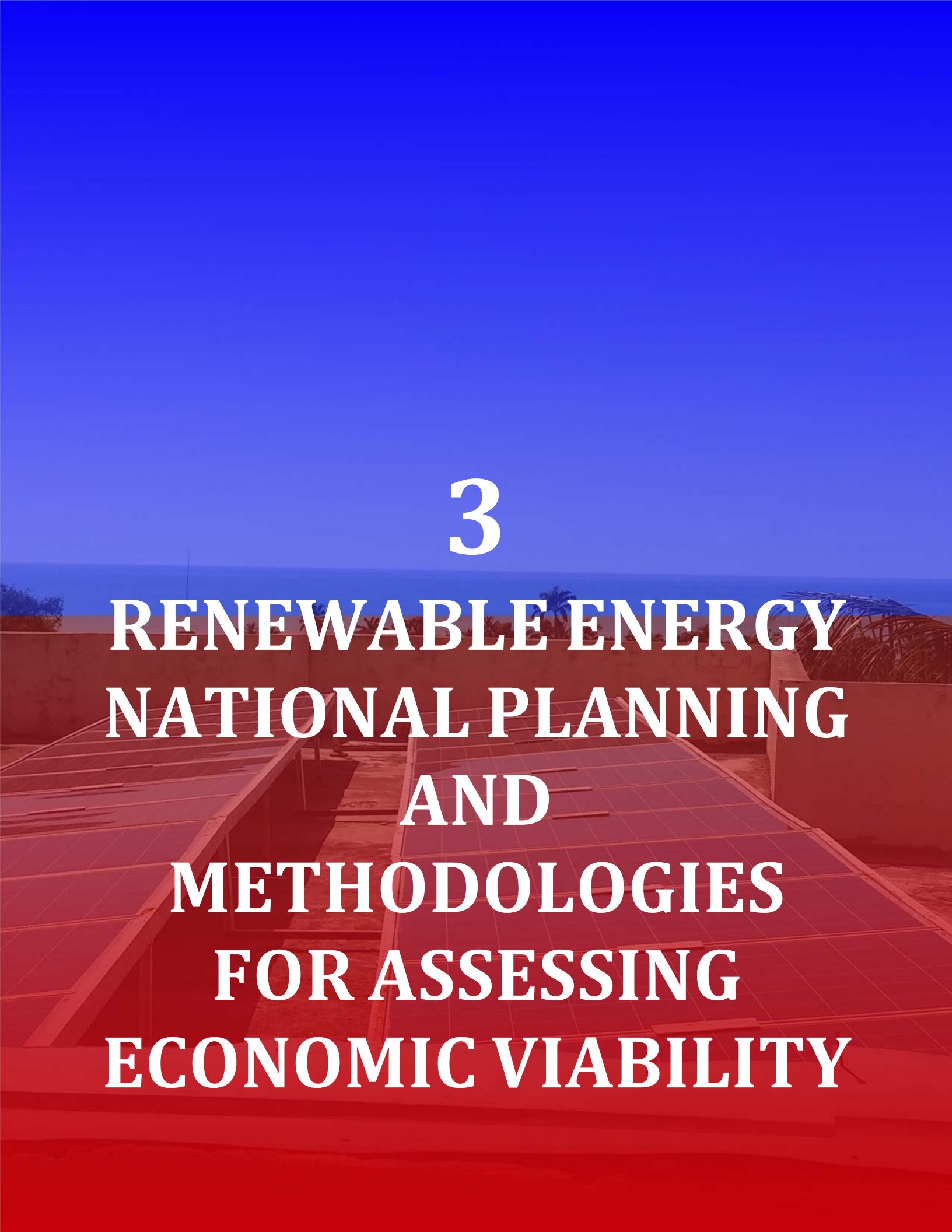
SREP will help dismantle barriers through "learning by doing" and related demonstration effects. Instead of putting all resources into one large project, it will finance smaller projects that will help test regulatory and risk-mitigation approaches and build confidence and capacities of the private sector and government for scale-up in the future. We consider this the optimal approach (for total SREP effect) in a country where many potentially viable RE market segments are at a very early stage due to market inefficiencies.

Table 7. Main barriers to renewable energy development and mitigation measures

Main Barrier	Mitigation Measure
Weak financial situation of EDH	**SREP and other projects will reduce EDH costs and improve its financial situation**
EDH recovers only about 22% of the value of the power it supplies due to high technical and commercial losses. EDH's financial situation presents substantial risks for private investors.	EDH losses will be cut via targeted investments in rehabilitating transmission and distribution lines under the supervision of the World Bank and IDB, and via measures to improve commercial performance, starting with a better collection system and upgraded metering. (See Section 1.6 for the government's loss-reduction plan backed by the IMF.) These investments are carried out through existing instruments, outside of SREP. More diversified power supply options for EDH, including those supported by SREP, will lower its reliance on expensive fossil-fuel generation from IPPs. Options include installing additional power generation capacity based on RE sources, rehabilitating hydro plants (Péligre is in process; other plants are in the present Investment Plan), and possibly power generation from imported LNG. SREP will demonstrate a new public-private partnership (PPP) approach for the development of grid-connected renewables. The resulting RE generation output will be provided at much lower cost than the current EDH generation costs, and will be therefore a part of a loss-reduction strategy, but initial progress on EDH's financial situation through the implementation of the above mentioned loss reduction plan must be demonstrated for the PPP investments to proceed.

Main Barrier	Mitigation Measure
Concerns about integrating intermittent generation capacity	**SREP investments in grid-connected renewables will remain well below absorptive grid capacity**
The government and EDH are concerned about integrating large intermittent generation with an already very unreliable grid without causing further problems. Transmission line capacity is constrained and its spare capacity once Péligre is fully on line is not fully ascertained. Dispatch is far from optimal given the severe generation shortage.	MTPTC, EDH, and the World Bank are evaluating the capacity of EDH's grid and dispatch strategies for integrating intermittent RE, including maximum grid-absorptive capacity, onsite restrictions, and network upgrades. SREP investments in grid-connected renewables (10–20 MW) will remain well below the "safe" capacity that the grid can absorb. SREP will also help the government identify strategies and complementary investments to prepare larger injection of RE into the grid (post SREP), maximizing total net benefits from RE growth.
Lack of clarity on the legal and regulatory framework	**SREP will help develop instruments and modify current ones**
There is no legal or regulatory framework for grid-connected renewables, such as feed-in tariffs (and rights) or similar certainty on tariff levels; no standard PPA; and no agency to provide regulatory protection to investors, etc. For off-grid renewables, the legal framework allows investments in off-grid electricity but is not transparent. The relationships and hierarchy among different laws is unclear and particularly affects potential mini-grid investors. (They could face stranded RE assets, possibly expropriated or losing value.) Legal/regulatory clarity on whether mini-grid operators are free to set tariffs is lacking (in practice they have been allowed to do so) or whether they will be subject to government tariff or quality-of-service regulations. No provisions have been set for what happens to assets if the EDH grid comes to the area. Roof-top solar PV cannot be used as collateral. (Current laws consider it fixed, or part of the building, and thus collateral of the building financier.)	SREP will help the government develop regulatory instruments to support on- and off-grid renewables, through the "Building enabling framework, capacity and skills for RE scale-up project" (Project Brief 5, annex I), as well as through applying, testing, and fine-tuning regulatory instruments in individual SREP-supported projects (Project Briefs 1–4). SREP will focus on removing the most important barriers first and fine-tuning the framework throughout implementation.
Lack of access to capital	**SREP will mobilize financing**
Access to capital for RE projects is problematic, particularly for smaller companies engaging in off-grid electrification. Projects rely mainly on donor and NGO grants, which are not sufficient for scaling up. The private sector has requested the government and donor community to facilitate soft loans for flagship projects in rural areas; provide improved access to commercial loans; and encourage less risk-averse capital to invest in rural projects.	SREP, with a parallel project co-financed by CTF, will mobilize a mix of commercial financing and results-based subsidies, progressively targeting local financial institutions in RE lending.

Main Barrier	Mitigation Measure
Inadequate fiscal policy for renewables	**SREP will aim to balance fiscal policy, helping the poor**
Fiscal policy disadvantages on- and off-grid renewables against fossil-fuel alternatives. RE equipment is subject to import duties and value-added tax, together amounting to over 30% of product value. Cumulatively this presents another 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. Targeted, market-friendly subsidies will be considered for the poor.
Information and capacity constraints	**SREP will run a component addressing the key crosscutting constraints**
A lack of in-depth information on the detailed performance, risk determinants, and good practice of technical and financial engineering is a main driver for extremely high risk-premiums (GIZ 2014b). Participants in all Haiti SREP consultations agreed on the information gaps in multiple areas, which should be closed. Enhancing RE curricula and improving hands-on RE experience among university graduates, and creating a pool of skilled technicians, is important for sustainability of rural energy projects, and for faster scale-up. The National Electrification Strategy, which also ranked high in consultations, would form a bridge between plugging this information gap and clarifying the legal and regulatory framework (above).	Given the prominence of information and capacity constraints and asymmetries cutting across all RE segments, SREP will include a project to address key crosscutting capacities and skills, as well as an enabling environment for scaling up RE in Haiti. See Component Brief 5 in annex I.



3

RENEWABLE ENERGY NATIONAL PLANNING AND METHODOLOGIES FOR ASSESSING ECONOMIC VIABILITY

3 RENEWABLE ENERGY NATIONAL PLANNING AND METHODOLOGIES FOR ASSESSING ECONOMIC VIABILITY

Haiti's power sector planning is driven by the general development needs and objectives set in the SPDH, which sets the path for the country to become an emerging economy by 2030, and which will be a key reference for the Electricity Master Plan (see Section 1.6). Reaching the SPDH goal of becoming an emerging economy by 2030 will require twin-track, on- and off-grid efforts.

Improving EDH performance and supporting on-grid generation capacity. The aim is to enable EDH to provide reliable and affordable electricity services in urban areas and surroundings. Grid-connected renewables provide an important alternative to expensive and volatile oil-based generation, and provide an opportunity to address EDH's financial situation directly and indirectly: *directly*, because on-grid renewables are a lower-cost generation option, allowing gradual displacement of the more expensive fossil fuel–based generation (Haiti's thermal generation costs are very high by international standards, as Haiti's RE supply curve in the next section illustrates); and *indirectly*, because the overall increase in generation capacity by way of added renewables (if planned and implemented correctly) will help improve service quality for existing customers, and potentially allow new customers to be connected.

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 mix of targeted investments and advisory activities—can help Haiti build RE experience, introduce and improve regulatory and planning instruments, and develop the skills needed at all levels (from technicians to dispatch) for RE scale-up.

Supporting off-grid electrification efforts for households, businesses, and institutions not served by EDH. 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) connecting households in the grid vicinity. It will therefore be years before EDH can start expanding deeper into rural areas. So, to achieve the 2030 universal access target, it is necessary to invest in parallel off-grid electrification.

Such investments are also strongly encouraged from an equity perspective. While nationwide Haiti has made progress in reducing poverty and extreme poverty, in rural areas it has not. The continued influx of people to the metropolitan area is unsustainable. Government policies thus continue targeting investments and job creation in secondary and tertiary cities, and rural areas, underpinning decentralization.

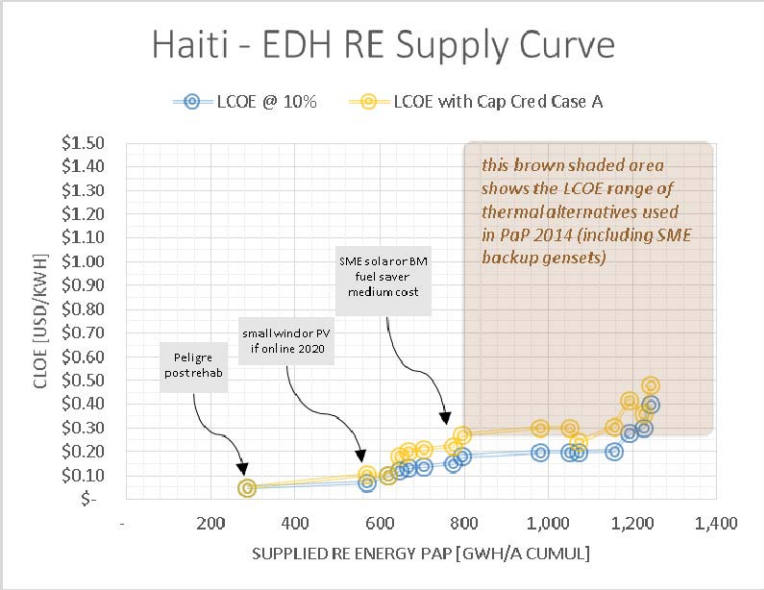
For all these reasons, the government is requesting SREP funds for a balanced program that will help it reconcile the need to simultaneously focus on strengthening energy sector capacity and on expanding access.

3.1 GRID-CONNECTED RENEWABLES

Haiti's current planning tool for grid-connected electricity investments is the National Energy Sector Development Plan for 2007–17. The plan is, however, outdated and EDH is developing a new Electricity Master Plan, which should be ready by late this year. The new plan—informed by the current World Bank–financed study on integrating intermittent renewables with the EDH grid and by the present SREP Investment Plan analysis—will provide recommendations for an optimal mix of RE over time. SREP implementation will make sure that the proposed grid-connected RE developed under SREP is fully consistent with the new Master Plan. As the SREP Investment Plan is based on an advanced analysis of economic costs and benefits of RE options and on a comparison with fossil-fuel alternatives, the Master Plan is expected to uphold (and further develop with better data and more detailed analysis) the SREP Investment Plan's recommendations.

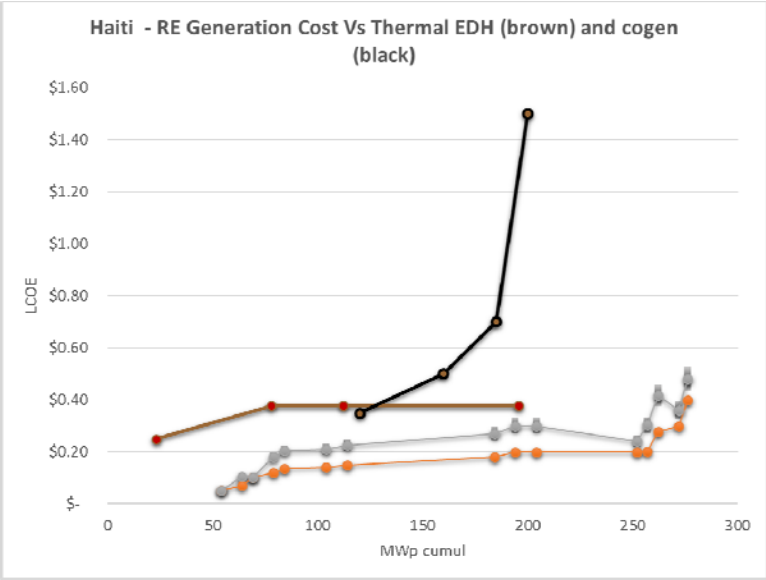
The EDH supply curve for RE is in Figure 11, and the RE generation cost against thermal EDH and cogeneration is in Figure 12, illustrating the economic attractiveness of RE.

Figure 11. EDH renewable energy supply curve



Source: iiDevelopment (2015).

Figure 12. RE generation cost vs. thermal EDH and cogeneration



Source: iiDevelopment (2015).

Note: The levelized cost of electricity is for the low-case weighted average cost of capital typically applied for SREP Investment Plans, as opposed to the (much higher) actual risk-adjusted returns that early-stage equity and debt providers would require when investing in Haiti RE today without the SREP Investment Plan. The capacity credits do not fully reflect all the dispatch challenges that EDH would face when integrating wind and/or solar above 10–20 MWp in the short term.

Nevertheless, planning the scale-up of private sector–led on-grid renewables in any given country is a challenge, because appropriate methods have started to emerge only recently.[45] Nor can approaches from pioneer markets such as the European Union or United States be simply transferred to sunbelt countries because of fundamental differences in "boundary" conditions,[46] most of which apply to Haiti. They include challenges such as weaker grids and less actual spinning reserve, as well as advantages, such as better RE resources, and the availability of hydro storage that can significantly increase the direct benefits derived from thermal fuel saved by wind/solar injection.[47] As a result of planning deficiencies, renewables are sometimes regionally clustered in network "hot spots" (where they are needed less than in other nodes of the national grid), or unfavorable PPAs may lead to inefficiencies, both of which the SREP Investment Plan aims to avoid. Due to the time needed to procure quantitative RE-optimization software services with solid data on network and generation, it is usually best to start pragmatically with a mix of methods and planning tools, such as the RE supply curve and score cards used for this SREP IP, and add more advanced planning tools sequentially (including the final Electricity Master Plan).[48]

SREP will therefore support the government's path along the learning curve of RE planning and dispatch by applying lessons from other countries and optimizing the volume of on-grid RE interventions. One main effect of SREP on the local RE market will be to improve financial costs of RE by reducing the risk-reflecting weighted average capital cost, for equity and debt providers.[49] The Appendix gives further detail on the issues and methods considered in the Investment Plan's comparison of costs and benefits of RE capacity

additions, and on-grid RE "SREP Cases" studied in more detail (SREP Cases 9–12 in Chapter 4). General recommendations for SREP's interventions in grid-connected renewables are in Box 4.

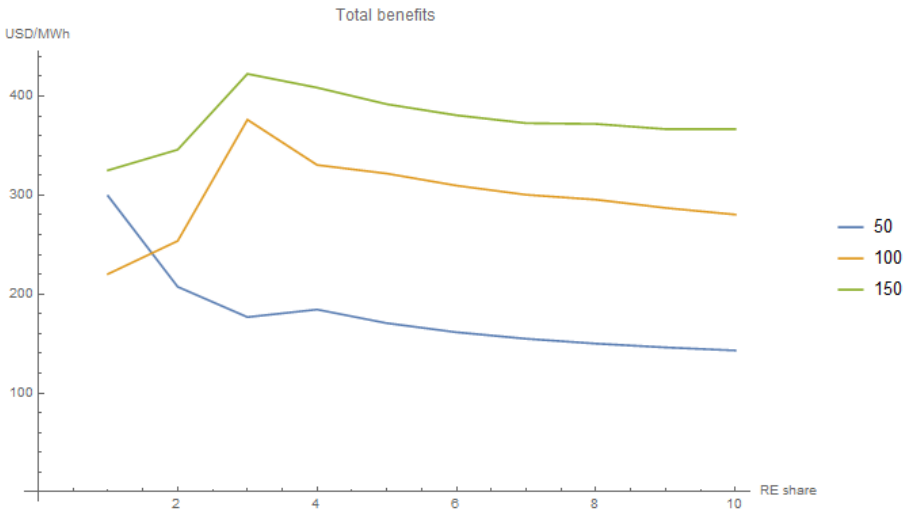
Box 4. General recommendations for grid-connected renewables

At this early stage of on-grid RE development, all analyzed SREP on-grid cases (SREP Cases 9–12) have significant potential for scaling-up under Haiti's conditions—once the necessary enabling conditions, including regulatory framework, adequate feed-in tariff, etc. are put in place. The effort it takes to reach that stage depends on the market segment and targeted market share. Hence an optimal target volume must be estimated for each case, as well as for the total sum of implemented cases—for instance, the total of on-grid RE volume in parallel to the optimal range for each individual on-grid RE segment. The optimal volumes for the final selected cases (under Step 5 in Chapter 4) are then used as a key input to the financing plan.

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

This is in a context of multiple trade-offs, including the current stage of the underdeveloped grid and dispatch capability; interdependencies of wind and PV with seasonal hydro generation and with demand, and the effect of growing wind and PV shares on fuel savings and line losses (box figure); the differences in the speed of capex reduction between wind and PV (Appendix); lack of information on the exact net benefits of the best wind site close by (which might result in unnecessary welfare losses with premature peak capacity commissioning); and the hefty risk premium that private sector players would add in light of the (pre-SREP) sector boundary conditions (which will be improved by SREP exit).

Box figure. Initial simulations of average annual fuel savings



Source: iiDevelopment (2015); GIZ 2013, 2014a and 2015.

Note: (y axis, in US$ MWh) 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.

Given that the country still needs to develop the regulatory and "market enabler" instruments for efficiently scaling up RE, the SREP Investment Plan recommends starting with moderate additions of up to 20 MWp of combined variable RE (vRE) capacity under SREP, thus jumpstarting the

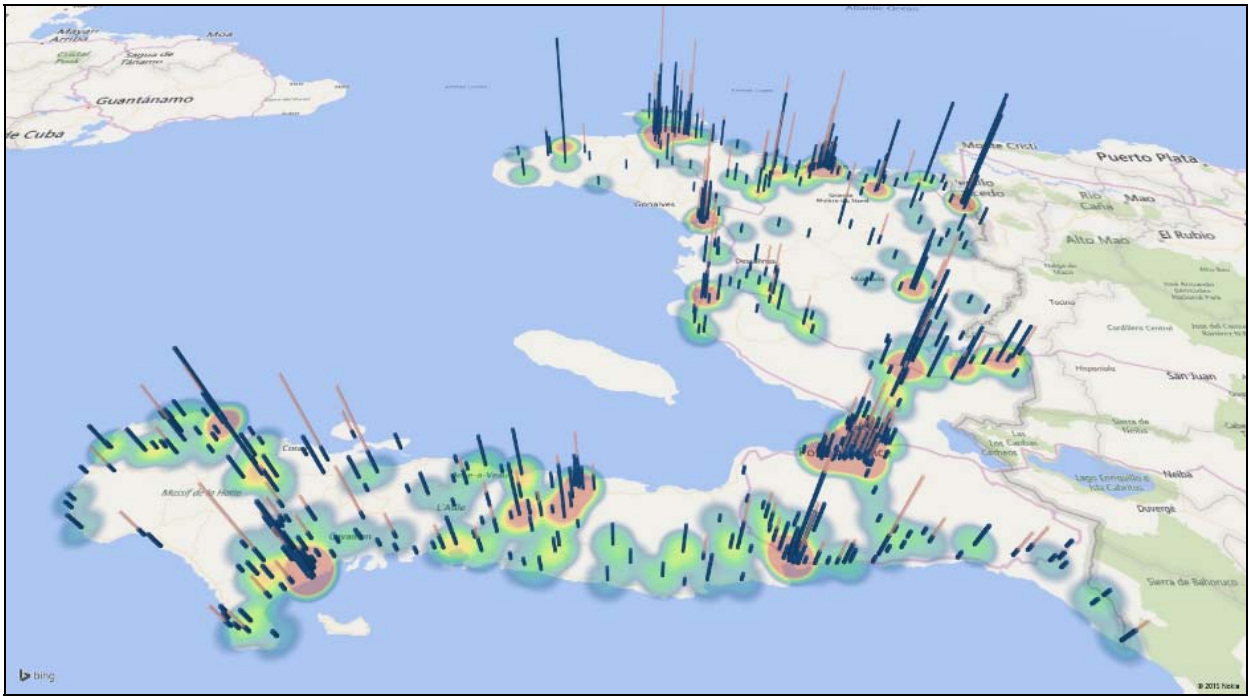
development of Haiti's experience with diverse grid-connected RE. All analyzed resource options are feasible in principle for the Port-au-Prince metropolitan area, with wind and solar PV primary candidates due to the wind's good levelized cost of electricity expected for Lac Azueï on the one hand, and solar PV's modular character and site flexibility on the other (which allows for smaller "line-loss reduction" distributed projects exactly at the segments of the EDH grid that can best accommodate them).

It is recommended that the actual business model—IPP, PPP, utility-owned with or without an O&M contract—is considered based on the feasibility at the time of project development, given degree of government and EDH success in improving EDH's financial viability to make private investments possible. Today however, PPP options appear the most attractive, at least for the first 10–20 MWp, as they leverage public funding (giving larger generation capacity than a pure public option) while reducing the risks for the private sector (reduced exposure and presence of risk-mitigating instruments) and for the government (lower tariff payment obligations) than in a purely private IPP approach.

3.2 OFF-GRID RENEWABLES

For SREP's off-grid RE planning, current energy supply and demand in areas not served by the EDH grid have been analyzed (figure 13 and box 5),[50] and alternatives for off-grid market segments defined. The economic and financial analysis looked at end-user prices at which existing energy demand would match RE off-grid supply options, based on willingness to pay (WTP) and welfare gains. (Details are in the Appendix.)

Figure 13. Spatial distribution of energy survey respondents



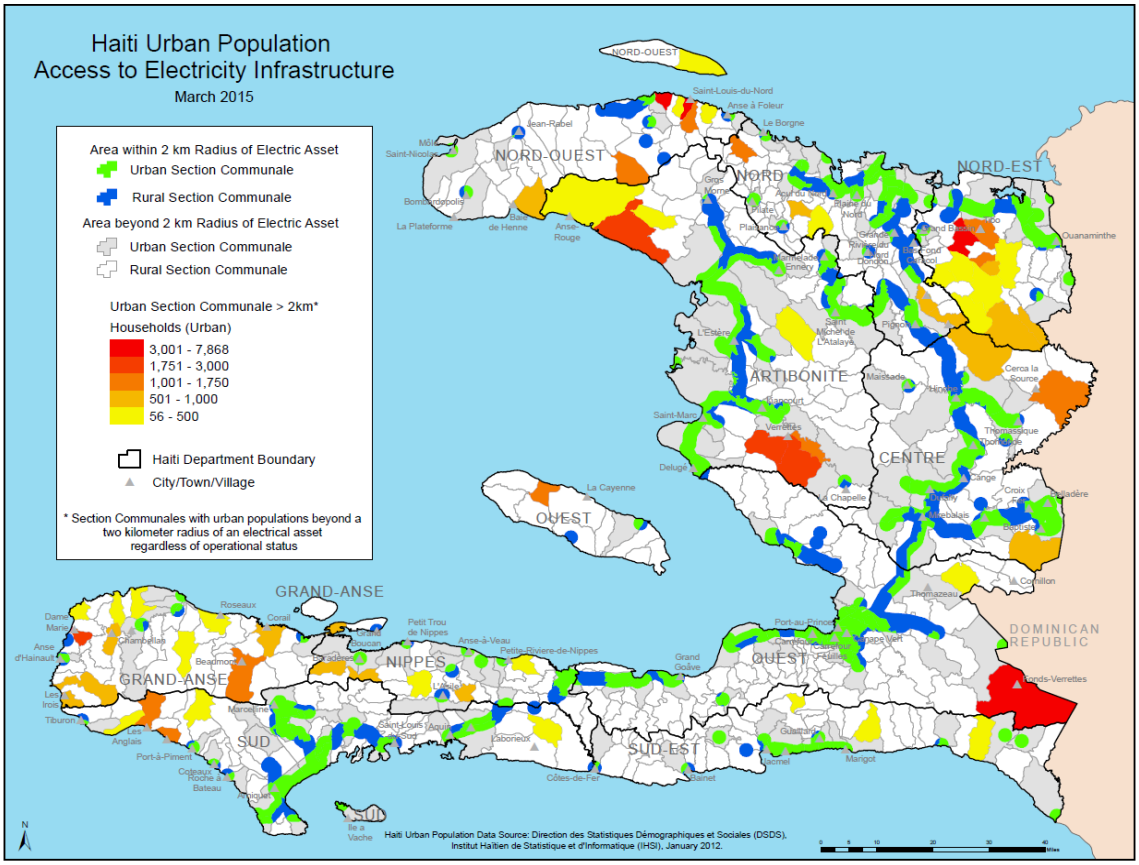
Source: Digicel and iiDevelopment 2015.

Note: The map shows survey results of the Digicel/iiDevelopment market survey for grid access (heat map: red = grid access); off-grid solar kits or lanterns (yellow spikes); and their current substitutable expenditures (on light, phone charging, radio dry cells, TV, etc.—blue spikes, where height of spike = monthly expenditures).

Box 5. Estimating the potential for mini-grids

The box figure identifies population clusters more than 2 km from the grid (generators, low-voltage transmission, substations), which represent potential for village-based supply options such as mini- and micro-grids.

Box figure. SREP assessment of the off-grid village grid potential in Haiti



Source: SREP Task Team / Navigant (2015).

Note: The colored ranges (red to yellow reflecting population size) correspond to the number of "urban" or "village" households in urban sections. A section is "urban" if it has any urban population according to the Haitian Institute of Statistics and Informatics. This is only a rough draft: results will be refined during further SREP preparation. Private firms will eventually be able to build their own estimates by technology and area based on the "Living GIS" and webpage that SREP intends to provide.

The three basic off-grid electrification options identified for Haiti's off-grid areas are (i) retrofitting and expanding the current larger remote systems (mostly EDH operated), (ii) investing in village mini-/micro-grids, or in (iii) stand-alone systems (such as solar home systems or smaller kits/lanterns). The analysis was carried out to estimate the potential market for each, based on the geo-spatial analysis of unelectrified population (table 8).

Table 8. Off-grid electrification potential

Off-grid RE option	Theoretical max. potential of segment (population)	Recommended SREP target (population)
RE retrofit, upgrade, and expansion of larger rural remote grids (mostly EDH, such as Port-de-Paix)	1,500,000	45,000–150,000 (3–10%)
Small and medium village grids (retrofit and greenfield)	300,000	30,000 (10%)
Stand-alone systems (households, social users, SMEs)	>5,000,000	500,000–1,000,000 (10–20%)

Source: Navigant (2015) and iiDevelopment (2015) for SREP Investment Plan.

Drawing on the estimates for each option, the most promising business models of each were assessed for scalability and transformational potential, based on existing off-grid business activities in Haiti. The models were then compared with international successes and failures, from which a "short list" (of eight market segments, including hybrid village grid cases and stand-alone users) was selected of the best suited SREP Cases for in-depth financial and economic analysis (see Step 3 in the following chapter).

It was then estimated what would it take to bring these business cases up to a higher level of quality, sales, and sustainability; and their users to higher access tier levels[51] via suitable public–private support instruments. This qualitative analysis was complemented by a quantitative analysis of typical cash flows and pricing strategies of Haiti RE off-grid provider models for relevant segments and technologies (picoPV and small solar stand-alones for village power and large social and productive users). For each case, effect and subsidy needs till 2020—and probable market development post 2020 (after SREP exit)—were estimated to gauge the effect of possible SREP interventions.

General recommendations for SREP's interventions in off-grid renewables are in Box 6. The Appendix gives more detail on the identified business cases for stand-alone segments (SREP Cases 1–5), and the different EDH remote grids and village grids market segments (SREP Cases 6–8).

Box 6. General recommendations for off-grid renewables

Urban market: SREP can achieve a significant impact from exploiting synergies with the emerging, dynamic solar PV market in urban areas. Several PV companies are now selling or leasing solar PV systems to industries and businesses that have intentionally isolated themselves from EDH due to problems with EDH power supply, and that self-generate with more expensive but also more reliable diesel generator sets.

Solar PV or other RE technologies can reduce energy costs of these enterprises and improve their competitiveness, while building distribution generation capacity in the country that can ultimately also be harnessed for the EDH grid.

Due to EDH's lack of financial sustainability, net metering for distributed generation is not considered a viable option for now. However, SREP recommends continuing to build on the existing growing self-supply market and to divert its development from diesel to renewables, which should create a more thriving solar PV industry benefiting on- and rural off-grid renewables. Once

conditions are right, net metering arrangements could be put in place to maximize benefits of this installed infrastructure for businesses and EDH.

Rural market: The initial geospatial and load analysis of unelectrified households suggests that there is scope for several off-grid technologies and business models to coexist. The fastest scale-up (through SREP and after SREP exit) is likely to be achieved by creating a largely technology neutral and business case neutral enabling framework for off-grid RE (including access to finance or equity facilities, results-based financing, or both) with the aim of benefiting a full range of RE supply options. A complementary TA and South–South exchanges would, however, be used to support those technologies and business models that show the most important promise for scale-up (annex IV presents examples).

As a starting point, maximum market penetration (with and without SREP funding) and "optimal ranges" were estimated for each technology (mainly solar for stand-alone; and biomass, solar, wind, hydro or hybrid for villages) and each business model. But the actual mix of off-grid cases funded by SREP may well differ from the estimates under the Investment Plan, as it will depend on private sector interest (an analysis which will be supported by the public SREP GIS on Haiti RE resources, expected to be completed by 2016) and demand for SREP support. Success factors of the most promising off-grid business models will be transferred to the local private sector as part of project TA.

For the village grid segment (SREP Cases 6–8), the most cost-effective intervention and the largest market potential by clients is for RE retrofitting of the larger remote grids (Cases 7 and 8). However, given that EDH runs the majority of these, feasibility is held back by EDH's financial position. SREP therefore recommends piloting one or two such interventions in one or two EDH grids (Component Briefs 2 and 4, annex I) and developing parallel interventions to scale up village grids for smaller rural towns (retrofitting existing municipal grids, possibly with greenfield activity) alongside accelerating market development for individual systems (Cases 1–5) (Component Brief 3). Private operators of Cases 6–8 may well become active in Cases 1–5, too.

4

PRIORITIZING STRATEGIC INVESTMENT AREAS

4 PRIORITIZING STRATEGIC INVESTMENT AREAS

4.1 RANKING INVESTMENTS

The above financial and economic analysis was but one element in a comprehensive sector-wide analysis and ranking of all possible RE investments for the SREP Investment Plan, which has considered all diverse technologies and business models that could be used to achieve the two government SREP goals identified in the previous chapter.[52] This comprehensive approach was used to avoid crowding out emerging success cases by supporting others.

The Government SREP Task Force (see Chapter 8 for its members) led by the Energy Cell (under MTPTC), with support of Multilateral Development Banks (MDBs), prioritized the investments. It consulted with stakeholders, whose contributions were essential to the five proposed SREP components (table 10 below). (The consultation process and results are in annex III.) Prioritization had five steps.

Step 1

The SREP Team (the Task Force and MDBs) used the Comprehensive Framework for National RE Program Planning[53] for analyzing local examples of private business models (private, public and NGO projects) and international examples of public interventions relevant to Haiti ("RE Intervention Universe"). With key stakeholders, it adapted this framework to local conditions, assembling a "long list" of potential business cases (Appendix).

Step 2

Those on this long list were analyzed to determine their suitability for Haitian conditions, fit with government priorities, readiness for implementation, and potential for scaling up. This identified 12 Haiti-specific potential business models for all RE market segments – the "short list"). (The Appendix has further detail.)

Step 3

Each of the 12 business models was ranked for economic and financial feasibility, and for relative cost-effectiveness by market share target (tables 9 and 10). The ranking used a variety of scorecard tools for transparent discussions of trade-offs, risks, and potential.

Table 7 illustrates some of these elements for on-grid cases (9–12). It contrasts typical values for unleveraged project internal rates of return;[54] typical minimum returns a private investor would require in light of the current subsector context;[55] the difference between these two (as a quick practitioner indicator of cases which might require de-risking for private agents to move in); the way capex[56] usually changes with growing cumulative share of each market segment;[57] the way benefits change with increased cumulative capacity in Haiti;[58] and the way capex changes over time, all else held constant.[59]

Table 8 summarizes another set of illustrative scores developed by the Task Force with independent consultants (Navigant et al. 2015) as one of several inputs to the short list.[60] The analysis was based on discussions with key stakeholders and the typical costs, firm-level rates of return, and maximum volume for the 12 cases, attaching relative scores to

each case to serve as the first filter. (For example, the cases “small public remote grid” and “large government-owned hydro” ranked lowest, failing to make it to the final round.)

Table 9. Comparative analysis of on-grid RE business models (early stage of 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	Label	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	Utility hydro	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	<10MW wind IPP or utility	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	Behind-Meter: PV fuel saver + feed-in	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	Self supply PV without feed-in	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	Behind-meter: biomass fuel saver + feed-in	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	Self supply biomass without feed-in	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)

Table 10. Potential on- and off-grid RE business models (early stage of analysis)

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 or Lease/PPA	business/NGO	SUPPLY RESIDENTIAL SOLAR PRODUCTS	solar	Enersa TOTAL Micama					2
	2	stand alone	kW	Enterprise or Lease/PPA	business/NGO	SUPPLY PRODUCTIVE PV (PPV) SYSTEMS	solar	Drip Irrigation (LAC) Rural Stores Refrigeration (in LAC) Rural Community Tourism Enterprises					3
	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 village minigrid	4	stand alone	kW	Government	business/NGO	SUPPLY COMMUNITY SOCIAL PV SYSTEMS	solar	L'Hôpital de Port-à-Piment School in Port-a-Piment (Electronic Learning Board)					2
	5	remote grid	kW	Seller	muni/coop	SMALL SCALE PUBLIC REMOTE GRID	solar	Companies starting in Africa: PowerHive, TTA, etc..					1
	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
	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
	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	Government	govt	LARGE SCALE GOV'T DG	hydro	Saut Mathurine (rehab) Guayamouc (new)					1
	#	main grid	MW	Seller	business/NGO	LARGE SCALE PRIVATE IPP	wind solar	Lac Azuei/Étang Sautmâtre may be part of virtual utility pv + wind					2
	#	stand alone/main 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
	#	stand alone/main grid 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

Step 4

The top-scored SREP cases were then compiled into a range of possible SREP components (or SREP interventions supporting the scale-up of these business cases or the development of these market segments) to assess and rank four elements: feasibility at component level (implementable at high probability and with manageable transaction costs); synergies and economies of scale (e.g. several potential off-grid electrification business models would be included in one "umbrella" off-grid electrification component); the overall effect of different "bundles" of market segment interventions on the overall energy market (with the aim of optimizing the total effect, efficiency, SREP scale-up potential, and transformational impact); and the specific process rules, safeguards, and priorities of SREP, the government, and MDBs. The resulting components or interventions were again ranked in a final order of priority by the SREP Task Force, which considered feedback from stakeholders (table 11).

Table 11. Ranking of final selection of SREP Haiti projects

Final selection of SREP components	Transformative impact	Development impact	Economic and financial viability	Leveraging additional resources	Leveraging private resources	Implementation capacity (nat. gov't)	Viability for MDB financing	Sum
1RE for Port-au-Prince metropolitan area	4	4	3	2	3	3	2	**21**
2. RE-for Port-de-Paix remote grid	2	3	2	2	3	3	2	**17**
3. Off-grid electricity 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**

Note: Scored from 0 to 4, with 4 the best.

Step 5

The potential components were discussed with key stakeholders, who requested a crosscutting component for building capacity and improving the enabling environment for scaling up RE in Haiti, giving the final proposed SREP Investment Plan five SREP components (table 12).

Table 12. Five proposed SREP components

SREP project	Priority
1RE for Port-au-Prince metropolitan area	**High**—important transformational potential for experience and capacities in integrating renewables in EDH grid. It will inject much-needed RE generation capacity in the grid and help unlock future investments in RE. It needs to ensure adequate maintenance if owned by EDH.
2. RE-for Port-de-Paix remote grid	**Medium/High**—less replication potential due to the small size of isolated grids, but can be replicated in the five other isolated grids. It provides good learning potential (cooperation with academia, etc.) and has strong development-impact justification (as it is for the poorest and most isolated department that has strong development potential but that lacks electricity).
3. Off-grid electricity for productive, social, and household uses	**High**—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**—cost-effective intervention, but limited replication/scale-up impact. Need to ensure adequate maintenance if owned by EDH.
5. Building enabling environment, capacities and skills for RE scale-up	**High**—crosscutting—essential complement of components 1, 2, 3 and 4, and for the future scaling up beyond SREP.

5

RESPONSIVENESS TO SREP CRITERIA

5 RESPONSIVENESS TO SREP CRITERIA

The SREP Investment Plan is responsive to all the SREP criteria (table 13).

Table 13. Summary of program responsiveness to SREP criteria

Criterion	Off-grid renewable energy	On-grid renewable energy for grid-connected infrastructure
Increased installed capacity from RE sources	It will lead to about 10 MWp (possible range 10–18 MWp) of decentralized RE capacity and solar stand-alone systems.	It will result directly in 10–20 MWp of grid-connected RE capacity (depending strongly on wind share and absorptive capacity, as well as the final deal structure) of installed generation capacity. It will build enabling framework and the capacity for further RE scale-up.
Increased access to energy through RE sources	It will provide new electricity access to at least 1 million residents -- including Port-de-Paix	It will improve electricity access—— to about 1 million EDH-using citizens.
Low emissions development	RE mini-grids and small stand-alone solar systems and products emit no carbon dioxide; mini-grids that use backup diesel for partial generation emit relatively small amounts relative to the baseline (Chapter 10).	RE (solar, wind, hydro) for existing grid-connected infrastructure emits no carbon dioxide.
Affordability and competitiveness of renewable sources	The economic cost of supply for mini-grids is far less than for diesel generation; the economic avoided cost of lighting is far less for picoPV than for kerosene. But given rural consumers' limited ability to pay and the need to reach low-income consumers to deepen access to the rural population, targeted incentives will be needed.	RE is cost competitive with existing Port-au-Prince generation, seen in the RE Supply Curve (figure 11) and advanced modeling of operational benefits from saved fuel.
Productive use of energy	Mini-grids directly support electricity supply to enterprises. Stand-alone systems support productive energy use, directly by enabling cottage industries and small retail ventures to increase productivity, and indirectly via the benefits from children's improved education due to better lighting and communication, health, and security.	On-grid renewables will increase the quantity and quality of Port-au-Prince electricity supply given the tough baseline, and thus help meet some suppressed demand, which now limits productivity.
Economic, social, and environmental development impact	Displacement of diesel and kerosene reduces local pollution and risk of fire. Greater economic opportunity results from electricity access. Local communities can retain money that previously would have been used to buy fuel.	In addition to obvious economic impacts, the local and wider environmental impacts are expected to be positive due to the displaced thermal fuel and the small size of the installed wind, PV, and hydro plants in the uncritical Port-au-Prince Lac Azueï areas.

Criterion	Off-grid renewable energy	On-grid renewable energy for grid-connected infrastructure
Economic and financial viability	Economic and financial viability have been confirmed in consumer surplus calculations based on an estimated, income-corrected demand curve using data of the Digicel/iiDevelopment 2014 and ECVMAS 2012 surveys. RE sources are least cost against 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,	Economic and financial viability have been confirmed via a standard economic and financial analysis for on-grid RE benefits and costs.
Leveraging of additional resources	Infrastructure is needed to rapidly scale up investments to achieve the national electrification goal. SREP resources also leverage investment financing from other sources (private sector, other MDBs, households, leveraged at about 1:4–1:6).	A leverage of about 1:1–1:5 (SREP to private and MDBs) is expected for the on-grid component, but will depend heavily on the final type of the investment, the deal structure and the risk appetite of the investors at the time the grid-connected RE component is developed.
Gender equity	Women and children are direct and major beneficiaries, gaining 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 such as building on the Fonkoze/ MicamaSoley example.	Improved power availability will benefit both men and women. Development of a new RE industry will create new opportunities for women's employment and businesses. SREP capacity-building project will specifically target women to help them take advantage of the new opportunities
Co-benefits of RE scale-up	Scaled-up RE reduces local air pollution and avoids risk of fire from fuel spillage. Electricity is an important input in poverty reduction efforts and rural development.	Local diesel fuel use will be cut, alleviating handling issues. Greater reliance on local RE supports energy security.

6

SREP FOR HAITI: PROGRAM DESCRIPTION

6 SREP FOR HAITI: PROGRAM DESCRIPTION

6.1 PROGRAM OBJECTIVES AND EXPECTED OUTCOMES

The SREP Investment Plan provides a balanced allocation of resources between two competing and urgent sectoral priorities: reducing costs and improving quality, reliability, and sustainability of services for existing customers (particularly in urban areas)—Components 1, 2, and 4; and increasing electricity access (especially in rural areas)—Components 2 and 3. In both cases, the services improved and the access increased will raise productivity and boost socioeconomic development.

As many customers receive fewer than 4 hours of power supply a day (tier 0 of the SE4ALL Multi-Tier Framework), the impact of improved services may be as striking as receiving electricity for the first time. The Multi-tier Framework will track the investments' impact, including new connections and improvements of service levels across tiers. The household surveys will include gender-disaggregated data to track specific impact on women. The baseline is planned for this year (Chapter 10). It will also closely track the impact of productive uses.

The main outcome of the SREP Haiti Program will therefore be the expansion and improvement of electricity services for households, businesses and institutions. Additional key outputs and outcomes include increase in RE capacity (MW) and generation (MWh); greenhouse gas emission reductions and avoidance; enabling regulatory framework enacted; expanded skill base for further RE scale-up; increase in number of RE enterprises; RE jobs created; a knowledge transfer/increased capacity of the local technicians; and opportunities created for female entrepreneurs and workers.

6.2 PROGRAM RATIONALE AND DESIGN

The SREP Investment Plan is conceived as a comprehensive program, with the objective to initiate a transformation from the underdeveloped, unreliable, and expensive fossil fuel–based electricity generation mix to a modern and sustainable energy system relying on diverse sources of power.

The underdeveloped state of the energy sector is a challenge and an opportunity. It is a challenge because the electricity sector has still a long way to go if it is to power the economy to emerging status with universal electricity access by 2030. This change will not happen through one program but will require long-term and consistent support. Diversifying to RE will be very important, but not the only element. Ultimate success is closely tied to structural changes in organizing and managing the electricity sector, starting with the recent government plan agreed with the IMF and supported by PRELEN (Chapter 1).

The opportunity comes from the underdeveloped state of the sector, making it open to influence toward a cleaner and more sustainable path from the start, in a leapfrogging via state-of-the-art know-how and technologies, including public RE planning methods and private RE business models. This allows the government to reap "second-mover advantage" by absorbing lessons from other countries' early-stage efforts.

SREP is designed to address these challenges and exploit these opportunities, so as to:

- Identify immediate, cost-effective, readily implementable opportunities for RE investments with the best success probability, replication, and scale-up potential.
- Demonstrate how RE can fill the gaps in the development of all levels of electricity systems, by working on these levels in parallel, from the EDH main grid, to EDH isolated grids, on existing (mostly non-operational) rural municipal grids, to smaller greenfield off-grid investments or smaller villages without anchor clients, to the smallest picoPV systems. This multichannel approach will help reduce transaction costs and showcase an integrated, national RE development plan. To minimize the risks from working on multiple fronts, SREP is bundling several smaller interventions into larger projects, focusing on creating a framework that can support diverse technologies and business models, while leaving the decisions on the most appropriate technologies and business models to the market, thus lowering transaction costs.
- Start small, but think big, by reducing the daunting barriers to RE investments (Chapter 2). Successful transformation to renewables will require a steep learning curve for the government and private sector, and many experiments and fine-tuning with what works. The Investment Plan thus recommends starting with multiple smaller investments that will allow learning by doing and pave the way for successful larger investments (see Boxes 4, 6, and 7).
- Complement SREP-facilitated investment with other energy sector interventions. IDB and the World Bank are assisting the government through MTPTC and EDH in overall sector development and reforms, capacity-building, rehabilitation of existing assets, and actions to improve EDH commercial performance and reduce losses (annex VI). SREP is integral to this broader program.
- Complement investments with a strong TA and capacity-building program beyond the needs of individual projects, so as to build the nationwide skills to support more ambitious and sustainable RE scale-up (during and after the SREP)—SREP Project 5.
- Coordinate with other donors, such as UNEP, the Norwegian government, USAID, and the Pan-American Development Foundation (annex VI). SREP will focus on filling the gaps between these organizations: for example, many of them 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.

Developing the energy sector in Haiti will be a long-term process, in which SREP can play an important role. To lift Haiti's electricity sector from its dire situation, investments in additional generating capacity for the grid will have to be sequenced with policy reforms, which in Haiti—as in other fragile or post-conflict disaster contexts—will be adaptive and incremental. The combination of IDA, IDB, and IMF support for EDH, alongside SREP support to start decreasing the gap between tariffs and costs of production, is the only viable approach for setting the stage for electricity sector growth, as well as for doing away with the subsidies to EDH for better use in eradicating poverty, including electrifying rural areas.

6.3 PROPOSED SREP INVESTMENT PLAN COMPONENTS

The SREP Investment Plan for Haiti has five components.

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


Photo credit: Caribbean Journal (Grenada)

.The component will deliver 10–20 MW of RE (depending on technology mix, final deal structure, and result of feasibility 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 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 daily supply time is 16 hours, but this average hides differences across geographic areas and types of clients. Many households receive fewer than four hours of service a day.

This Port-au-Prince on-grid component will support the country's first grid-connected variable RE project (either one large project or several smaller, parallel or consecutive RE projects) to test and fine-tune the approaches proposed by the government. The experience would be used to develop a suitable policy and regulatory framework to encourage larger investments (post-SREP scale-up). The approach will be a PPP, encouraging private investments (and adequate O&M), with SREP financing focused on reducing the total investment costs and the risk exposure for that sector.

The projects will be selected following competitive procedures. The PPP option will be conditional on a demonstrated commitment to improve EDH finances. If a PPP option is not viable when this SREP component is developed, a public alternative could be considered, but it would involve, at a minimum, a private contract for O&M, following established international examples of such contracts.

Various RE technologies will be considered (wind, solar, biomass, and hydro), with wind and solar PV the probable primary candidates due to wind's high economic attractiveness at the best sites and due to the solar PV modular character, which makes it easier to develop smaller projects. Also, the most suitable wind sites are near the existing transmission line, while solar PV is site flexible and can therefore feed into the grid in areas where grid is best equipped to absorb the variable renewable energy. The final technology choice of this component will be decided at the start of SREP implementation, based on the more detailed analysis in the new Electricity Master Plan (2015) and information on vRE grid absorption (annex II), relative benefits in situ, private sector interest, and EDH performance.

Proposed total capacity of intermittent RE of 10–20 MW remains well below the safe grid absorption limit. Component implementation will also benefit from the rehabilitation of the transmission line from Péligre to Port-au-Prince, which is being upgraded to allow for additional RE output. Increased hydropower generation from the rehabilitated Péligre dam will also smooth integration of intermittent wind and solar (GIZ 2013).

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

Photo credit: Winenergy, Haiti (Port-de-Paix town)

Apart from the main grid serving Port-au-Prince, EDH runs 11 isolated grids, from 300 kW to 25 MW, with power mostly supplied intermittently by diesel units and some hydropower. They have O&M problems, thus making it harder to extend access to more households, even though it is estimated that over 300,000 households (see Table 6) could be reached by rehabilitating and expanding these grids.

The Port-de-Paix grid is in the North-West department, the most isolated with the highest proportion of 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 supplies of diesel fuel, for which transport is often a challenge, particularly in the rainy season.

The area has proven wind and solar resources. The component would expand capacity of the Port-de-Paix grid with 1–2 MW RE (most likely a solar–wind hybrid) to improve quality for existing customers and to help expand the isolated system to some further 14,000 customers. This component will serve as a pilot case for potential replication of a similar arrangement in other EDH isolated grids. Learning from the previous wind pilot project installed in Port-de-Paix in 1978 (but no longer working), the component will explore a PPP arrangement to support its sustainability. At a minimum, the private sector will be contracted for Engineering, Procurement, Construction (EPC) delivery as well as O&M. The feasibility of the private sector investing directly in the component will be explored during final component design.

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

Photo credit: UNEP – Mark Steed

Investments in rural electrification have remained scarce in the last 30 years, keeping rural electrification extremely low (around 5%). With EDH largely absent, local rural governments and users have found their own solutions. Until recently, individual diesel systems and kerosene were the only lighting and power solutions for most households and businesses. More recently, RE technologies, especially solar PV, have taken off as a new alternative for off-grid energy access. Paradoxically, in urban areas, many industries and enterprises have intentionally

went off-grid, isolating themselves from the EDH grid due to unreliability and voltage fluctuations, supplying themselves with more expensive but more reliable diesel generation.

Innovative and promising business models have recently emerged to offer RE services to off-grid households and businesses in rural and urban areas. They include village RE/diesel hybrid grids; service provision through pay-as-you-go individual solar kits/home systems and solar-lantern sales in rural areas; and solar PV leasing approaches to hybridize diesel generation of business clients.

The component would scale up access to modern electricity services, supporting these business models. It is expected to result in about 10 MWp of new RE capacity and more than 200,000 newly electrified households, businesses, and other institutions.

SREP support will be technology and business model neutral. All technologies will be eligible for SREP support: mini-hydro, solar PV, biomass, and wind. This technology and business model neutrality is needed to incentivize private sector innovation and not to crowd out potentially viable business models by narrowing support to only a few "winners." However, a parallel TA, including South–South exchanges, will be used to develop those business models that appear the most promising to achieve scale and impact.

Ultimately, the technology choice will be decided throughout the component implementation by private sector take-up and performance under each of the SREP off-grid segments, as participating firms will decide on their own business plans and priorities (based on the public GIS[61] developed during SREP preparation and their own market intelligence).

As the component targets areas outside EDH range, the utility will not be involved in implementing this project, although investments will be coordinated with EDH to ensure that the component's off-grid areas are not scheduled for grid electrification.

The component will be co-financed with the existing IDA Rehabilitating Infrastructure and Access project and the parallel CTF-funded Modern Energy for All Project (annex V). Urban off-grid market development would be co-financed by IFC (box 7).

Box 7. Urban off-grid market potential

IFC is considering supporting development of a solar PV leasing solution to medium to large industrial and commercial private players ("lessees"), the first such attempt on a large scale in Haiti. This type of projects would target users that are almost entirely operating off-grid due to grid reliability issues generally. It would not displace EDH as a source of electricity supply in the long run. Instead it would aim at reducing the cost of self-generated electricity for those off-grid customers, improving their efficiency and competitiveness. If successful, it may open the doors for solar PV leasing to a wider range of users via aggregators. It could also develop a local solar PV construction and maintenance industry.

This project is targeting those almost entirely operating off-grid out of reliability concerns, and so does not displace EDH as a source of supply. Instead it aims to reduce the cost of self-generated electricity for those off-grid customers, improving their efficiency and competitiveness.

IFC's pipeline of projects under this SREP component would be first-of-their-kind projects,

deploying a business structure not yet tried in Haiti and relying on long-term financing in a high-risk market environment. The business models under those transactions would generally be tested and their robustness confirmed by targeting customers with better credit risk first, and over time moving to weaker credit customers. The use of SREP funds by those initiatives would reduce lending risk and help ensure the business models' sustainability. SREP funds are not intended to be grants, but could be deployed in the form of debt or guarantees following the principle of minimum concessionality

For EDH, this pipeline of projects would improve Haiti's business potential in the short term, while preparing off-grid segments for grid connection (for when reliable EDH supply comes on stream).

Current IFC's pipeline of off-grid projects offers a solar PV distributed generation platform, which could deliver immediate and significant benefits and leverage private sector funds. These projects would ultimately allow EDH to tap into the resulted installed capacity via net metering or other types of arrangement. In the shorter term, given poor EDH electricity supply or the focus on customers already off grid, those projects are unlikely to compete with EDH's operations or weaken its financial position.

4. Rehabilitation of small hydro plants

Photo credit: UNEP – Marc Steed

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; none of the others produces at potential capacity out of need for repairs and rehabilitation.

Such rehabilitation is a cost-effective way of expanding RE capacity. Further, increasing the share of hydro resources in the overall generation mix will attract other investment in intermittent renewables, such as wind and solar. EDH has commissioned a study evaluating the potential for rehabilitating the small hydro plants, potentially adding up to 20 GWh a year of renewable generation at a total cost of around US$10 million. The component as well can be developed in phases. Given EDH's maintenance deficiencies in the past, the component will aim to ensure that credible arrangements are put in place for maintenance, such as setting up a maintenance fund with obligatory EDH contributions, outsourcing O&M to the private sector, or concessioning the hydro plants to private operators.

Studies are also under way to assess in detail the potential for new mini- and micro-hydro plants. The proposed component will also provide funding for development of one to three new mini/micro-hydro plants, for which PPP arrangements will be considered.

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

All RE investments lack a transparent and consistent regulatory framework, have to face fiscal policies favoring fossil fuels, and operate with a dearth of capacity and skills


Photo credit: UNEP – Marc Steed

throughout the supply chain. RE scale-up therefore requires comprehensive and systematic efforts to eliminate these barriers nationally for all types of RE investments. For that reason, the SREP Investment Plan includes a specific component for these crosscutting issues, as opposed to integrating TA/capacity-building directly in each investment components. This component will cover a range of enabling activities,[62] but the key focus will be on two areas, which the stakeholder consultations revealed as the main bottlenecks: lack of an enabling legal and regulatory framework; and lack of local capacity and skills. Implementation will be closely tied to the execution of the four investment components described above, offering a real-life RE market development laboratory. Capacity-building will include a gender dimension.

This component, by removing information asymmetries and other market inefficiencies, is expected to help lift several RE market segments to a new, more efficient level, bringing down the risk-adjusted financing costs of new RE projects (GIZ 2014b). Additionally, this component will coordinate SREP-wide monitoring and evaluation, using the SE4ALL Multi-tier Framework.[63]

Sequencing and packaging components into projects

The five components will be phased in order not to overstretch the implementation capacity of key agencies, and will have their own implementation arrangements.

Components 2, 3 and 5 are natural expansions of activities already carried out by PRELEN (and IFC for the IFC-managed activities under Component 3) and can therefore be developed quickly. Component 1 is new and will require further studies and preparation efforts, and is therefore likely require a longer preparation period. Component 4 will be implemented in the third round, as additional financing is mobilized.

The World Bank–supported components (1, 2, 3, and 5) are likely to be bundled into two World Bank SREP projects. The first project *Renewable Energy and Access for All* will include Components 2, 3 and 5, the second project: *Renewable Energy for the Metropolitan Area* will cover Component 1.

In parallel, IFC will implement its activities under Component 3 and may also provide advisory services for Component 1.

Table 14. Packaging of components into the World Bank and IFC projects

SREP component	WB Project	IFC Project
1. RE for metropolitan area	RE for the metropolitan area project	(Advisory Facilities may be provided, tbd)

2. RE for the Port-de-Paix remote grid	RE and access for all project	
3. Off-grid electricity for household, productive and social uses		. Off-grid electricity for household, productive and social uses
5. Building enabling framework, capacities and skills for RE scale-up		
4. Rehabiitation of small hydor	Not yet included in a project	

6.4 PROGRAM CO-BENEFITS

In a development pattern in which environmental and social benefits are enmeshed, SREP is expected to reduce dependence on fossil fuels; cut local pollution; create economic activities and jobs related to new technologies with private participation; boost private involvement in RE production through building technical and organizational capacity in energy and crafting legal and regulatory arrangements that engage the private sector; cut poverty and improve the quality of life of the rural population, for which improved access and use of electricity is a key enabling condition; and raise the socioeconomic status of women.

7

FINANCING PLAN

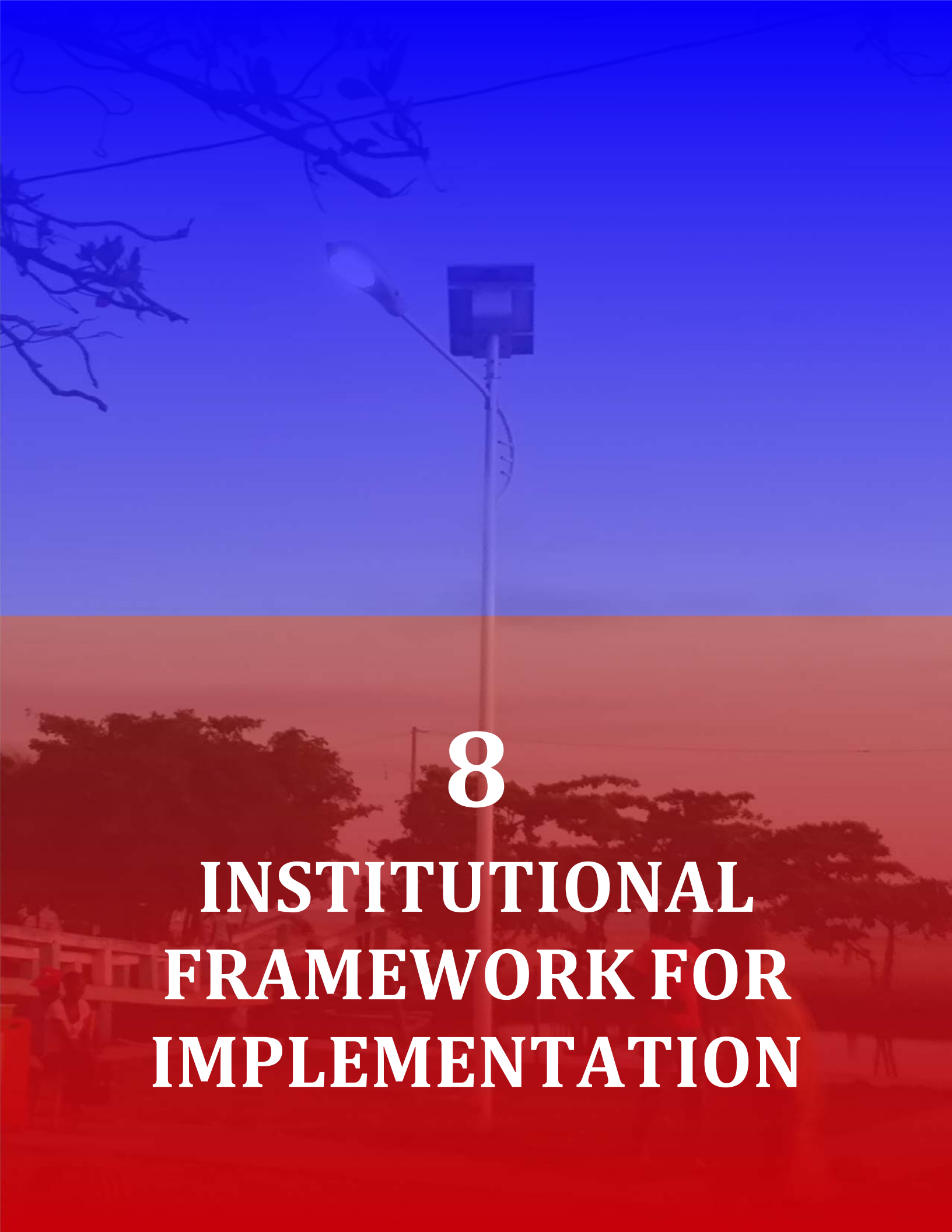
7 FINANCING PLAN

The total estimated budget for SREP Haiti is US$149.5 million with SREP's contribution of US$30 million for Components 1, 2, 3, and 5 (Component 5 is a part of the program package but will seek additional financing from other sources). SREP is seeking cofinancing from participating MDBs and other development partners, including US$30.5 million from the World Bank to support all five components (including the forthcoming CTF-eligible Modern Energy for All Project under preparation) and US$15 million from the IFC to support Component 3. Finally, SREP is expecting to mobilize just under US$80 million from the private sector. The SREP leverage factor is expected to be 1:4–1:5, depending mainly on the final design and the deal structure of the on-grid component (Component 1). (See table 14.)

Table 15. SREP financing, co-financing, and private financing leverage

SREP Component	SREP funding			Public co-financing			Private leveraging		Total leveraging
	WB	IFC	Total SREP	WB-IDA[d]	WB-CTF[e]	Other public[f]	IFC	Other private	Public + private
1. RE for the metropolitan area	8-10	0-2[b]	10	6				16[g]	22
2. RE for Port-de-Paix remote grid	2-4[a]		2-4	10				2	12
3. Off-grid electricity	8-9	7-9[c]	15-17	8	11.5		15	60	94.5
4. Small hydropower rehab			0	4		14		tbd	18
5. Enabling framework, capacity and skills	1		1	2.5	0.5				3
Total	21-23	7-9	30	30.5	12	14	15	78	149.5

a. The exact amount needed from SREP will be determined through a detailed feasibility study.
b. IFC participation in the Component 1 is dependent on viable conditions in place for the PPP option. If a PPP option is not viable, IFC resources may shift to expand Component 3.
c. The initial allocation for the sub-component is US$ 7 million. However, IFC SREP contribution could be expanded to US$9 million if the sub-component progress is satisfactory and if IFC contribution under Component 1 does not materialize.
d. World Bank co-financing is from the existing IDA-financed PRELEN, which is prioritizing SREP-prioritized investments.
e. Project under development, Concept note approved in February 2015
f. Financing being sought from other sources, such as the Green Climate Fund
g. Minimum leveraging estimate. Final leverage for on-grid RE, where private sector project sponsors would feed into EDH the grid will depend on the specific SREP Case (9–12) and may vary from about 1:1 (SREP to private investment for typical wind on-grid case with moderate risk-appetite investors) to 1:5 (for small distributed generation analogous to the "fuel saver" case in Chapter 2). Deal structures with international bidders will depend on the off-take risk at project development and on the debt terms they can secure in the global market.



8

INSTITUTIONAL FRAMEWORK FOR IMPLEMENTATION

8 INSTITUTIONAL FRAMEWORK FOR IMPLEMENTATION

The implementation of the proposed SREP-funded components will be overseen and coordinated by MTPTC through its Energy Cell (with support from the SREP Task Force). It is expected that the same Task Force that prepared the Investment Plan will retain an advisory role.[64] MTPTC has much experience with implementing donor programs, and is also managing PRELEN.

MTPTC created the Energy Cell in 2012, to support energy sector development. As the key implementing unit for SREP, the Energy Cell will get more staff or consultants to support its increased duties. PRELEN is supporting capacity-building activities for MTPTC and its Energy Cell, EDH, and other stakeholders, and this support will be raised under Component 5. As possible, implementation arrangements for the individual components will build on those established under PRELEN.

Parts of program implementation—especially the off-grid component—will be assigned to private sector entities, with MTPTC focusing on the enabling environment and oversight (with funds channeled to the private sector primarily through IFC and a competitively selected financial intermediary). The beneficiary companies, in on- and off-grid sectors, will receive further TA and will benefit from exchanges with similar enterprises in other developing countries.

Implementation arrangements per component

Renewable Energy for the Port-au-Prince Metropolitan Area (Component 1) will be managed by MTPTC Energy Cell and EDH (the exact arrangements are to be defined), which will be in charge of project preparation studies and the competitive process for selecting private firms for the PPP contract. The component will be supported by the World Bank with the possible option of TA/advisory services provided by IFC.

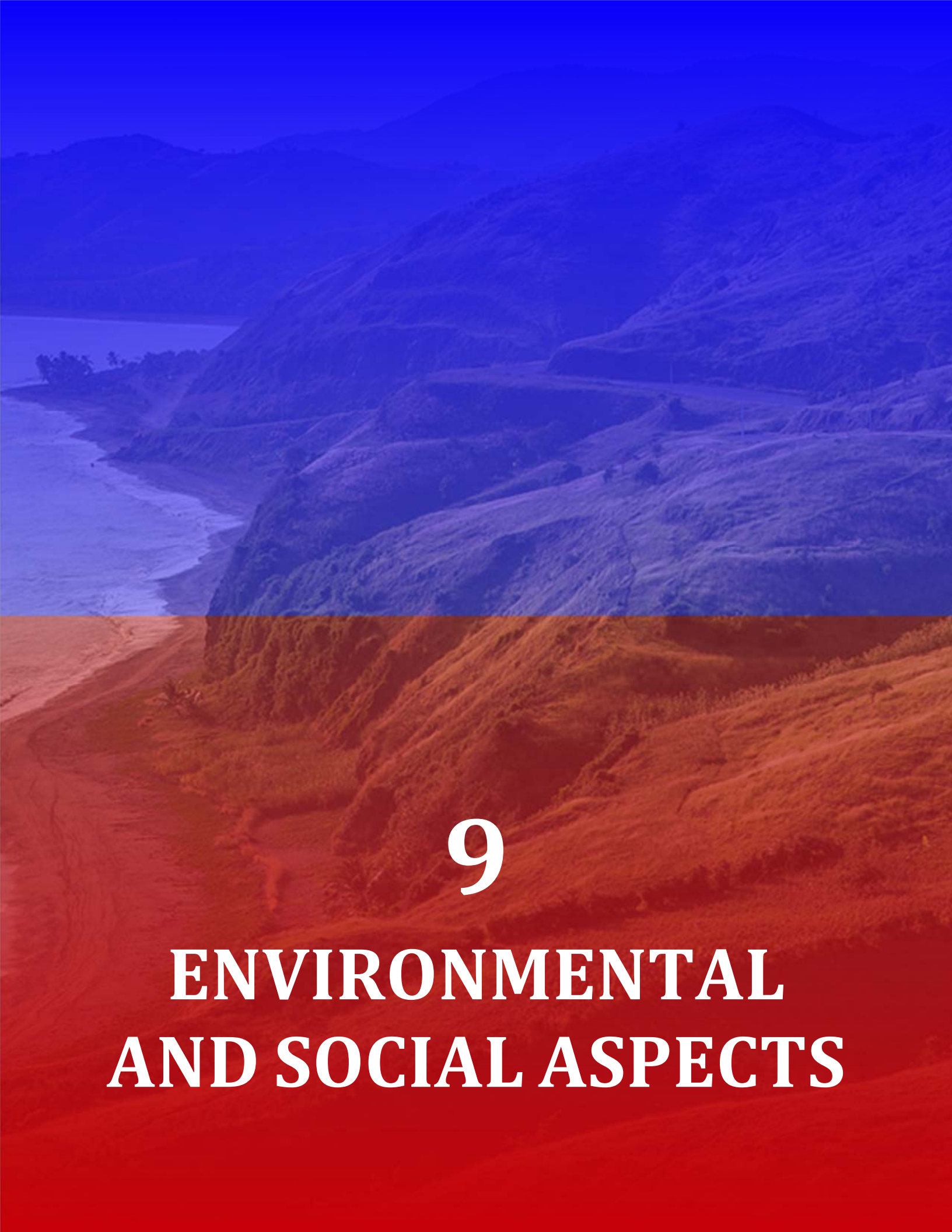
Renewable energy for Port-de-Paix remote grid (Component 2) will be managed by the Energy Cell with EDH, which will be in charge of project preparation studies and the competitive process for selecting private operators, and channeling subsidies to the project. EDH will implement the upgrading and expansion of the Port-de-Paix isolated grid. The component will be supported by the World Bank.

Off-grid electricity for productive, social and household uses (Component 3) will be managed by the Energy Cell with the support of BME, except the CTF-funded access to finance facility, which will be run through a competitively selected financial intermediary, and the private sector support facility, which will be directly managed by IFC. The component will be supported by the World Bank Group (both World Bank and IFC).

Small hydro rehabilitation (Component 4) will be managed by EDH, the owner of small hydropower assets. The component is part of the broader SREP Investment Plan but not included in SREP financing. Additional funding for implementation is being sought.

Building enabling environment, capacities and skills for renewable energy scale-up (Component 5) will be managed by the Energy Cell, which will work with university RE programs such as those at the State University of Haiti and Quisqueya University, and the

Gender and Energy Interagency Commission. The component will be supported by the World Bank.



9

ENVIRONMENTAL AND SOCIAL ASPECTS

9 ENVIRONMENTAL AND SOCIAL ASPECTS

The lead national SREP coordinating entity, MTPTC (via the Energy Cell), has already undertaken lending and TA projects with the World Bank and IDB, and so it has policies and procedures to ensure compliance with government, World Bank, and IDB environmental and social (E&S) safeguards. IFC performance standards, and its policies on E&S sustainability, will be applied. Specific arrangements are as follows.

E&S Management Framework. Because some investment locations will be determined during project design, a framework will be prepared that defines E&S plan, review, and clearance processes that follow national and MDB guidelines. The Ministry of Environment will play a key role in designing this framework.

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

Strengthening the Safeguards Compliance Capacity under SREP will be of utmost importance and require continued joint efforts between the government, World Bank and IFC.

E&S 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.[65] Adequate stakeholder consultations must be undertaken and guide the development of E&S studies. Additional specialized E&S management plans or initiatives may be required to address the impacts associated with given projects or subprojects. 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 subproject implementers (e.g. SREP-supported RE IPPs or mini-grid operators), are responsible for complying 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 (ESIA, ESMP, and RAP), obtaining clearances, implementing all required mitigation and monitoring measures, providing adequate funds to sustain these activities, and complying with any directives issued by relevant parties.

The detailed E&S studies prepared by subproject implementers must be submitted to the Ministry of Environment and to the MDBs for their review and approval. The Ministry's approval is based on Haitian laws and regulations, while that of the MDBs is based on their E&S policies, guidelines, and standards. The Ministry will be responsible for reviewing and clearing 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, via its Energy Cell, has overall responsibility for implementing the ESMPs, resettlement policy frameworks, and any specialized E&S management plans or initiatives developed for the subprojects. MTPTC will not issue licenses or permits to subproject

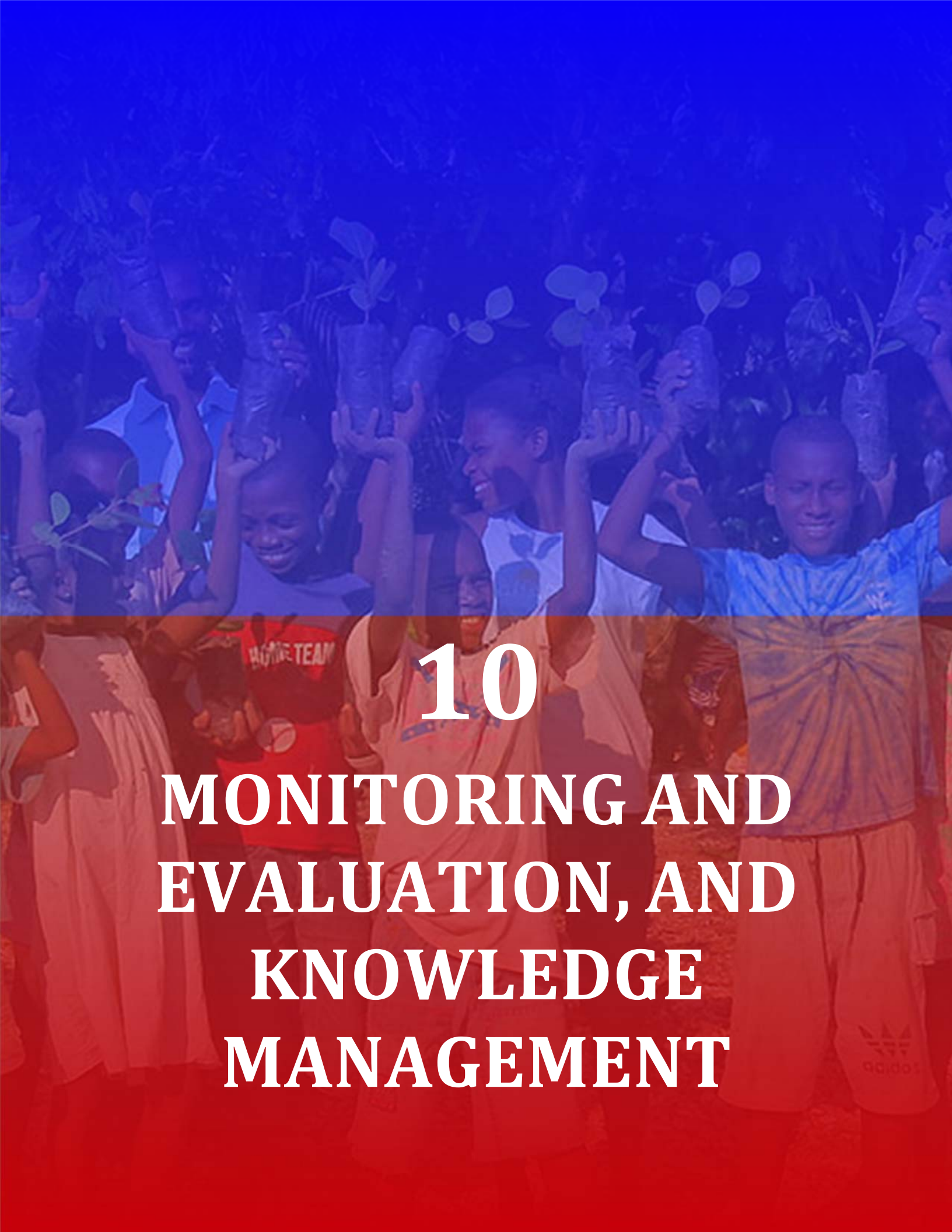
implementers (if they are required) until the environmental entity or other relevant authorities issue E&S clearances.

Stakeholder consultations. The E&S Management Framework 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 (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 used in organizing and conducting the consultations. Gender considerations must also be factored in.

Capacity-building. The government, working with its MDB partners, has carried out numerous workshops and other capacity-building activities for key stakeholders through PRELEN, through IDB projects, and in preparing the SREP Investment Plan. Capacity-building activities under PRELEN include hiring a consultant to support MTPTC and EDH in implementing safeguard policies during project preparation and TA. SREP interventions will build on those and other MDBs' capacity-targeted activities. It is thus expected that these improved capacities will facilitate implementation of safeguard instruments under SREP.

Environment, Health, and Safety Management System. Project and subproject implementers will design, construct, and operate the projects and implement such a system.

Public Disclosure. Project and subproject implementation will require communication and consultation with the Haitian stakeholders affected directly and indirectly by the subproject, and with other stakeholders within and beyond the project zone of influence. Disclosure of the detailed E&S studies (ESIA, ESMP, and RAP) must be done in compliance with the public-disclosure requirements of 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

10 MONITORING AND EVALUATION, AND KNOWLEDGE MANAGEMENT

The SREP Investment Plan will strengthen monitoring and evaluation (M&E) and knowledge management, relying in part on the SREP M&E framework (to be coordinated by the MTPTC Energy Cell), and the SE4ALL Multi-tier Framework.

10.1 STRENGTHENING MONITORING AND EVALUATION

The Energy Cell will define and implement the SREP M&E system aimed at collecting, analyzing, processing, and reporting on key information related to program activities, as well as progress in reaching SREP impacts and outcomes, and applying lessons learned. SREP will contribute to efforts to establish an energy sector-wide M&E system (box 8) to ensure that the sector-wide M&E framework includes SREP indicators to facilitate reporting, improves indicators on RE, and sets up a data collection system to obtain baseline information.

Box 8. Building M&E capacity for MTPTC and EDH

The IDA, through PRELEN, is providing TA to the sector-wide M&E system, which is short of human and technical resources, targeting MTPTC and EDH.

TA shows how to develop an effective M&E framework. Under PRELEN, MTPTC has overall responsibility for the M&E of project activities. It prepares the project's M&E reports that include quarterly reports on project performance, based on the M&E framework set during project preparation; quarterly interim financial reports; and annual independent financial audits of the project and of EDH.

TA further helps MTPTC set up its own monitoring framework. EDH, as part of its corporate responsibilities, reports on its performance regularly, providing the project coordination unit with information.

10.2 STRENGTHENING KNOWLEDGE MANAGEMENT AND LESSONS SHARING

The outcome of consultations with stakeholders from academia (August and November 2014, February 2015), and from civil society and from among end-user beneficiaries (February 2015), revealed the need to focus SREP on building capacity of RE technologies, including a pool of skilled technicians.

The lack of appropriately skilled labor is often identified as a major barrier for scaling up RE.[66] Government agencies, private enterprises, multilateral institutions, and NGOs widely recognize the shortage of skilled technicians for installation and O&M of renewable and decentralized energy systems as major barriers. For Haiti, a recent World Bank Systematic Country Diagnostic (February 2015) outlines the correlation between high education and skills and higher labor income. It explains that skills and experiences, with access to services such as electricity, contribute to higher productivity in the country. Absent skills, the private sector will most likely be unable to increase productivity (box 9).

Box 9. World Bank's systematic country diagnostic, February 2015

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

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, and 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 identify the characteristics and inputs that could improve understanding of what is needed to raise 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% 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 to spreading risk, strengthening food security, and preserving biodiversity. Further, 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 so as to increase the profitability of employment. Greater economic opportunities and better jobs, especially in urban areas, would contribute to reducing crime and violence, further improving the business climate.

Another important barrier is the lack of awareness of RE technology, as found by a World Bank mission to numerous departments in Haiti in February 2015 (annex III).

Component 5 will focus on building capacities and skills—working closely with academia. Where feasible, the remaining SREP-funded components (Components 1–4) will integrate learning and capacity-building activities, and where feasible, involve universities in implementation.

10.3 RESULTS FRAMEWORK

Table 16 below summarizes the SREP M&E results framework for Haiti.

Table 16. SREP results framework

Result	Indicator	Baseline	Minimum target by 2020	Minimum target 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 on- and off-grid renewables in GWh per year (excluding baseline hydro)	2	42	200	MWp installed and feeding into grids + off-grid sales reports; dispatch of vRE in Port-au-Prince
	Increased national annual public and private investments (US$) in total targeted subsector(s)	about 1.5 million	40 million	60 million	Annual reports, government, EDH, RE IPPs and off-grid sales companies as per supply-chain analysis
Increased supply of RE	Increased annual electricity output (GWh) as a direct result of SREP off- and on-grid interventions	n.a.	40	n.a.	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.	1 million people	n.a.	M&E, sales reports of companies
New and additional resources for RE projects	Leverage factor: SREP funding (off- and on-grid) versus financing from all other sources compared with (notation: SREP: Others)	n.a.	Minimum 1:4	n.a.	Donor reports; private sector financial statements; sales reports; PPAs signed, etc.

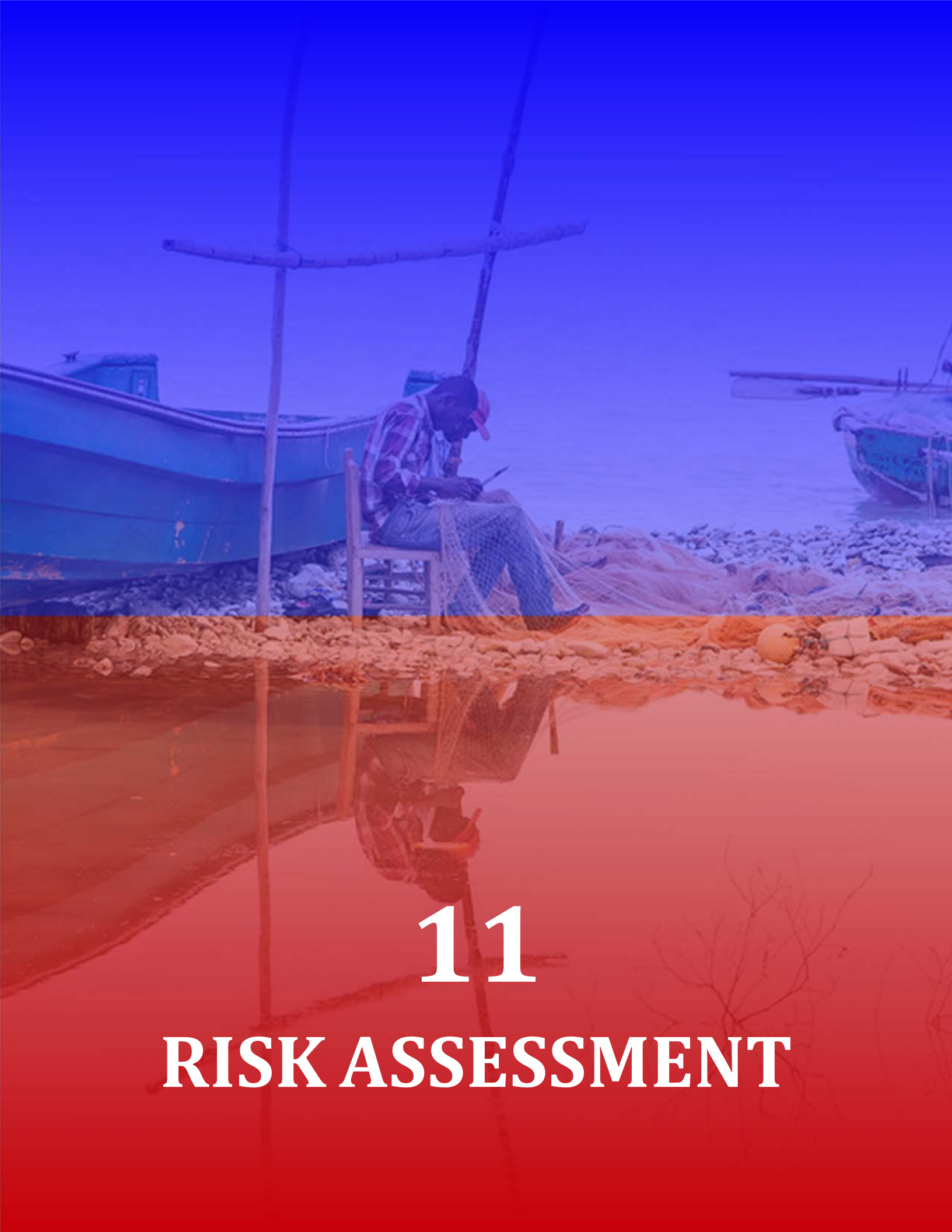
n.a. = not applicable. MEPI = U.S.–Middle East Partnership Initiative. tbd = to be determined.

10.4 SE4ALL Multi-tier Framework for Measuring Energy Access

SREP will apply the SE4ALL Multi-Tier Framework introduced in the Global Tracking Framework of 2013, and updated this year. This framework replaces the traditional "binary" measure of energy access (with or without) with a five-tier measurement approach, which also assesses other attributes of the energy service such as quantity, quality, affordability, and duration of supply. The framework thus allows for assessment not only of whether households, businesses, and institutions have electricity access, but also whether the service is adequate to meet demand, allowing tracking of new access *and* improvements in access across tiers.

The framework can differentiate between a minimum level of service (like that provided by a small solar kit—tier 1) and final aspiration, which is 24-hour unlimited reliable and affordable power (tier 5), acknowledging that a grid connection does not guarantee the

highest tier. Intermittency and unreliability of supply would, for example, downgrade a tier 5 connection to a lower tier.



11

RISK ASSESSMENT

11 RISK ASSESSMENT

The overall implementation risk of the SREP Investment Plan is assessed as Moderate to High, mainly due to overall country political and governance risks. Table 17 presents the main identified risks and mitigation measures. Appropriate corrective and supportive measures will be put in place during implementation in light of lessons to be drawn from activities. Guidance from members of the SREP Task Force will be regularly sought.

Table 17. Main identified risks and mitigation measures

Risk type	Description	Mitigation measure	Residual risk
Technical	Solar PV and other RE, 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 under way will provide 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 poor grid capacity and reliability.	The 10–20 MW of SREP-supported intermittent RE capacity is well below the "safe" limits for integrating intermittent renewables into the EDH grid. However, SREP will also prepare conditions for facilitating a larger injection of RE in the future. The World Bank is supporting a study that analyzes optimal ways of integrating RE into the EDH grid. Its findings 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. SREP grid-connected project will allow testing and fine-tuning of technical and regulatory approaches for integrating intermittent renewables.	Low
	O&M fails.	EDH had deficiencies in the past with maintaining its assets. The proposed SREP investments will establish mechanisms for supporting maintenance and sustainability of investments. These include relying on the private sector for investing and operating SREP RE projects (grid-connected and off-grid), with PPPs structured to provide incentives and contractual obligations to the private sector for sustainable O&M. 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. Technician training will be expanded.	High
	River/stream flow data quality and adequacy are uncertain. Hydrology is 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

Risk type	Description	Mitigation measure	Residual risk
Financial	Mini-grid and solar off-grid customers have limited ability to pay or will not pay.	WTP and market studies have been carried out during preparations for the SREP Investment Plan. The surveys confirmed a fairly high WTP for electricity (about US$30 per month on average, with wide differences across regions and customer types). To accommodate different WTPs, SREP will support a range of technologies and business models, which will cater to different market segments with varying WTPs—from solar lanterns, through pay-as-you-go solar kits/home systems up to village mini- or 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, as through prepaid meters.	Moderate
	EDH presents payment default risk or delays payment.	The government, with MDBs and development partners, is aware of EDH's financing difficulties and is working with EDH to overcome them. SREP will develop risk mitigation instruments to support private sector investment, mitigating the EDH off-take risk. Even in today's difficult conditions, three IPPs are already operating in Haiti and several serious potential (international and local) investors are exploring grid-connected renewables, having expressed a possible interest in investing in a PPP approach, along the lines presented in SREP. Implementation of Component 1 will be conditional on the government/EDH demonstrating progress on the actions that improve EDH performance.	High
	The associated CTF credit line will not disburse due to lenders' lack of interest or knowledge in off-grid businesses.	CTF's access to finance facility is being designed. Several financial intermediaries (FIs) have shown interest in supporting off-grid SMEs but successful implementation of the 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. The SREP risk-mitigation facility will be developed to progressively seek greater participation of FIs in off-grid electrification lending. The IFC-run facility will first target urban off-grid market but over time it is expected to progressively extend its reach to rural areas Training to FIs on pipeline development and due diligence for appraising RE 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 currency depreciation risk. SREP will consider offering guarantees to cover such risks.	Moderate
	The government fails to secure funding for the proposed projects.	Co-financing from the MDBs is secured, except CTF co-financing, for Component 3, which is expected to be confirmed by June 2015. If these resources are not secured during project preparation, the implementation of Component 3 could be phased, with the first phase having secured funding and the second scaling up once additional funding is secured.	Low
Insti-tutional	Poor governance—Haiti has one of the worst transparency indexes in the world.	SREP will be designed to promote transparency. This will include development of a transparent regulatory framework, The CTF access to finance facility will be managed by a competitively selected FI and loans will be awarded according to transparent rules published in the Operating Guidelines. All projects will need to adhere to MDB procurement and financial management rules.	High

Risk type	Description	Mitigation measure	Residual risk
	Regulatory and contractual mechanisms are not adhered to or are delayed. The regulatory framework for grid-connected and off-grid renewables is weak and inconsistent. There is no regulatory agency.	The minimum necessary legal/regulatory conditions for private agents to invest in grid-connected and off-grid renewables exist. For the former, PPAs are in place for the current IPPs, although each is negotiated individually. For the latter, there are already private investments in either individual systems (which, as in most countries, are not subject to regulation) or in mini-grids taking advantage of municipal and cooperative legislation, allowing private sector mini-grids under certain conditions. All investment projects can therefore start, while SREP assists the government in improving this framework to provide better certainty and incentives to investors, while protecting users.	Moderate to High
	Human capacity for project development and implementation is limited.	SREP is ambitious, which may stretch existing implementation capacity of government entities. The government is aware of this risk, and several measures have already been, or will be, put in place. For example: The Energy Cell has RE and rural energy specialists. Further recruitment is in process. Post–SREP Investment Plan approval, it will be strengthened with staff supporting the SREP. PRELEN is already building capacity in MTPTC and its Energy Cell, as well as EDH. SREP will include a project focusing on building local capacities of government, the private sector, academia, and technicians to facilitate RE scale-up. Parts of program implementation, including most of the off-grid component, will be delegated to private entities, with MTPTC focusing on creating an enabling environment and on oversight. Beneficiary companies will receive TA and will benefit from South–South exchanges with similar enterprises in other countries. Individual components will be phased, in order not to overstretch the implementation capacity of key agencies.	High
	Clearance and approval are delayed.	The Energy Cell will work with project developers to forestall bottlenecks.	Moderate to High
	Power-planning capacity gives inadequate consideration to RE development.	The SREP will support EDH in improving planning processes to incorporate generation from RE, intermittent and dispatchable technologies, starting with the new Electricity Master Plan. New expansion planning tools will be introduced and capacities of power planners strengthened.	Moderate
Environ-mental	Projects have unacceptable environmental impacts.	All projects must comply with environmental assessments as part of Ministry of Environment oversight and clearance procedures. The Ministry of Environment and MTPTC (via the Energy Cell) will monitor impacts according to national legislation and MDB requirements.	Moderate
Political	Instability surrounds the 2016 presidential election. Social unrest appears in areas with electricity supply issues.	The extensive consensus-building process as part of SREP preparation and implementation should build a broad base of support for the project, The SREP program will be also accompanied by a communication and consumer awareness strategy, communicating benefits of renewable energy to public and potential users, especially in rural areas.	Moderate to High

Risk type	Description	Mitigation measure	Residual risk
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 assessments will be undertaken per regulations of the BME and the Gender and Energy Interagency Commission, and compensation or other mitigation actions will be undertaken in accord with the framework, as well as government 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.. Design of financial mechanisms under the SREP will take affordability and WTP into account, supported by information, education, and communication campaigns. The program will mainstream gender consideration in its design.	Low
Project design	The 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 FIs/ microfinance institutions.	Measures include: a pipeline of scalable projects; FIs' interest in accessing the funds; consultations with key stakeholders about lending terms and risk sharing; arrangements to ensure that terms respond to key stakeholders' needs; and provision of TA to stakeholders, including private actors and FIs.	Low to Moderate

Annex I
Component Briefs

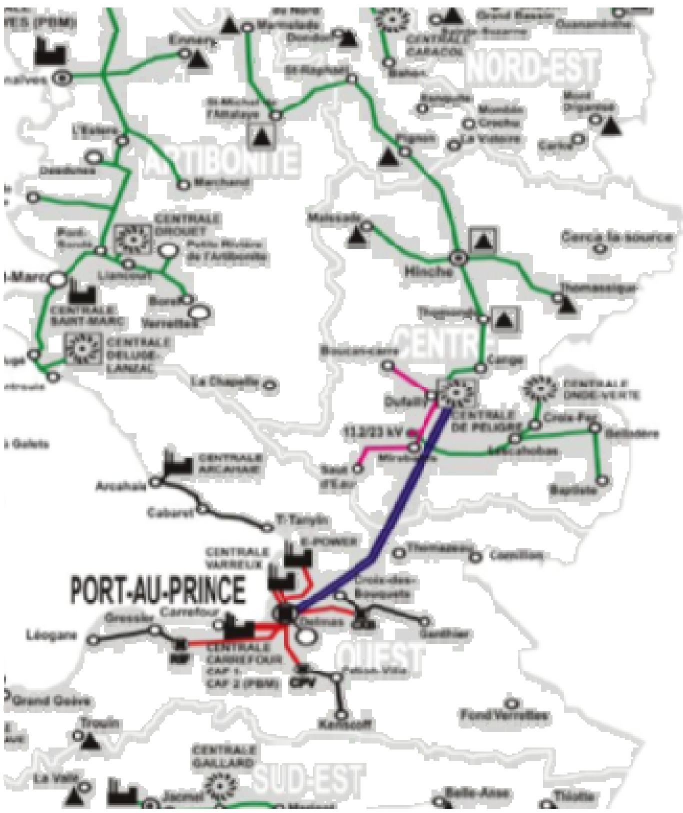
Annex I. Component Briefs

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

Background

Haiti's central power grid consists of the main network of Électricité d'Haïti (EDH), which connects the Port-au-Prince Metropolitan Area (West) with the Central Department. Separate from this main power grid are 11 medium and small low-voltage "island" grids that range from 300 kW to 25 MW peak load (installed, but not fully operational). The main interconnected grid covers Haiti's most densely populated area—almost half of its population (4.6 million) live in the West and Central Departments, which are growing fast. It serves over 160,000 active, legal customers (over 200,000 if irregular customers are counted), with a total installed capacity of 248 MW, of which only about 100 MW is operational. This is insufficient to satisfy rising electricity demand in the fast-growing capital and its surroundings, with peak load currently estimated at close to 500 MW. As a result, load shedding and blackouts are frequent and payment morale is weak. Most firms and other large users who have a high willingness to pay (WTP) for stable electricity operate or buy power from on-site cogeneration generator sets (gen-sets), totaling another 200 megawatt-peak (MWp).

Figure A1. The main existing electricity generation and distribution assets in Haiti **(source: EDH, 2014)**



Péligre, Haiti's largest hydro plant (54 MWp peak, half operational) feeds into the main grid and is under rehabilitation with its 115 kV transmission line, to increase capacity. Rehabilitation is supported by the Inter-American Development Bank (IDB) and Kreditanstalt für Wiederaufbau (KfW). The remaining power is provided by thermal plants, mostly independent power producers (IPPs) with high generation costs set in power purchase agreements (PPAs), contributing to EDH losses.

Available capacity is inadequate. On average, power is supplied 16 hours a day, but many customers receive fewer than four hours of service a day. Consequently, industries and businesses (as well as wealthier individuals) all rely on back-up diesel generators. Due to problems with quality of service (voltage fluctuations, etc.), many

customers have decided to intentionally go off grid and self-supply, despite higher costs of diesel generation.

EDH's ability to improve this situation is hampered by its weak financial position. Technical and nontechnical losses are 65%, a large part due to illegal grid connections. In addition, the collection rate is only two-thirds—meaning that between technical and commercial losses, EDH recovers only 22% of the value of the electricity it generates. The losses contribute to an annual financial deficit of US$200 million—4% of the national budget.

The government's approach to address matters consists of two parallel tracks:

- *Reduce EDH losses* by targeted investments in rehabilitating existing transmission and distribution lines (carried out with support from the World Bank and IDB), and a comprehensive plan to reduce commercial losses, starting with improving collections through installing new meters.
- *Increase availability and reduce costs of power supply,* decreasing EDH's dependency on the expensive fossil-fuel power from IPPs. Diversification options include rehabilitating existing hydro plants (Péligre already in process, additional plants included in the present Investment Plan); importing liquefied natural gas (LNG); and increasing the share of renewable energy (RE), including additional hydro plants, as well as wind, solar, and biomass sources.

Resource-mapping studies (see Chapter 2) indicate that Haiti has ample RE resources that could be harnessed for power generation. Moreover, many economically and financially feasible sites are close to the interconnected grid, and could therefore be developed without a need to invest in long transmission lines.

Objectives

The objective of the proposed Scaling-up Renewable Energy Program (SREP) will be to build government and private experience with developing and operating grid-connected RE projects through supporting investments in grid-connected RE generation capacity of 10–20 MW of RE.[67]

Approach

Apart from hydroelectricity, there are no grid-connected RE projects operating in Haiti. There are, however, several potential investors, including reputable international companies, that have been exploring RE opportunities, particularly wind and solar, carrying out detailed studies and initiating discussions with the government on potential terms that would make RE PPAs viable. However, none of these projects have materialized and no PPA for RE has been signed. The reasons for this slow progress are multiple. From the private sector perspective, EDH's financial situation poses significant risks, even if the PPA can be backed by government guarantee. From the government/EDH perspective, there is a concern about how to integrate large intermittent generation into an already very unreliable grid without causing additional reliability and quality issues. The government is therefore interested to use SREP funds to develop a viable public–private partnership (PPP) model that would unlock RE potential, starting with a more modest 10–20 MW investment that the grid can safely absorb, and building conditions for future scale-up.

the proposed component would therefore support the country's first grid-connected non-hydro RE project or projects (if more than one, parallel or consecutive) to develop,

demonstrate, and fine-tune the proposed PPP approach and to build capacity for RE investments in government and in the private sector. The experience would be used to develop a policy and regulatory framework encouraging larger investments.

Photo credit: Caribbean Journal (Grenada)

The proposed approach will be a PPP, encouraging private investments (and operation and maintenance [O&M]), with SREP funding focused on reducing the total investment cost and risk exposure for the private sector. The project(s) will be selected following competitive procedures. The PPP option will be conditional on the demonstrated commitment to improve EDH finances and the resulting PPA terms that would make the project viable for the government and the private sector. If a PPP option is not viable when the component is developed, a smaller public sector alternative could be considered. However, in that case, it would involve at a minimum a private contract for O&M following internationally established standard contracts for such agreements.

Various RE technologies will be considered (biomass, wind, photovoltaic [PV]), 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. In addition, wind and solar resources are present and abundant, and close to the current transmission line/distribution grid. This will allow potential output from RE plants to be maximized.

The transmission line from Péligre to Port-au-Prince is being upgraded to allow for additional RE capacity, accommodating additional power feed-in of wind farm(s) or solar power plants. Increased hydropower generation from rehabilitation of Péligre will also facilitate integration of intermittent RE (as described in GIZ 2013). In all cases, the proposed total capacity of intermittent RE to be added under the proposed SREP Haiti component remains well below the safe limit for grid integration. SREP preparation has included initial advanced analysis of fuel savings and line losses of different variable RE technologies, as well as a whole range of practitioner methods to gauge the "safe" and "optimal" volume of pre-2020 (i.e. up to SREP exit) variable RE injections, so that the targeted volume is expected to be well in line with the updated government analysis of national RE targets (supported by World Bank research).[68]

Sub-Components

SREP funding will have three sub-components; cost break-down is indicative:

1. *Technical assistance* for feasibility, environmental, social and grid capacity studies, preparation and management of the procurement process for the turnkey contractor and for the O&M contractor. Estimated costs: SREP US$ 1 million; International Development Association (IDA) US$3 million.

2. *SREP incentives for the private sector* (public share in PPP and risk mitigation mechanism). Estimated costs: SREP US$9 million.

3. *Connection to the grid/grid upgrades*. Estimated costs: IDA US$3 million.

Results

- 10-20 MW of RE capacity (depends on technology mix, final deal structures, and result of ongoing wind studies), connected to the main EDH interconnected grid serving the Port-au-Prince metropolitan area
- Private sector investments leveraged
- Increased government and private sector experience and capacity to develop and operate RE projects in Haiti
- Regulatory instruments developed for the scale-up phase
- Greenhouse gas (GHG) emissions reduced or avoided

Implementation arrangements

The component will be developed by the Ministry of Public Works, Transportation and Communications (Ministère des Travaux Publics, Transports et Communications; MTPTC) through its Energy Cell in partnership with EDH. If sufficient commitment to improve EDH finances is demonstrated to allow a PPP option, IFC advisory services may be supporting Government in the development of the PPP transaction.

The component will be supported by the World Bank with a possible option of TA/advisory services provided by IFC.

Sustainability

Investments. This will be assured through the PPP approach, which will require private entities to invest their own resources and to operate and maintain the new plants. The provision of public funding for the project and the risk mitigation instrument through SREP will mitigate the risk of nonpayment by EDH by reducing the feed-in tariff to an affordable level, favorably comparing with alternative fossil fuel generation; by conditioning the component on the continuation of current progress in addressing EDH financial losses; and by providing adequate payment guarantees to the private sector as EDH transitions to a financially sustainable utility.

Approach. Leveraging future investments will be carried out through parallel development of a more comprehensive regulatory framework, which will provide greater security to investors for larger RE projects, and will be facilitated by increased experience and learning from the first grid-connected RE projects under SREP. The public and private learning curves, and improved wind data, will allow for lower total financial costs of future wind parks and solar plants.

Component readiness

Component can be developed and appraised in about 15 months time.

COMPONENT BRIEF 2. RENEWABLE ENERGY FOR ISOLATED GRIDS—PORT-DE-PAIX DEMONSTRATION PROJECT

Background

The EDH network consists of the main interconnected grid—connecting the Port-au-Prince metropolitan area (West) with the Central Department—and 11 smaller isolated grids, ranging from 300 kW to 25 MW peak load (Chapter 1). These grids are mostly served by diesel plants providing intermittent, low-quality power—a constraint for further expansion. Some of them have some small, mini-, or micro-hydro generation, but most are operating below capacity or not at all as EDH has consistently lacked funding for repairs and even basic maintenance.

Suffice to say, these grids typically serve only a small share of the population in their departments, typically constrained by their available generation capacity. RE resource analysis carried out during preparation of the SREP Investment Plan has demonstrated that considerable, yet so far untapped, RE resources (solar, biomass, small-hydro, and wind), exist near these grids, and could be used to hybridize existing diesel grids to increase generation and reduce the costs of supply—thereby allowing both improvements of service for existing customers and expanding access to new customers. The analysis also shows that substantial access gains could be made by connecting households in the vicinity of the existing grids (about 300,000 households).

The Port-de-Paix grid, serving the North-West region, is a good example of the challenges and opportunities for these smaller grids, and is therefore a good candidate for a demonstration project. The North-West Department, also among the most isolated and poorest departments, further highlights the value added of an SREP Haiti component in this region (figure A2).

Figure A2. Percentage of population poor and extreme poor by department

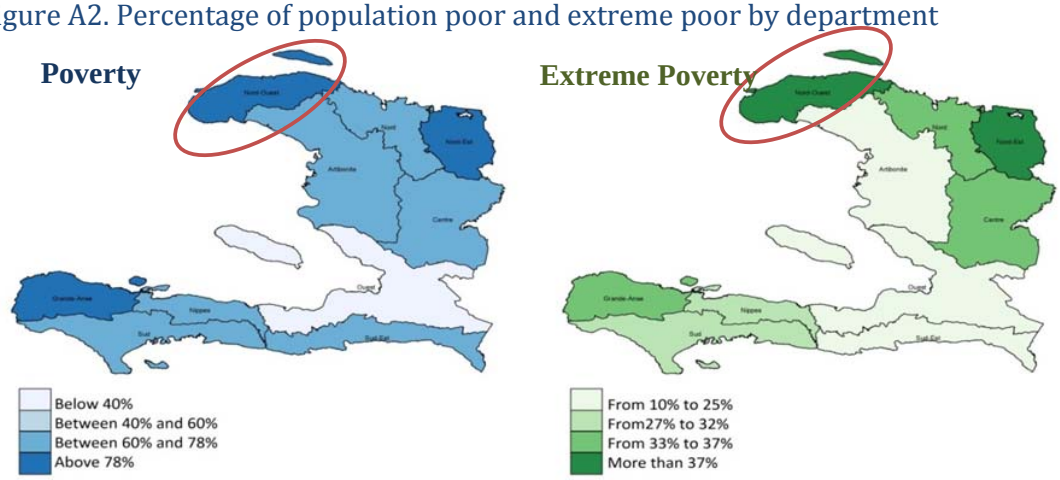


Table A1. Population and poverty rate in North-West department

Location	Poverty headcount (%)	Total population	Total poor	Population share, %	Share of poor, %
Urban	65	189,278	122,305	25	20
Rural	87	574,227	502,319	75	80
Total	82	763,505	624,624	100	100

Source: ECVMAS 2012; World Bank calculations.

The North-West Department is home to 763,505 people, of whom 75% live in rural areas and 82% are classified as poor (table A1). The region is served by an EDH isolated grid with some 3,500 active customers—covering less than 3% of the department's total population (assuming average household size of five). Port-de-Paix city itself has some 200,000 habitants and is experiencing rapid urbanization, putting even more demand on the EDH grid.

The grid is served by a diesel plant of about 2.2 MW available capacity, but the service is often affected by unavailability of fuel, due to the region's isolation and poor transportation, especially during the rainy season. Consequently, power is typically available only 5–12 hours a day. As remoteness makes an interconnection with the main grid infeasible, the only option for increasing access is by expanding the grid reach, which requires additional generation capacity, rehabilitation of the existing distribution infrastructure, and investment in new connections, including new meters for all customers to improve collections. In the past, the Port-de-Paix grid had a 300 kW wind generator to complement the diesel plant operated by EDH (figure A3), but due to lack of sustainable O&M, this plant has not been in operation since 1991 and is now beyond repair.

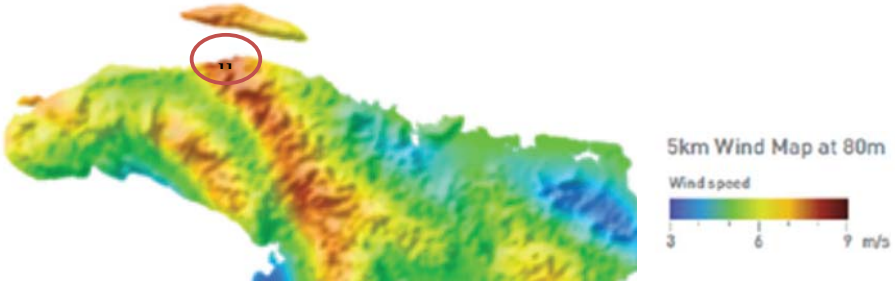
Figure A3. Port-de-Paix and its nonoperational wind plant

Photo credit: Winenergy, Haiti

Photo credit: Winenergy, Haiti

Available renewable resource assessments indicate solar wind potential (wind speed 6–9 m/s based on existing data, to be confirmed by studies during component preparation—figure A4). Hence there is good potential to hybridize the diesel plant to provide a higher service tier (per the SE4ALL Multi-tier Framework) to existing customers and to expand the grid to new customers.

Figure A4. Wind resource map of North-West department



Source: Worldwatch Institute (2014).

Objective

The objective of the component would be to demonstrate improvements and expansion in energy access in the Port-de-Paix isolated grid through its hybridization with RE. This component would serve as a demonstration project for other isolated grids that, due to their isolation, cannot be connected to the main grid.

Approach

The component will invest in RE to hybridize existing Port-de-Paix diesel generation with 1-2 MW renewable power (SREP funds), and will rehabilitate and expand the grid to allow more customers to connect (IDA funds). Detailed resource assessments will be carried out to confirm solar and wind capacity. If wind capacity is confirmed above 6m/s, it is recommended to invest in a solar/wind hybrid plant. Alternatively, if it is below 6m/s, only solar power and batteries appear a more economic option. The existing diesel plant and grid also need to be rehabilitated to allow for efficient integration of the solar/wind energy.

The added generation capacity will upgrade the current intermittent service level to a reliable 24/7 supply and expand the number of customers from the current 3,600 active customers to 18,000.

Learning from the earlier wind project at Port-de-Paix, special attention must to be given to ensure sustainable O&M. The component will therefore be developed with participation of the private sector. At a minimum, that sector will be contracted for the O&M, although a PPP approach would be pursued as a preferred option if feasible (to be decided on at component design stage).

The component will be linked to and conditional on EDH developing a viable plan for reducing losses in the grid. This will include installation of meters to all Port-de-Paix grid customers as part of the project.

Sub-Components

The component will have three sub-components. The cost break-down is indicative.:

1. *Technical assistance* for feasibility, environmental, social and grid capacity studies, design and implementation of the PPP structure (or O&M contract), regulatory and risk mitigation instruments, and other specific project development–related studies. Estimated costs: IDA US$2 million.

2. *Investments and risk mitigation* to reduce total investment costs and the risk to the private sector—PPP or EPC and O&M contract. Estimated costs: SREP US$4 million.

3. *EDH investments in* grid and diesel power rehabilitation, installation of meters for all households and connections of additional households. Estimated costs: IDA US$6 million.

Results

- 1-2 MW of RE connected to the Port-de-Paix isolated grid
- Upgrading the current service level of 5-12 hours of intermittent service a day to full 24/7 service (from Tier 1-2 to Tier 4-5 f the SE4ALL Multi-tier Framework)
- Increasing the number of active customers from 3,600 to 18,000
- Increased government and private sector experience and capacity to develop RE projects in Haiti

- Regulatory instruments developed for the scale-up phase
- GHG emissions reduced or avoided

Implementation arrangements

Components 1 and 2 would be managed by MTPTC through its Energy Cell, which will be in charge of implementing the project preparation studies and carrying out the competitive process for selecting the private sector operator, working closely with EDH. Component 3 would be implemented by EDH. The component would be supported by the World Bank.

Sustainability

Investments. This would be assured through the PPP approach or an O&M contract, which would provide incentives for the private sector for sustainable O&M of the plant. Securing funds for EDH investments would be a precondition for generation investments, to ensure that the added solar/wind plant will be compatible with the grid and have a sufficient customer base to absorb its generation output. Another condition would be for EDH to develop and start implementing a viable plan for improving collections. All Port-de-Paix customers will have meters installed as part of this component.

The provision of public funding for the component and the risk mitigation instrument will mitigate the risk of nonpayment by EDH by reducing the feed-in tariff to an affordable level, favorably comparing with alternative fossil fuel generation; and by providing payment guarantees to the private sector. Additional risk mitigation measures will be explored to protect Port-de-Paix from spillovers from EDH commercial difficulties elsewhere, such as revenues collected from Port-de-Paix customers could be secured for priority payment for the private sector operator of the hybrid plant, before being passed onto EDH central office.

Approach. Leveraging future investments would be carried out through parallel development of a more comprehensive regulatory framework, which would also include incentives for hybridizing and expanding EDH's remote grids, developed on the Port-de-Paix experience.

Component readiness

Component can be developed and appraised in about 15 months time.

COMPONENT BRIEF 3. OFF-GRID ELECTRICITY FOR PRODUCTIVE, SOCIAL AND HOUSEHOLD USES

Background

Photo credit: UNEP – Mark Steed

The government aims for Haiti to become an "emerging economy" by 2030. This vision includes the objective to reach universal electricity access by 2030—in line with the Sustainable Energy for All goals.

Reaching this goal will require dual electrification efforts: 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 supporting off-grid electrification efforts to those who cannot be served by EDH.

RE can play a transformative role in both, but success requires that RE markets and capacities be developed. That said, as the on-grid market is constrained by EDH's financial capacity and lack of sector/regulatory reform, Haiti's incipient RE market is developing primarily in off grid.

The market is emerging in urban and rural areas. In urban areas, several PV companies are now offering leasing services to hybridize diesel generation of commercial and industrial clients who have intentionally isolated themselves from the EDH grid due to its unreliability. Solar PV can reduce their energy costs and thus improve their competitiveness. Once the EDH technical and financial situation improves, this new installed capacity of distributed renewables can then feed into the grid, e.g. through net metering arrangements (box A1).

In parallel, several local and international companies offer solar PV lanterns to unelectrified households in rural areas, and the first pioneers have recently built (and continue to build) RE micro- and mini-grids. Furthermore, in line with the global trends, new business models are emerging for leasing small solar kits/solar home systems (SHS). (Annex IV describes examples of Haiti-grown innovative business models). SREP Haiti will leverage these innovations to bring off-grid electrification efforts from a pilot to scale-up stage (box A2).

Box A1. Urban off-grid market potential

IFC is considering supporting development of a solar PV leasing solution to medium to large industrial and commercial private players ("lessees"), the first such attempt on a large scale in Haiti. This type of projects would target users that are almost entirely operating off-grid due to grid reliability issues generally. It would not displace EDH as a source of electricity supply in the long run. Instead it would aim at reducing the cost of self-generated electricity for those off-grid customers, improving their efficiency and competitiveness. If successful, it may open the doors for solar PV leasing to a wider range of users via aggregators. It could also develop a local solar PV construction and maintenance industry.

This project is targeting those almost entirely operating off-grid out of reliability concerns, and so does not displace EDH as a source of supply. Instead it aims to reduce the cost of self-generated electricity for those off-grid customers, improving their efficiency and competitiveness.

IFC's pipeline of projects under this SREP component would be first-of-their-kind projects, deploying a business structure not yet tried in Haiti and relying on long-term financing in a high-risk market environment. The business models under those transactions would generally be tested and their robustness confirmed by targeting customers with better credit risk first, and over time moving to weaker credit customers. The use of SREP funds by those initiatives would reduce lending risk and help ensure the business models' sustainability. SREP funds are not intended to be grants, but could be deployed in the form of debt or guarantees following the principle of minimum concessionality

For EDH, this pipeline of projects would improve Haiti's business potential in the short term, while preparing off-grid segments for grid connection (for when reliable EDH supply comes on stream).

Current IFC's pipeline of off-grid projects offers a solar PV distributed generation platform, which could deliver immediate and significant benefits and leverage private sector funds. These projects would ultimately allow EDH to tap into the resulted installed capacity via net metering or other types of arrangement. In the shorter term, given poor EDH electricity supply or the focus on customers already off grid, those projects are unlikely to compete with EDH's operations or weaken its financial position.

Box A2. Electricity for rural development

World Bank's 2015 poverty assessment "Creating Opportunities for Poverty Reduction in Haiti" concludes that "continued advances in reducing both extreme and moderate poverty will require greater, more broad-based growth, but also a concerted focus on increasing the capacity of the poor and vulnerable to accumulate assets, generate income, and better protect their livelihoods from shocks. Special attention should be given to vulnerable groups such as women and children and to rural areas, which are home to over half of the population and where extreme poverty persists." The study identified rural electrification as one of the areas that can improve agricultural productivity and support nonfarm income generation—both sources for increasing income in rural areas.

Investments in rural electrification in Haiti have remained scarce in the last 30 years, resulting in an extremely low official rural electrification rate of around 5%. For most people living in rural areas, a diesel gen-set is unaffordable, and they rely on kerosene and candles for lighting, and charge their phones at commercial charging stations. In the framework of component preparation, a telephone survey of 1,400 households was conducted with Digicel, Haiti's largest cell phone provider. The 2014 Digicel/iiDevelopment energy survey among mobile phone users confirmed a fairly high level of electricity-substitutable expenditure of households with at least one mobile phone. The survey found that these households spend on average US$30 per month on electricity or electricity-substitutable expenditures such as lighting, cell phone charging, and batteries, but expenditure patterns vary strongly by household income, urban/rural context, and locations. For example, in Artibonite, some 80% spend less than US$8 a month on electricity (and its substitutes), while in Port-au-Prince, only 10% pay less than that. The energy use and expenditure data have been analyzed for each of the 10 departments, and will be made available via a publicly available GIS tool and web-based "data room."

The three basic identified options for Haiti rural off-grid areas are retrofitting and expanding the current larger remote systems (mostly EDH operated); investing in village mini-/micro-grids; and stand-alone systems (such as solar home systems). The analysis was carried out to estimate the potential market for each, as well as optimal volumes that could be targeted under each segment when considering supply-side constraints, subsidy efficiency, and optimal scale-up during and after SREP, based on a geo-spatial analysis of the unelectrified population (box table 1).

Box table 1. Off-grid electrification potential

Off-grid RE type	Theoretical max. potential of segment (population)	Short-term (SREP time-frame) potential (population)
RE retrofitting, upgrading and expansion of the larger rural remote grids (EDH or municipal)	1,500,000	45,000–150,000 (3–10%)
Small and medium-sized village grids (retrofit + greenfield):	300,000	30,000 (10%)
Individual system clients (HH, social users, and SMEs)	>5,000,000	500,000–1 million (10–20%)

There are strong grounds for the component to cover the urban and rural markets, and develop synergies between them. Both markets require competent skilled labor and financing mechanisms encouraging the banks to lend to all types of RE off-grid interventions etc., which the SREP component will explore. Ultimately, urban-oriented companies can also be motivated to serve rural markets, as mini-grid IPPs or by expanding the leasing arrangement to agri-businesses and other rural enterprises, if the right conditions are created.

Objectives

The proposed SREP component will scale up access to modern electricity services for productive, social, and household users.

Approach

The proposed component design is built on extensive consultations with stakeholders (annex III). The key information for the design of the SREP off-grid electrification component was collected during the Haiti Rural Energy Forum, held on November 24 and 25, 2014 by MTPTC, with support from the World Bank and IDB, which gathered some 200 of the key governmental, private, and nongovernmental organization (NGO) stakeholders involved in planning, financing, and providing rural energy services. Several real-time polls allowed tracking of stakeholder views. Among the findings, participants agreed on principal requirements for scaling up rural energy activities (annex III). By type of rural investments, stakeholders recommended the following order of priority (respected in the SREP): village mini- and micro-grids; individual solar PV systems; solar lanterns; and grid extension.

SREP support will be technology and business model neutral. All technologies will be eligible (mini-hydro, solar PV, biomass—as in one of the analyzed promising key SREP case examples—and wind). Solar PV, due to its site flexibility and scalability, is likely to be the most common option, at least for stand-alone users. The proposed instruments will build in flexibility to support multiple business models to incentivize private sector innovation and not to crowd out potentially viable business models by narrowing support to only a few selected "winners." However, the parallel technical assistance (TA), including South–South exchanges, will be used to support, particularly, those approaches appearing the most promising to achieve scale and impact.

The share of each technology and business model will ultimately be determined throughout the whole SREP implementation duration by private sector demand for SREP support and by implementation performance in each of the market segments supported by SREP. The component differs from the on-grid Component 1 (and also from Components 2 and 4), where the final "optimal" technology mix will be determined during each component preparation, based on the detailed analysis possible at that stage.

The pace of mini-grid development can also be affected by the regulatory risk. Regulatory risk is more significant for village grids (however, despite this risk, several providers already started pilots which are the key cases analyzed for SREP preparation) and close to zero for solar stand-alone suppliers. The technology mix mentioned above will not only be determined by private sector performance as such, but also by the velocity with which village grid regulations can be improved and clarified.

Leveraging Synergies among Co-financiers

The component will leverage existing and planned financing instruments to exploit synergies between market segments and maximize development potential. These include:

The existing *IDA-financed Haiti Rebuilding Energy Infrastructure and Access Project* (PRELEN), which has developed an approach for off-grid electrification of schools with solar PV, while improving educational outcomes by integrating innovative information technology (IT) solutions (Smart Boards) and related educational content. SREP/IDA

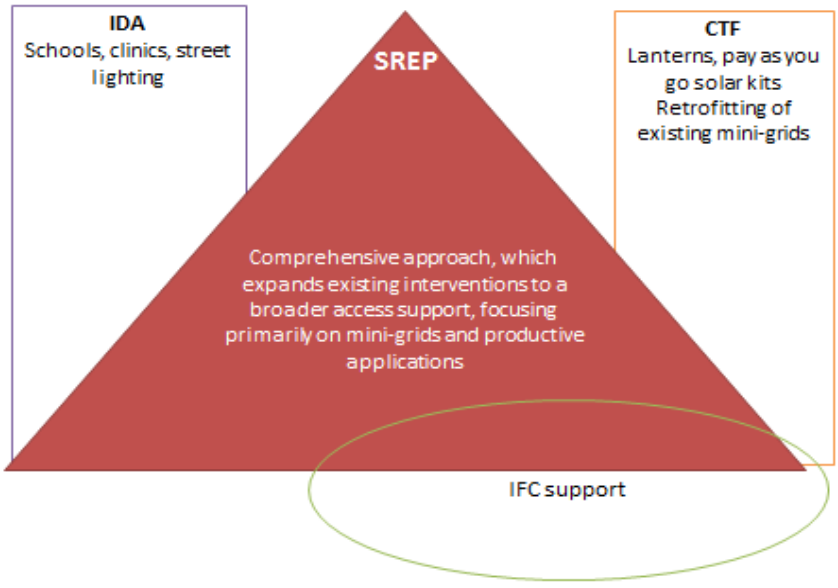
cofinancing will scale up this model and will develop similar approaches for other public services (particularly health).

The CTF-eligible Modern Energy for All Project is developing an access to finance facility to be managed by a competitively selected financial intermediary (FI) to channel capital (loan and equity) to the emerging off-grid electricity enterprises serving rural areas. The project is expected to be presented to CTF in May/June 2015 (annex V).

CTF will support commercially driven and commercially viable off-grid electrification businesses, building on the existing market for solar lanterns and promising pilots with services-oriented approaches using pay-as-you-go (PAYG) SHS and retrofitting of municipal diesel grids with renewables. Thus CTF will only be able to capture those segments of the rural off-grid markets that can be developed on commercial (or almost commercial) terms. SREP will complement CTF efforts by expanding off-grid electrification to areas requiring a greater share of public funding, including PPP for greenfield RE mini-grids.

IFC is considering various approaches to support the development of a solar PV leasing solution to medium to large industrial and commercial private entities (box A1). However, if IFC-SREP support will be technology neutral, as long s other technologies can meet the Component objectives. SREP funding will leverage larger IFC investments and even larger other private sector investments in this scheme (expected leveraging is 1:7). If successful, it could be adapted for rural off-grid enterprises, building on the initial structure and FI capacity developed by the CTF project.

Figure A5. Synergies between SREP, IDA, CTF, and IFC instruments



Sub-Components

The SREP component will have four sub-components. The cost break-down is indicative.

1. *Scaling up village systems.* Village systems refer to both RE and hybrid (renewables + diesel) mini- and micro-grids developed for rural towns and villages. The village systems may include a combination of a village grid and individual systems for more dispersed households in and around the village.

The SREP component will build on already-promising experiences with village micro-grids (including solar PV, micro-hydro, and biomass) and scale up primarily two emerging business models, suitable for different village socioeconomic characteristics: PPP between municipalities and the private sector; and rural cooperatives (annex IV).

Estimated costs: SREP US$4 million; IDA US$2 million; CTF US$4 million.

2. *Scaling-up individual renewable energy systems in rural areas.* Not all off-grid rural populations without service are mini-gridable. The demand assessment carried out for the SREP Haiti Investment Plan has estimated that the majority of off-grid households will require individual system solutions (total SREP potential of 300,000 households). In addition, SREP could reach around 1000 agri-businesses and other rural enterprises, and schools and small clinics outside rural towns that will require individual solutions—replacing or retrofitting the diesel systems or first-time electrification.

- Productive uses—SREP will provide results-based incentives for adopting RE for agribusinesses and other rural enterprises
- Social uses—SREP will finance packages for electrifying schools and clinics (based on national prioritization criteria) with results-based incentives for sustainable O&M
- Household uses—these will mainly be financed through the CTF access to finance facility. However, to support faster progression from lanterns to larger pay-as-you-go solar kits/home systems, very limited and market-friendly results-based incentives may be contemplated.

Estimated costs: SREP US$3 million; IDA US$4 million; CTF US$7 million.

3. *Scaling-up individual renewable energy systems in urban areas.* To overcome high transaction cost of financing individual RE systems and working directly with fragmented end-users, financing can be provided to private sector aggregators who are pursuing different business models. SREP funds can be used to expand financing options available to private companies selling or leasing RE systems and/or to businesses that wish to purchase the systems. For example, financing can be provided to RE distributed generation leasing vehicle serving off-grid industrial and commercial customers in Haiti. SREP funds can then be structured to support the expansion of these aggregators/FIs into RE space and provide needed protection against perceived and real risks, over time progressively growing the scope of end-users these institutions are comfortable serving. Some element of TA for capacity building of the aggregators may be sought in small amounts, associated to the above. If successful, the project could reach tens of US$ millions in scale over three-five years.. See box A1 for an example of activities that SREP will support.

4. *Technical assistance.* This subcomponent will complement broader policy, regulatory, and capacity-building activities included in Component 5 of the SREP Investment Plan, by focusing specific TA tasks directly related to implementing specific off-grid subprojects financed under the Component, including:

i) Market development activities—building a pipeline of subprojects

ii) Setting up and enforcing quality standards

iii) TA to service providers and users, including TA for energy efficient use of off-grid electricity (including the use of smart technology, dissemination of energy efficient appliances, intelligent user communication, simple demand-oriented tariff solutions in village grids, and support for productive applications

iv) verification and monitoring and evaluation (M&E), including setting up mechanisms for beneficiary feedback. Estimated costs: SREP US$1 million; IDA US$2 million; CTF US$0.5 million.

Results

The key component results are expected to include:

- At least 200,000 people provided with access to electricity
- At least 10 MWp of RE installed
- Enterprises provided with cheaper electricity or/and access to electricity
- Community facilities (schools and clinics) provided with access to electricity
- Private sector financing leveraged
- Opportunities created for female entrepreneurs and workforce
- GHG emissions reduced or avoided

Implementation arrangements

SREP Components 1 and 2 including IDA cofinancing would be managed by MTPTC, in charge of implementing the component. CTF access to finance facility cofinancing Components 1 and 2 will be channeled through a competitively selected FI. TA Component 2 will be managed by MTPTC, with some functions being delegated to the FI managing CTF's access to finance facility. A private sector support facility (Component 3) will be managed directly by IFC.

The component will target clients not served by EDH, and EDH therefore will not be involved in implementation, although it will be involved in the planning stage to avoid including areas scheduled for EDH grid connection.

The component will be supported by the World Bank (Components 1, 2, and 4) and IFC (Component 3).

Sustainability

Sustainability issues in off-grid electrification projects have usually arisen for one of the following reasons.

Inadequate tariffs in village grids

The component will support cost-recovery tariffs. To reduce the burden on rural households, however, it will provide subsidies for grid infrastructure (to remain a municipal asset to be eventually connected to the EDH grid when it arrives).

Low capacity to operate village systems

The subprojects will need to submit a business plan, including a demonstrated capacity to carry out the investments and operations before they can receive SREP or CTF support. Comprehensive technical support and advice will be provided to them.

Lack of after-sales services

After-sale services will be required for all individual systems. The component will in particular support service-oriented approaches, such as PAYG business models—which focus on providing electricity service to customers as opposed to just selling the systems.

Lack of financing for spare parts

This can be an issue for households and institutional clients. For households, this problem often occurs in heavily subsidized projects, where a solar home system is provided to a household for free or at a very low price, but the household then cannot afford to buy a new battery or other spare parts. To avoid this problem, the SREP and CTF project will focus on building the commercial market for SHS. The subsidies, if any, would be minimal and target market development. The affordability issue would be dealt with, rather than via subsidies, by supporting user-finance approaches, such as PAYG, which allow households to spread payments over time; and supporting different sizes of systems—from lanterns to SHS.

A similar problem often arises with projects supporting electrification of public institutions. To avoid it, SREP investments will be linked to long-term maintenance contracts. The component will use IT solutions to track system functioning and to detect potential problem at an early stage.

Poor technical quality of systems/components

The component will have a strong quality assurance component. For individual systems, support will be restricted to systems certified only by Lighting Global, or equivalent for larger systems. For mini-grids, the component will apply a new quality assurance framework, currently being developed by the United States Department of Energy and National Renewable Energy Laboratory with partners, and will provide support to the mini-grid operators to support quality of service. For IFC-led activities, the systems should be subject to due diligence to ensure satisfactory quality requirements and associated warranties. To the extent possible, exposure of the aggregators to some limited degree of off-take risk will ensure their alignment of interest with the donors on the equipment selected.

Component readiness

Component can be developed and appraised in about 9 months time.

COMPONENT BRIEF 4. SMALL HYDROPOWER REHABILITATION

Background

Photo credit: UNEP – Marc Steed

The main provider of electricity services in Haiti is EDH. It generates roughly 15% of the energy produced in Haiti, with the rest coming from IPPs and Tripartite Cooperation (Haiti–Venezuela–Cuba).[69] The electricity infrastructure is aging and has been poorly maintained. Installed generation capacity is about 320 MW, of which only 176 MW is available.

Most (81%) of the power is supplied through oil-based thermal generation (diesel and fuel oil), with hydropower contributing the rest (19%). The hydropower plants are owned and operated by EDH. The largest hydro plant is Péligre (54 MW but operating at half capacity), which connects to the metropolitan area through a 115 kV transmission line. The plant and the transmission line are currently undergoing rehabilitation.

Apart from Péligre, EDH operates six smaller hydro plants under 2.5 MW each, but only one is fully operational. The power output from the others is severely constrained due to the need for urgent repairs and rehabilitation (table A2).

Table A2. Small hydropower rehabilitation plan

Hydropower plant	Installed capacity (kW)*	Cost estimate (US$ million)
Délugé	1,100	3.6
Saut-Mathurine	1,600	0.6
Caracol	800	2.1
Onde-Verte	950	0.4
Gaillard	500	1
Drouet	2,500	3
Total cost estimate		**10.7**

* Largely non operational
Source: EDH, 2015.

There is a substantial potential for additional investment in new micro- and small hydropower in Haiti, with potential above 100 MW estimated by several studies[70] (table A3).

Table A3. 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 (2012).

EDH is facing huge technical and commercial challenges. Technical and nontechnical losses are at 65%—a large part of which can be accounted for by illegal grid connections. In addition, the collection rate is only at two thirds—meaning that between technical and commercial losses, EDH recovers only 22% of the value of electricity it generates. The government's approach to address this situation consists of two parallel tracks:

- *Reduce EDH losses* by targeted investments in rehabilitation of existing transmission and distribution lines (carried out with support from World Bank and IDB), and a comprehensive plan to reduce commercial losses, starting with improving collections through installation of new meters.
- *Increase availability and reduce costs of power supply*, decreasing EDH dependency on the expensive fossil-fuel generators.

Objectives

The component objective is to increase hydropower generation in EDH grids through rehabilitating existing small-hydro plants operated by EDH.

This rehabilitation is a cost-effective option for increasing RE generation capacity. It would have an important impact, especially on the smaller remote grid EDH operates, because these remote grids are now powered almost exclusively by diesel, some of them facing additional diesel supply constraints due to their remoteness and transport bottlenecks, particularly during the rainy season; and because most of the existing small hydropower plants and much of the additional micro- to small hydropower potential are close to these remote grids.

Improved power supply can facilitate access expansion. It has been estimated in this Investment Plan that at least 300,000 new connections could be achieved through expanding EDH's 11 remote grids.

Approach

EDH has identified six small hydropower plants that are candidates for rehabilitation. Implementation would result in increasing generation by about 20 GWh a year.

In addition, the component would attempt to develop at least one or two new mini- to small hydropower plants, based on identified potential (see Table A4).

The component would also develop and pilot different PPP arrangements for the rehabilitation/new investments and O&M, depending on particular conditions of each hydropower plant and the grid it operates on. Some plants may continue being operated by EDH, while for others an O&M contract or a full concession could be explored.

Sub-Components

The SREP component will have the following sub-components:

1. *Investment studies and other technical assistance,* including detailed feasibility studies, design of PPP arrangements, procurement and contracting, supervision of works, development of arrangements for sustainable O&M, etc. Estimated costs: US$3 million.

2. *Rehabilitation/construction.* Estimated costs: US$15 million.

Results

- Increased hydropower generation (kWh)
- Arrangements for sustainable O&M
- GHG emissions reduced or avoided

Implementation and sustainability arrangements

The component will be implemented by EDH—the owner and the operator of small hydro plants, with support from the MTPTC's Energy Cell. However, given EDH's maintenance deficiency in the past, the component will focus closely on ensuring that credible arrangements are in place to ensure future maintenance of the rehabilitated facilities, such as setting up a maintenance fund with obligatory EDH contributions, outsourcing O&M to the private sector, or concessioning the hydro plants to the private sector.

The component can also be developed in phases, thus EDH has identified three priority investments: Drouet: (2.5 MW resulting total)—for which funds have already been mobilized from IDA, followed by Gaillard (0.5 MW), and Caracol (0.8 MW), at an estimated total cost of US$6 million.

Component readiness

Component can be developed and appraised in about 18 months time.

COMPONENT BRIEF 5. BUILDING ENABLING FRAMEWORK, CAPACITIES AND SKILLS FOR RENEWABLE ENERGY SCALE-UP

Background

Photo credit: UNEP – Marc Steed

RE in Haiti is still in its nascent stage and faces high barriers to development. Further, constraints to RE investments are similar across all RE types. All RE investments suffer from the lack of a transparent and consistent regulatory framework, must deal with fiscal policies that favor fossil fuels, and must overcome capacity and skill constraints at professional and technical levels throughout the supply chain.

RE scale-up requires comprehensive, systematic, and consistent efforts to eliminate these barriers at national level for all types of RE investments.

Throughout the consultation processes (annex III), RE stakeholders (government, private sector, civil society, and academia), identified the main barriers for scale-up, of which regulatory and capacity issues were highlighted as a priority for SREP. Sectorwide—specifically SREP-wide—M&E is another crosscutting issue that will be included in this component.

Regulatory issues

Despite favorable RE resource endowments and a strong interest from the private sector as manifested in its studying RE projects (particularly wind and solar), there has been no private investment yet in grid-connected renewables and no PPA signed.

From the private sector perspective, EDH's financial situation poses significant risks, even if the PPA can be backed by government guarantee. In addition, there is no regulatory framework for RE—no feed-in tariff or similar certainty on tariff level, no standard PPA, no regulatory agency—providing regulatory protection to investors. Consequently, all contracts and regulatory issues are dealt with case by case, reducing certainty for project developers. Stakeholder participants agreed that improving the financial performance of EDH and developing a regulatory framework and risk mitigation instruments should be a high priority.

Similarly for off-grid renewables, regulatory issues were highlighted as the main bottleneck to investments in the sector. In particular, the legal and regulatory framework for mini- and micro-grids lacks transparency and discourages private financing. For example, the Organic Law of Electricity provides EDH with a monopoly for purchase, transmission, and distribution of power on all Haitian territory. However, the 2006 Law on Decentralization allows municipal governments to produce, distribute, and commercialize energy, as well as manage energy infrastructure, at municipal level. In addition, cooperatives also seem to be permitted to self-supply to their members. More so, the Law on Economic Free Zones provides the possibility for a third party to sell electricity in the free zone without having to acquire a concession.

The relationships and hierarchy among these different laws are unclear and affects, in particular, potential mini-grid investors who are reluctant to invest in stranded assets that could be expropriated or lose value. In addition, 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 is no provision of what would happen to the assets if the EDH grid arrives in the village. Consultations stressed the need for an institutional set-up with clear roles and responsibilities for rural energy (accountability) and a clearly spelled out National Electrification Strategy.

Both grid-connected and off-grid renewables are held back by a discriminating fiscal policy, which favors fossil fuels over RE. While diesel fuel and kerosene enjoy explicit and implicit tax incentives, RE equipment are subject to import duties and value-added tax (VAT). Cumulatively, various duties and taxes can amount to over 30% of the product value. This impacts negatively on the relative competitiveness of renewables vis-à-vis fossil fuels, and in case of off-grid renewables imposes an additional burden on the poor. For example, solar lanterns are typically classified at customs as flash lights (torches), with an even higher duty category than solar panels. Consequently, poor rural households wanting to switch from polluting and hazardous kerosene lamps to solar lanterns have to pay a premium of 30-40% for import duties and taxes. This has been a frequently cited barrier in all consultations, with government, private sector, and civil society stakeholders all agreeing that the government should level the playing field between renewables and fossil fuels.

Capacity issues

Despite some improvements in the last 10 years, formal education rates in Haiti are among the lowest in the Western Hemisphere. Haiti's literacy rate of about 53% (55% for males and 51% for females) is below the 90% average literacy rate for Latin American and Caribbean countries. The country faces shortages in educational supplies and qualified teachers. The rural population is less educated than the urban. The 2010 earthquake in Haiti exacerbated matters by destroying infrastructure and displacing 50-90% of the students (depending on locale). The educational sector is under the responsibility of the Ministry of National Education and Vocational Training (Ministère de l'Éducation Nationale et de la Formation Professionnelle; MENFP). The ministry provides limited funds to support public education and hence is constrained in its ability to improve the quality of education. The private sector has become a substitute for government public investment in education, as opposed to a complement.

Higher education is provided by the universities and other public and private institutions. The university system is composed of four or five private institutions in addition to the State University of Haiti. All higher education institutions are in the capital city. They offer five-year degrees in various disciplines, including engineering. Very recently, basic short-term skills development was developed. The State University of Haiti also intends to launch a two-year course on RE from 2016. There are also some 200 schools that offer training for electricians. Nevertheless, a graduate program and a program of short cycle or of technical training on RE are not offered.

The lack of skills is also an issue at professional level—engineers and other specialists with RE orientations are scarce. Private enterprises in the RE sector widely recognize the shortage of skilled workers and experts. The stakeholder consultations under SREP (annex III) revealed that this major barrier is also recognized by government agencies, multilateral institutions, NGOs, and academia.

Objectives

The objective of the component is to start building an enabling regulatory framework, capacities, and skills for supporting grid-connected and off-grid RE scale-up.

Approach

Regulation. The component will focus on development and testing of regulatory and risk mitigation instruments that initially can serve SREP Components 1 to 4, but eventually can be developed into a regulatory framework, with standard instruments that the government adopts and applies for future RE investments post SREP. The focus will be on learning by doing—developing instruments, testing them, and adapting them to support future scale-up.

The key issues to be addressed are:

- Development of a an overall regulatory structure for the sector, including support for setting up a regulatory agency
- Fiscal policy adjustments to level the playing field for RE and fossil fuels
- Specific instruments for grid-connected renewables, such as feed-in tariffs and PPAs, and design of risk mitigation instruments
- Specific instruments for off-grid renewables, especially mini-grids, rules, tariffs, service quality standards, and what happens if the grid arrives, etc.

Capacity/skills. The approach will be to support nationwide building of capacities for RE deployment at all levels of the supply chain, both academic training at universities and vocational training for technicians. The focus will again be on learning by doing (including involving universities in implementing some SREP investments, such as Port-de-Paix wind/solar plant or rural mini-grids).

The following priority areas have been identified as potential actions, which will be further elaborated during component design:

- Support the creation of a pool of skilled technicians in rural areas. Private enterprises repeatedly raise the shortage of skilled technicians for installation and O&M of renewable and decentralized energy systems. SREP will support ongoing initiatives that offer potential for replication.
- Support development and actualization of certified technical training and professional courses specializing in RE in Haiti. Develop an inventory of programs, courses, and curricula, as well as certification. The courses and training should ideally cover social, environmental, and gender aspects, as well as standards and norms for RE projects. SREP's interventions might complement and build on the activities implemented under the Renewable Energy Education Network (RENET).
- Establish a coordination platform for engaging the private sector in curricular development and facilitate matchmaking of internships, apprenticeships, and placement of graduates. The coordination platform would: incentivize regular exchanges between MENFP, the utility EDH, MTPTC, Institut National de la Formation Professionnelle (INFP), the future Haitian Renewable Energy Industry Association and all the relevant institutions to ensure a complementarity of efforts; and engage the private sector to ensure that the curricula are adequate and appropriate to the skills requirements of the private sector. Further, at the crossroads between the private sector and academia, the coordination platform would also support the matchmaking of internships and apprenticeships for students and for placement of graduates at RE companies.

- Develop lessons learned and experience sharing, as well as multicountry or regional efforts and South–South knowledge exchanges for fast diffusion of emerging lessons on, for instance, PAYG and similar innovative business models (such as those in Tanzania, Kenya, Uganda and Bangladesh); as well as on how to approach the education sector as a whole (especially with Burkina Faso and Mali), including documentation and experience-sharing on gender-sensitive RE project design.
- Design a widespread consumer-awareness campaign of the benefits and future potential of RE in Haiti, including outreach to women as energy users and potential entrepreneurs

On approval, and in the context of the coordination platform, the implementing agencies will develop sequenced, capacity-building activities.

Implementation will be closely linked to implementation of the four investment components, which will provide a real-life RE market development laboratory for testing and fine-tuning the regulatory instruments and for learning by, for example, involving universities in running some RE investments. Capacity-building will include a gender dimension. It is expected that the effect of this component on removing information asymmetries and other market inefficiencies will help "lift" several RE market segments to a new, more efficient level, which would bring down the risk-adjusted financing costs of new RE projects.[71]

The component will have the following subcomponents:

1. Improving legal, regulatory and fiscal frameworks

2. Comprehensive capacity and skill-building program

3. Building M&E tools for SREP program and sectorwide monitoring

Estimated costs: SREP US$1 million; IDA US$2.5 million; CTF US$0.5 million.

Results

The key results would include:

- Enabling regulatory frameworks for both grid-connected and off-grid renewables
- Increased hands-on experience and capacity of university graduates specializing in RE
- A pool of technicians in rural areas
- Comprehensive M&E of SREP activities, including application of the SE4ALL Multi-tier Framework

Implementation arrangements

The component will be implemented by the MTPTC Energy Cell with the members of the SREP Task Force and the Coordination Platform that will be developed for this component, including universities with RE programs, such as the State University of Haiti and Quisqueya University, and the Gender and Energy Interagency Commission. The component will be supported by the World Bank.

Component readiness

Component can be developed and appraised in about 6 months time.

Annex II

Assessment of Country's Absorptive Capacity

ANNEX II. ASSESSMENT OF COUNTRY'S ABSORPTIVE CAPACITY

MACROECONOMIC AND FISCAL SITUATION

Over the last 10 years, Haiti managed to keep a relative macroeconomic and fiscal stability, despite the disruptions caused by the 2010 earthquake, the 2008 hurricanes and the tense political context. GDP growth rate in 2007-14 averaged 2.2 percent per year. With population growth rate of around 1.3 percent, this implied positive, if low, growth in income per capita.

The January 12, 2010 earthquake caused unprecedented loss of life and destruction of physical capital. Before the earthquake, the political and security situation had been gradually improving and foreign investors' interest in some areas (including tourism and textile manufacturing) had begun to materialize. After the earthquake, total donor pledges of aid for 2010-12 amounted to US$8.1 billion (37 percent of 2010-12 GDP), of which US$1.2 billion (18 percent of 2009 GDP) corresponded to debt relief, which significantly reduced Haiti's external indebtedness.

Haiti's twin fiscal and current account deficits both remained below 3 percent of GDP for most of the time but the deficit unexpectedly increased to 7.1 and 6.3 percent of GDP in FY2013 and FY2014, respectively. This deficit overshoot mainly reflected transfers to the public electricity company (EDH), which amounted to about 1.5 percent of GDP in FY2013 and the fuel retail price freeze that had a fiscal cost of almost 2 percent point of GDP. The counterpart of the rising fiscal deficit was a rising external current account deficit, which was largely financed by concessional flows from Venezuela (Petrocaribe program).

Haiti benefitted from significant debt relief during 2009-11, with external debt declining from 29 percent of GDP in 2008 to 9 percent in 2011. Debt has since rebounded to an estimated 23 percent of GDP in 2014 reflecting larger-than-expected Petrocaribe borrowing, which currently accounts for 84 percent of total external debt. Debt sustainability may be a challenge given Haiti's narrow export base and low government revenue. In addition, Haiti is vulnerable due to its dependence on Petrocaribe financing from Venezuela. A sudden stop in Petrocaribe financing may cause a severe fiscal and balance-of-payments adjustment, compromising public investment and growth.[67]

A tighter monetary stance is constraining credit to the private sector. A wider current account deficit is putting pressure on Haiti's currency. The BRH, the central bank, responded to these downward pressures in the foreign exchange market by increasing legal reserve requirements and raising the policy rate (the 90-day bond rate). This tighter monetary stance reduced excess reserves and bank lending growth slowed. Any further credit growth would be tightly linked to expansions of the deposit base and concerns are rising that private sector credit may be crowded out.[68]

GOVERNMENT'S ABSORPTION CAPACITY IN THE ELECTRICITY SECTOR

Post-2010 earthquake, the development assistance has been channeled primarily in the form of grants. More recently, concessional loans are also contemplated. For example, Government has recently signed an MOU with the Chinese private company Sinohydro (signed in February 10, 2015) for the construction of a new 32 MW hydropower plant, the Artibonite 4C power plant, located on the Artibonite river between existing Peligre hydropower plant and Port-au-Prince. This project was identified in all hydropower assessments done for Haiti and would include a dam for irrigation and electricity

generation; borrowing from Chinese financial institutions is envisioned for financing of Artibonite 4C project. The main development partners supporting Haiti's electricity sector are the World Bank and IDB. Both development partners have focused primarily on the rehabilitation of key assets and on helping EDH improve its financial performance, while also beginning to build conditions for expanding energy access.

World Bank is supporting the MTPTC and EDH through a US$ 90 million IDA Rebuilding Energy Infrastructure and Access Project (PRELEN). Effective since February 2013, the objectives of the project are to (a) strengthen the Government's energy policy and planning capacity; (b) improve the sustainability and resilience of the Recipient's electricity sector and restore and expand access to reliable electricity services; and (c) provide financial assistance in case of an Energy Sector Emergency. To that end, the project is financing several components, including:

- Strengthening the institutional capacity of MTPTC and Enhancing energy sector governance and transparency,
- Improving off-grid electricity access,
- Improving EDH performance and Rehabilitating EDH grids.

IDB's main interventions in the energy sector are the 'Rehabilitation of the Electricity Distribution System in Port-au-Prince Project', a US$ 18 million grant to the GOH signed in 2008 to enhance impact on the losses reduction, and the 'Peligre Hydropower Dam Rehabilitation Project', that has been approved in 2010 with a grant of US$ 78 million grant from IDB, a US$ 13.7 million grant from KfW and a US$ 15 million in concessional financing from OFID, OPEC's international development fund. This rehabilitation project was decided before the 2010 earthquake, and the upgrade of the hydropower plant from 35 to 54 MW had the objective to provide more clean and cheap electricity in the metropolitan area. Additional financing from IDB is currently envisioned to complete sustainably the rehabilitation (sediments removal, rural development around the site). In 2014, IDB also approved a US$ 23.4 million grant for the rehabilitation of the 115 kV transmission line between Peligre and Port-au-Prince. Smaller IDB technical assistance activities in Haiti's off-grid energy sector are summarized in annex VI.

These projects are coordinated on the Haitian authorities' side by a unique coordination unit, which experience and efficiency has progressively increased since the first projects in 2007. This Electricity sector Project Implementation Unit (PIU) is now composed with eight staff and consultants, experts in energy project management, procurement and fiduciary management; financed mainly by the World bank and IDB projects, this team has benefited from the institutions' training throughout the years (on Safeguards, Procurement, Monitoring and Evaluation, and Communication), and has been considered in 2014 as the best Government's team for financial reporting of donor funded projects, all sectors wide.

Nevertheless, these projects have been experiencing delays in their initial implementation, mainly due to difficulties to coordinate with EDH and MTPTC technical teams for the development of planned activities. In 2014, complementary capacity building provided by the PRELEN project has now improved both MTPTC and EDH capacity, and the implementation progress has drastically accelerated in 2015.

Additional development partner activities are described in annex VI, but most of them are not channeled through the Government.

As discussed above, one of the key challenge for the Government's fiscal sustainability are related to the large losses of EDH which are covered from the Government budget (about US$ 200 million a year), which together with fossil fuel subsidies amount to 3-4 percent of GDP. With the implementation of EDH 2015 commercial recovery and performance action plan, deep structural transformation in the chain of command and transformation of the utility's organizational structure has been initiated; from the local commercial agencies to the EDH Board, reshuffling of staff and Directors started to take place since February 2014 and will continue this year, with the mid-term objective to improve the company's commercial revenues, accelerate the decision process for donor funded projects and hold staff and managers more responsible and accountable on implementation timelines and objectives.

Therefore, from the fiscal policy stand, Government's short and medium term priorities for the development assistance are to reduce EDH financial losses and country's dependency on fossil fuels; the Government is hence strongly convinced that increasing hydropower and promoting alternative renewable energy sources is a must in this context, and is expecting SREP investments to directly contribute to these goals.

ANNEX III
STAKEHOLDERS CONSULTATIONS

ANNEX III. STAKEHOLDERS CONSULTATIONS

The SREP Haiti Investment Plan is the product of a comprehensive participatory process involving many institutional, national, and international actors, led by the Government and primarily represented by the Minister of Public Works, Transportation, and Communication, with the support from the multilateral development banks (MDBs). The main stages of the process are as follows:

- The MTPTC appointed a SREP Task Force representing the key public stakeholder groups and established a mechanism for further consultations with the private sector, civil society and academia.
- Holding multiple technical meetings during the Scoping Mission, Joint Missions and Technical Missions with the development partners, nongovernmental organizations (NGOs), private sector and end-users (October 2014, February 2015 and March 2015);
- Holding two SREP consultative workshops with academia, civil society and private sector during the joint mission (February 2015), as well as a dedicated one-day workshop on defining the capacity needs and possible solutions (August 2014); and
- Putting the draft Investment Plan on the Ministry of Public Works, Transportation and Communication (MTPTC) website for two weeks to allow national stakeholders to review and comment on the proposed investments (March 2015).

The lists of stakeholders consulted during the joint missions are available in various Aide-Mémoire posted on the Climate Investment Funds (CIF) website www.climateinvestmentfunds.org

Private-Sector Feedback for Renewable Energy Development, November 2014 and February 2015

The SREP consultations for private sector were launched at the Haiti Rural Energy Forum, organized on November 24 and 25, 2014 by MTPTC, with support from the World Bank and IDB. The Forum gathered approximately 200 of the key governmental, private and NGO stakeholders involved in the planning, financing and provision of rural energy services. Participating energy experts commented on the unusually and remarkably high quality of stakeholder discussions during this event; and several real-time polls allowed efficient tracking of current stakeholder views. Among the findings, participants agreed on principal requirements for scaling up rural energy activities in Haiti and indicated the following priority needs:

- Establish a conducive regulatory framework and an institutional set-up with clear roles and responsibilities for off-grid energy
- Facilitate access to 'less risk-averse' and commercial finance
- Develop a National Electrification Strategy/Plan and provide other necessary 'doing business' information, and
- Support capacity building, including the creation of a pool of skilled technicians in rural areas.

In February 2015, the Government hosted a SREP consultative workshop that brought together some 60 participants from government agencies, the private sector, NGOs, academic institutions, and development partners. The government presented the

proposed investments to national stakeholders and encouraged them to provide inputs and comments. Two working sessions—for academia (11 February) and private sector/civil society (12 February)—were organized to discuss aspects of the SREP Investment Plan in more detail.

The stakeholders concurred with the priorities selected for seeking SREP support. Several private developers noted the risks of EDH's subpar technical and commercial performance, and the resulting dampening of interest to invest in renewable-energy projects bound by the power purchase agreements (PPAs) with EDH. They also raised the importance for the Government to have a clear and strong vision for the successful and systematic deployment of renewable energy technology in the country. Success of SREP Haiti is contingent on increasing investor confidence.

Private companies working in the renewable energy field who were consulted during preparation of the SREP Investment Plan offered the following suggestions:

- Specify a clear pathway for private-sector engagement in scaling up renewable energy. The private sector emphasized the necessity of a longer term strategy that outlines the role of the private sector and encouraged the Government to address this requirement in energy development plans and policies.
- For the private companies interested in entering and/or scaling up as IPPs, streamlining processes and removing bottlenecks are essential to speed up development and reduce transaction costs.
- Policy, which favors quality assured products (such as those that are 'Lighting Global' approved), is encouraged. This is a result of Haiti already having a strong market for solar lanterns with several companies competing in the market; however, they are facing difficulties as a result of an influx of cheaper low quality products and the fact that kerosene is duty free.
- Access to finance for both the ability for the companies to scale-up business models, as well as access to finance for end-users to be able to afford investing in RE technology systems.
- Training and availability of skilled technicians throughout the country is needed to address service and maintenance issues that inevitably accompany the use of renewable energy technologies, both at the level of picoPV systems up to larger grid-connected projects.
- Consumer awareness of solar/RE and its benefits highlighting the longer term economic benefits.

Many of these suggestions were also raised at project visits in the South region during the Joint Mission on 21-23 November 2014. The mission team visited the first successful private sector- and community-led micro-grids; including the first stand-alone prepaid diesel/solar hybrid micro-grid (Les Anglais) and the new, formally registered rural electric cooperative (CEAC) which will operate the single, upgraded electric distribution system of the towns of Port-a-Piment, Coteaux and Roche-a-Bateaux (for a total of 2,655 households).

Academia and Educational sector Feedback for Renewable Energy Development, August 2014 and February 2015

The consultations with academia and the educational sector were launched at the Workshop on Capacities and Professional Training in the field of Renewable Energy on August 26, 2014 in Haiti. The Workshop was organized by the World Bank, under the

auspices of the Minister Delegate to the Prime Minister in Charge of Energy Security, Ministry of Public Works, Transportation and Communications, and gathered approximately 70 stakeholders from academia and the educational sector, as well as from private sector, civil society and government entities. Additional consultations with academia were held in February 2015. Participants were informed that SREP envisages a crosscutting component on capacity-building and lessons sharing which was strongly supported. During consultations, it was confirmed that the scale-up of renewable energy in Haiti requires a new approach for capacity-building and training. Stakeholders identified the following capacity and training needs and gaps in the sector: (i) technical and management competencies (engineer and technician level), (ii) concise information about existing training programs, (iii) opportunities for graduates (internships/jobs), (iv) collaboration between education and private sector. As a result, participants identified the following potential solutions: (i) to establish an internship program for graduates, (ii) to strengthen training centers with equipment and additional specialized training for the trainers in renewable energy technology, (iii) to support universities and training centers with the development of curricula and academic programs including courses on standards/norms and environmental and social aspects, (v) support to research.

Furthermore, Workshop discussants observed that shared learning and experience-sharing were underscored as key components required for creating an enabling environment for designing and implementing the proposed renewable-energy investments. The stakeholders expressed interest in learning from others that have implemented projects in the proposed areas. They also expressed interest in learning good practices from other countries that have already begun to implement the SREP (Honduras, Tanzania, and Mali) to avoid repeating mistakes and to enhance replication of innovative ideas.

Financial-Sector Feedback for Renewable Energy Development, November 2014 and March 2015

Financial institutions providing financing options to businesses and consumers (some with experience lending for the purpose of renewable energy technologies, and some without experience but interested in the potential) consulted during preparation of the SREP Investment Plan offered the following suggestions:

- The need to generate demand for loans through a greater awareness of solar/RE and its benefits. The more people that know about the benefits of RE, and the increase in demand such awareness will generate, is essential for financing institutes to see a value in incorporating lending schemes aimed at RE companies.
- Staff will require specific RE technology training to be able to originate, price and market RE loans appropriately.
- Additional capital requirements to support RE loan offers.
- Partial risk guarantee fund will enable the financing institutes to lend more generously to start up RE companies, which currently most MFIs only lend to well-established companies.
- Adequate aftersales service critical to reduce default rate when products fail.

End-user Beneficiaries Feedback for Renewable Energy Development, February 2015

Potential end-user beneficiaries' consultations of SREP interventions were launched during the Investment Plan preparation phase. Consultations were held in order to receive perceptions and views on the country's renewable-energy development, its economic and social impacts, as well as the current energy supply situation of the population.

A mission team, comprised of Government and World Bank staff, travelled to several places in the Central Department and Artibonite Department where they consulted with groups of potential end-user beneficiaries of SREP interventions. The communities visited were a mix of grid-connected, completely isolated and those having electricity through RE technologies.

The beneficiaries consulted represented (i) regional leaders with an awareness of the local energy matters, (ii) groups—consisting of men and women between 20 and 60 years, (iii) individuals, (iv) business owners, and (v) youth. The mission took place from February 25 to 27, 2015. Below are the main outcomes from the mission as well as exemplary voices from the consultations.

Main outcome

- Most of the urban areas have access to the grid, and there are some planned extensions. But access to electricity is still very minimal, as electricity is provided only a few hours at night (if that)
- Even the urban areas can benefit from hybrid system to address the unmet electricity demands due to the inefficiency of the actual grid
- There is potential to supplement the existing grid with hybrid RE inter-ties
- In areas where there is no grid, RE can be interconnected to existing diesel gen-set systems to established independent mini-grids/SHS
- There appears to be potentials for micro hydro energy generation
- Alternative energy generation (complimenting the EDH grid where grid exists and providing access to electricity where there is no grid) is seen as very opportunistic and can be highly beneficial for an improved life in general
- Solar energy is widely known, however the full spectrum of the benefits are not fully understood
- People often are familiar with RE technology, but awareness to the extent of its benefits is lacking—a strong consumer awareness campaign is therefore strongly suggested
- The initial investment cost for SHS-type technology is too expensive, which limits potential RE access indicating a need to develop user finance modalities, such as microfinance or PAYG.

Voices and specific beneficiary feedback

Regional Leader for energy matters of populations in the Central Department (based in Hinche):

> "(…) This Department has 112 municipalities, nine of them have access to electricity throughout the grid. About the other ones, Savanet and Cerca La Source don't have any electricity; but Belladere has a grid build by EDH but electricity is flowing thanks to a generator from time to time. The municipalities that have electricity from the grid only have few hours at night, and sometimes, just some of them. Electricity is rare during the day, which is slowing development in this area and disturbs office's affairs. In the urban areas and in some other remote places around, they are aware of RE that can be used to generate electricity, such as solar and hydro. Some private homes, few clinics and schools use solar energy. There are several micro-credit organizations there where people could reach out to for credit in order to buy their own solar home system - if ever the demand is expanding. The three main ones are Fonkoze, ACME, and COOPECLAS. (…)"

> "(…) About the benefits, people see that type of technology is necessary even when EDH's grid is available as electricity is not available 24/7. Also durability and sustainability is expected, which can lower operational costs and help develop other services and businesses such as communication (computer science and services through internet), cooling system for drinks, restaurants, entertainment, etc. Population in the city of Hinche thinks that energy is their main priority at the moment.. (…)"

Group meeting with a dozen persons, between 20-60 years, at Bassin Zim, Hinche. This small town has at least 300 people and started benefiting from EDH grid. There are some meters installed. And electricity is provided during the day, not at night.

> "(…) They were very positive about solar source of electricity which they were well aware that is much more reliable than the actual EDH grid. They think that such energy would help

them develop other businesses in the area such as bars for tourists and also that such a system will keep the tourists longer into the night, as currently, some use their car's light to brighten the place after dark. They think that such system will have very positive social impacts especially for their kids—as they will be able to study at night and enhance entertainment. (…)"

Additional beneficiaries were visited in the Central Department, including (i) a business owner operating a club, bar, concessionary and lottery and, (ii) a family of six people operating a grain-packing business.

(i) "(…) Electricity is critical for his business. He is connected to the grid but the day before EDH took the breaker so for the moment he didn't have electricity. The business is mostly open days and nights as the owner has different types of business operating into just one place. First, the lottery needs electricity because the lottery system is used through an iPad that needs to b recharged. Second, the nightclub needs electricity for music, lights, and other kind of entertainment during the day such as movie projection, or soccer game projection (so people pay at the entrance also). And the third one is a store where people buy cool drinks. Without electricity he can't run any business. Because of irregularities of the grid, he had to buy his own generator and for one night can spend 400 gourdes on gas. He is in favor of solar system but is having some concerns. One of them is the investment of such a system and the other one is about his management and maintenance. Another of his concern was that if ever the people will pay for such a system as they are close to the grid, and suggest that we make a real campaign so they will know the true benefits of renewable energy.(…)"

(ii) "(…) There is no grid at all. Not even solar street lights. As for the needs of this area, first thing that came out was electricity. They think that electricity, especially solar, will help develop economical activities related to agriculture or else, like welding, where people in the area wouldn't have to go miles away into the city to get those services (for example, getting a bed fixed, or a cook stove). Electricity will also help with the trade of some tomato and lettuce culture, etc. (…)"

Other beneficiaries' voices in La Chapelle (Artibonite Department) included two businessmen (one business center and one hardware store) and four young men who are running an entertainment (DJ) and charging business with PV system. La Chapelle is where a pilot solar home system project was implemented, but stopped since December 2014 when the grid arrived.

"(…) Even when the grid arrived, they expressed the need of having a back-up system that will allow their business to run all day long. Some are still using their own gen-sets and share the costs and electricity with neighbors in order to be able to work during the day. Some businesses even sell solar panels and batteries. By driving around, we could realize that many small businesses such as lottery, cooler, and others have at least one panel connected to their system and being used during the day. Even small houses with "plastic roof" have solar panel. We also ran into solar lanterns and we have been told that there are some stores that also sell those. Concerns were that solar systems require much more investments and capacity. (…)"

Two businessmen (one restaurant and one tailor) were consulted in Marchand Dessalines (Artibonite Department). The town does have an existing grid, but electricity is available only at night.

"(…) The grid is there. In La Chapelle, people using the grid are the ones being by the main road. So even within the urban places, some houses or offices don't have access to that grid.

We have seen some meters from time to time but not in every house. People never stop complaining about EDH poor quality service. They are aware of Solar systems and are really open to it. (…)"

A discussion was held with a group of 20 men from different ages in Saint Michel de l'Attalaye (Artibonite Department), a grid connected town.

"(…) The residents don't really have access to electricity. In the urban area, electricity is provided sometimes at night, which hinders proper functioning of businesses. In one rural area that we drove by, electricity was only provided each January 25th to celebrate the city's anniversary, through a diesel gen-set that still exists but not used because the closest gas station is miles away, causing the fuel to be really expensive. They were paying a 100 gourdes fee for electricity. They are aware of other sources that can generate electricity and mentioned both hydro and solar. The people were really open to having more electricity through solar mostly. They express that with access to electricity many other small or big business opportunities could be developed. (…)"

Comments Received on the Draft Investment Plan Posted on MTPTC Website

In order to facilitate review by national stakeholders, the Investment Plan was made available on the MTPTC website from March 30 to April 10, 2015. Comments can be summarized as follows:

Table A4. Haiti SREP Investment Plan: Matrix of comments and answers

Comments received from peer reviewers: Gerard Boulos (Home Control President—company); Andrew Morton (UNEP-Haiti Sustainable Energy Manager); and Allison Archambault (EarthSpark)

General	
Thank you for the opportunities to review this document. I will make an effort to be sincere and direct. I believed the final 5 SREP projects are legitimate and urgent, the objective are clear and well defined. (GB)	Thank you.
We note that components 1 to 4 all entail significant risk. The experience of UNEP in energy in Haiti is that diversification into at least 3 fully disconnected components are needed to reduce risk at the portfolio scale (as some components will partially or fully fail, but it is impossible to accurately predict which component at project design stage). In balance, investment into more than 4 components can spread the investment too thinly for impact. In this case we suggest a total of 4 components and deleting component 2. (AM)	The final version of the proposal SREP funds will not going to finance component 4 (small hydro), but coming from external funds.
Based on EarthSpark's experience, "learning by doing" is exactly what is needed to unlock the models that will be able to scale. (AA)	We agree and this is the key aspect of the proposed IP.
RE for the Port-au-Prince metropolitan area	
The proposed RE investments for components 1. and 2. need to manage the technical and financial aspects of intermittent RE injection into a grid with limited and unpredictable operating hours and frequent blackouts and restarts. Feed in tariffs and take or pay arrangements are designed for functional grids, which is not the case for the PauP and PaPaix grids. Hence both technical and financial protection mechanisms need to be built into the designs and contracts. (AM)	Agreed and noted. The design of any associated tariffs will be done so in a functional way.
RE for the Port-de-Paix remote grid	
As mentioned in the study, Port-de-Paix could be a model for future scale up for energy project in Haiti, therefore it is imperative that it is conceived and designed accordingly. - This project should benefit from the latest conceptional and technological innovation of the energy landscape such as Distributed Generation, Energy Storage, configuration such as microgrid and technology like smart inverter for better frequency and voltage regulation, smart metering for bi directional and time of used pricing, Advance SCADA for supervisory and control, Demand Response for energy management. (GB)	Thanks for the ideas. We agree technology choice is critical and your suggestions will be worth exploring at the time of implementation.
The proposed RE investments on all scales will only deliver energy access benefits if linked to a functional distribution system including metering.	This is detailed in the IP annex. The investments will include rehabilitation of the existing network (reduction of technical losses) and measures to increase collection (e.g. installation of meters for all customers).

This is not the case for the PauP and PaPaix grids. Mitigation measures for this are mentioned for component 1 but not component 2. (AM) Unit costs [for comprehensive investment in both distribution and organizational capacity building] is expected to be below US$1500 per household. This analysis infers that a proposed investment of up to US$4M for RE into Port a Paix will be simply too small to have a transformative impact. The budget needs to include allocations for RE, thermal, distribution, metering and organizational development. A more appropriate project budget would be in the order of US$20M+. (AM) The lesson learnt is that investments in infrastructure which are left in the care of EDH regional centres are partly wasted and will not last. Hence we would recommend that any major investment in the Port au Paix grid is accompanied by outsourcing operation of the grid as well, via a PPP. (AM)	The Port-de-Paix project will be co-financed by IDA. The total project budget is estimated by SREP studies at $14M but IDA financing can be increased if the final project design arrives at higher costs. A PPP will be explored as detailed in the IP annex.
Off-grid electricity component	
Productive Uses of Energy: In addition to C+I, minigrids also unlock productive uses of electricity for cottage industries and SMEs. (AA)	We agree and this is one of the reasons why the Component 3 puts a great weight on development of mini-grids.
Rehabilitation of existing small hydro plants	
We also suggest that Saut Mathurine is included as a priority SSH site for rehabilitation. At present it generates less than 50% of its potential and has several maintenance-rehabilitation priorities that if not addressed could see it cease operations during the SRPE project. SM is a good case for analysis of the pinch points for RE injection—the Les Cayes switchyard is completely dysfunctional, which limits the potential for SM to inject energy. (AM)	Thank you for the idea. As the project design advances, this option can be considered.
Building enabling environments for RE scale-up	
Based on EarthSpark experience, "information and capacity constraints" are indeed significant. (AA)	We agree and that is why we have included a significant capacity building component in the program.
M&E	
We applaud the use of the multi-tier framework. (AA)	Thank you
Key risks	
Being in the sector for more than 40 years, I am pessimistic regarding government commitment to integrate renewable energy to the grid. (GB)	We are fully aware of the limitations and complications currently existing within the Government/EDH that have since hindered the incorporation of RE into the grid. As a result, the SREP program will work closely with the Government through the Energy Cell to address such barriers (which has not yet been done in the history of Haiti) encouraging RE integration. We understand it is not a fix that will happen overnight, but the Government is committed to make this change happen.

Annex IV
Renewable Energy Business Models in Haiti

ANNEX IV. RENEWABLE ENERGY BUSINESS MODELS IN HAITI

The 12 renewable energy (RE) market segments targeted by SREP Haiti and their related generic business models have been described in the sections above. These are based in large part on real business case studies we have analyzed in Haiti. Some of these are described below (see annex V for the CTF).

HAITI BUSINESS CASE EXAMPLE 1—EMERGING PARTNERSHIP BETWEEN THE MFI FONKOZE AND THE LANTERN DISTRIBUTOR MICAMASOLEY

Fonkoze is Haiti's largest microfinance institution, offering a full range of financial and development services to Haiti's rural poor. Since 2004, it has worked to provide tens of thousands of Haitian women with a comprehensive approach to poverty alleviation. One such enabling partnership is with MicamaSoley. Created in 2009 as a social division of SAFICO, a longstanding Haitian trading and manufacturing company, MicamaSoley supports products that improve the lives of rural Haitians. In a joint effort, Fonkoze and MicamaSoley empower woman to have access to solar-powered lights.

How it works: Fokonze has 60,000 credit customers who are affiliated within 2,000 credit centers throughout rural Haiti. At each center an elected chief manages operations. MicamaSoley visits the branches of Fonkoze and sells the solar lanterns wholesale to the chiefs. The chiefs then sell the lanterns retail to members of their credit centers under either a women's group-lending scheme or as an individual credit line. Under this burgeoning partnership, Fonkoze makes a 6% commission on sales; women—via access to microfinance options—improve rural livelihoods; and through this channel MicamaSoley has sold over 47,000 lanterns to date.

HAITI BUSINESS CASE EXAMPLE 2—RE-VOLT SERVICE APPROACH WITH INDIVIDUAL PV SYSTEMS

Re-Volt, an innovative start-up off-grid utility, aims to provide a highly efficient direct current (DC), pay-as-you-go, solar-powered energy service to Haiti's residents at affordable prices. Re-Volt was conceived in 2012 and the first two years were spent refining the concept and visiting successful international programs of similar intent (OMC in India, Off-Grid Electric, M-Kopa, M-Power, and d.Light Design in East Africa). In 2014 Re-Volt began piloting the program in Haiti.

Re-Volt has a memorandum of understanding with Digicel, the main telecommunications provider in Haiti, to integrate with its TchoTcho mobile payments system and use its Machine-to-Machine (M2M) SIM cards in the Re-Volt Systems to allow monitoring of the performance of the units and to track the amount of energy credit purchased and used.

Re-Volt distinguishes itself from common solar home system businesses by providing a service rather than a "box"—Re-Volt customers are guaranteed 98% availability of their systems, have access to a 24/7 call center, will benefit from promotions and upgrades, and will get access to highly efficient DC-powered appliances and devices.

The initial Re-Volt product is a solar-powered, "DC Energy System" that features three LED light fixtures and a charging plug for mobile phones and other small device. Larger systems will be added after the pilot stage. Re-Volt is also exploring local assembly of the products after the initial pilot stage. Post-installation customers will receive a lifetime "utility like" service from DC Energy Systems.

How it works: Customer sign up to the service at one of many Re-Volt Power Agent locations or are approached door to door by Re-Volt agents. Re-Volt will charge a small deposit or "connection fee" which includes installation of the system and basic training on how to use it efficiently. The cost is US$10.

Once the system is installed at home, customers can top up the credit on their Re-Volt in a similar fashion to buying prepaid credit on a mobile phone.

Re-Volt as a company expects to grow strongly between 2014 and 2018. Based on its initial estimates, the company sees potential for up to 500,000 units to be installed during the first five years of operation in Haiti (a roughly 20% market share on a per household basis). By year five, Re-Volt expects production costs to decrease and revenue per user per month to increase as additional services are launched, such as Internet/communications, entertainment, refrigeration, and a range of other DC appliances.

HAITI BUSINESS CASE EXAMPLE 3—OFF-GRID ELECTRIFICATION FOR IMPROVED PUBLIC SERVICES

The IDA-financed Rebuilding Energy Infrastructure and Access Project (PRELEN) (2012) is expanding an innovative pilot for using off-grid renewable energy for improving education outcomes, currently carried out by an NGO Haiti Futur. The World Bank team visited a school in the Southern Province of rural Haiti in November 2014. The school is equipped with a Smart Board, solar panels and a battery bank funded by the NGO Haiti Futur. The Smart Board is an interactive white board that functions as a computer screen providing digital contents to pupils in rural schools. The digital contents are in French, soon to be translated into Creole, and are aligned with the requirements of the Ministry of Education.

All courses are available online, free of charge (open source). The cost of one system is estimated at US$3,000. The challenge for the smooth operation of the Smart Board connected to a projector is reliable electricity. Most of the schools (85%) in Haiti are private and typically do not have electricity. Therefore, electricity from solar energy will be essential to the success of the scale-up. Haiti Futur has trained technicians to maintain the systems and has set-up a contents team in Port-au-Prince. The contract for O&M is with the Ministry of Education.

Interviews with teachers where the systems have been installed point to two main benefits: increased interest in learning by the children; and greater confidence among teachers as a result of better access to education materials, which in effect leads to a greater variety of subjects covered.

Based on positive experiences from Haiti Futur, PRELEN is envisaging scaling this model in up to 500 schools.

HAITI BUSINESS CASE EXAMPLE 4—EARTHSPARK MICROGRID

EarthSpark, a nonprofit working as an incubator for clean energy enterprises, is leading an innovative approach to delivering sustainable energy services in off-grid Haiti.

In partnership with the government, local officials, and the United Nations Environment Programme, EarthSpark has launched an example micro-grid in the town of Les Anglais, Haiti, that provides affordable, reliable, and environmentally sensitive electricity service through EKo Pwòp—EarthSpark's micro-utility enterprise.

Launched in November 2012, the EKo Pwòp grid has been providing continuous electricity to 52 households and is now being scaled up to 430 customers—the expanded grid is being tested and expected to start full operation by May 2015 The solar/diesel hybrid micro-grid taps into the excess capacity of a mobile phone tower from Digicel, one of the largest companies in Haiti, but will be primarily solar powered after expansion to be completed in early 2015.

The EKo Pwòp mini-grid uses another innovative technology developed in house, the SparkMeter. The SparkMeter micro-grid metering system enables utilities to have prepayment as well as real-time monitoring and control on micro-grids and central grids alike. The low-cost system consists of four hardware components, a cloud-based operator interface, and a mobile money or cash-based prepayment system. Data collected over the local wireless network is uploaded over the cellular network to SparkMeter's servers. Micro-grid operators can then access and monitor customer usage and system status information over SparkMeter's secure cloud-based user interface. The SparkMeter micro-grid metering system also gives operators flexibility to choose and create unique billing structures to suit their application. Tariffs and service levels are infinitely customizable, and billing can be conducted on a pre- or post-paid basis for energy consumption, hourly consumption, or with flat monthly fees. Operators can also create "credit" accounts for customers to pay back fixed-cost expenses, such as connection fees or appliances, out of their tariff payments.

EarthSpark is using the SparkMeter technology as a prepay system that has enabled improved access to its micro-grid customers. Large lump-sum utility bills are problematic because they do not fit with the way that rural Haitian people can afford to pay. Prepayment allows customers to purchase electricity as they purchase kerosene—in small quantities and as they need it. This service mimics how most Haitians purchase credit for mobile phone minutes, with prepay scratch cards or direct mobile top-ups.

EarthSpark is also enabling access by supporting what it calls "deep efficiency." Deep system efficiency—encompassing end-use, grid management, and power generation—enables high-quality energy services with low generation costs. With energy efficiency at its core, the Les Anglais EKo Pwòp mini-grid can deliver high-quality service at a lower, more accessible cost to its rural clients.

HAITI BUSINESS CASE EXAMPLE 5—A RURAL COOPERATIVE

NRECA International, by designing distribution grids, constructing lines, and applying a set of standards that meet the needs of the off-grid population, has pioneered low-cost rural electrification in Haiti. To ensure long-term success, NRECA-Haiti also provides comprehensive training programs to local institutions in all aspects of utility operations and management to ensure that the employees can effectively and efficiently operate and administer a functioning and economically viable utility.

In southwestern Haiti, NRECA's Haiti Rural Electric Cooperative project has helped the communities in three towns to establish the Coopérative Electrique de l'Arrondissement des Coteaux (CEAC), a not-for-profit, member owned cooperative with support from the United Nations Environment Programme—whose financing comes from the Norwegian government and the United States Agency for International Development (USAID). Still in the early stages, CEAC is governed by its members, and will provide member-owners in three towns with affordable and reliable power. NRECA is partnering with Solar Electric Light Fund (SELF) to design and construct a solar-

diesel hybrid system for CEAC that has registered more than 670 members and intends to serve 1,600 or more consumers. While CEAC faces many challenges in the road ahead, it represents a huge opportunity for communities across Haiti that that are underserved by the state utility, EDH.

In 2011, NRECA provided electric supply design and construction to interconnect the new National Teaching Hospital at Mirebalais, a major program overseen by Partners in Health. Now fully serviced by reliable 24/7 electricity, this hospital provides services to 185,000 people who previously had limited access to health care.

ANNEX V

PROJECT INFORMATION DOCUMENT FOR THE PROPOSED CTF-SUPPORTED MODERN ENERGY FOR ALL PROJECT

ANNEX V. PROJECT INFORMATION DOCUMENT FOR THE PROPOSED CTF-SUPPORTED MODERN ENERGY FOR ALL PROJECT

I. Introduction and Context

Country Context

Haiti is located on the island of Hispaniola in the Caribbean, which it shares with the Dominican Republic. It has a population of about 10.4 million people on a territory of 27,750 km2, which makes it one of the most densely populated countries in the Latin America and Caribbean (LAC) Region. 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 over $1.8 billion annually. This is comparable in magnitude to one third of Haiti's GNP.

Haiti is the poorest country in the LAC region and one of the poorest in the world, with significant needs in basic services. GDP per capita stood at $820 in 2013 - compared to a LAC average of close to $12,000 (PPP, 2011). According to the latest household survey (ECVMAS 2012), almost 60% of the population is poor (living under the national poverty line of $2 per day) and almost a quarter of the population is extreme poor (below $1 a day).

Haiti's development has historically been hampered by fragility and characterized by social fracture. Deep social and economic inequities, intense concentration of wealth and power in the hands of a few, and a lack of social justice and of the rule of law have repeatedly led to spikes of violence. Longstanding lack of transparency and the absence of service delivery have led to citizens' low trust in government. Governance challenges - including rule of law, the absence of clear rules for market-based competition and corruption - have been major constraints on growth and investment.

In addition to the internal structural issues, Haiti's development has been affected by its vulnerability to external shocks, including food and fuel price fluctuations and natural disasters. The most devastating impact was registered from the magnitude -7 earthquake on January 12, 2010, which killed 230,000 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 damage and losses of around $8 billion (120% of GDP). One third of the country's civil service and most of government buildings were destroyed in the earthquake. Although most of the official reconstruction efforts have been completed, much remains to be done to ensure sustainable development and improvements in living standards of the Haitian population.

Despite these setbacks, there has been some modest progress since 2000. At the national level, the extreme poverty rate fell from 31% to 24% between 2000 and 2012. Access to some basic services, especially education and sanitation, has also improved during this period. Other infrastructure services, including electricity, however, remain highly inadequate and have not registered much progress in the past decade.

Haiti is also the most unequal country in the LAC region. The richest quintile holds over 64% of the total country income, while the poorest quintile holds less than 1%. As of 2012, the Gini coefficient was 0.61, the highest in the region. There are also strong disparities between urban and rural areas.

The poverty reduction of the last decade have been almost exclusively driven by improvements in urban areas, thanks to their better access to non-agricultural employment opportunities, larger private transfers, narrowing inequality, and generally better access to

goods and services.

In rural areas, where half of the Haitian population lives, there has been practically no progress in reducing poverty in the last 10 years. Still today, 38% of the population in rural areas are unable to satisfy their nutritional needs and almost 70% of rural households are considered chronically poor (both below poverty line and lacking access to basic goods and services), which makes it especially difficult for them to emerge from poverty. Of those classified as extremely poor, 80% live in rural areas. (World Bank: Creating Opportunities for Poverty Reduction in Haiti, 2015).

Sectoral and Institutional Context

Haiti has the lowest electrification rate in the region—with an official electrification rate of 30%. However, estimates vary due to unreliable statistics. The per capita consumption is more than 80 times lower than the average for the LAC region, reflective of the very low income levels, low access to electricity and supply constraints. The distribution of electricity access is also highly unequal. While about 40% of people in Port au Prince have grid electricity (although many of them only for a few hours a day), only an estimated 5% of rural residents are estimated to have access to electricity (estimates vary due to lack of reliable data and increasing access to off-grid electricity which is typically not accounted for in official statistics).

Institutional framework

The institutional structure of the power sector is very weak, characterized by fragmented leadership, an unclear regulatory framework and severe capacity constraints. There is no specific agency or department for rural electrification/energy access. Some expertise in that area exists but is scattered among different institutions/departments. Official oversight of such activities are intended to be handled by the offices of the MTPTC through the 'Energy Cell ' that was created in late 2012.

Grid electricity

The main official provider of electricity services in Haiti is the national, Government-owned utility Electricité d'Haiti (EDH), which has a monopoly over the purchase, transmission and distribution of electricity. EDH operates 6 separate grids, serving about 240,000 customers (1). Most of these customers are on the main grid covering Port-au-Prince and the surrounding areas. Five smaller grids are serving other parts of the country with power mostly supplied intermittently by diesel units and some hydro power, both with severe O&M problems.

EDH owns 100% of the transmission and distribution networks (with the exception of a few municipal grids and individual systems for self-supply—see below), but generates only about 15% of the energy produced in Haiti, with the balance coming from IPPs and Tripartite Cooperation (Haiti-Venezuela-Cuba). Generation capacity is at 212 MW, of which only about 160 MW is available. This is insufficient to meet the estimated peak load demand of more than 250 MW in the metropolitan area, resulting in frequent load-shedding and service interruptions. Most of the power is supplied through oil-based thermal generation (85%), with hydropower contributing 15%. The average tariff is 31c/kWh ($).

EDH faces considerable technical, managerial and financial challenges. Technical and commercial losses amount to 66%. In addition, the collection rate is 65% which translates into EDH recovering only 22% of the value of electricity it supplies. Consequently, EDH faces difficulties to pay for fuel, basic maintenance services and other operating costs, and remuneration to IPPs. To bridge this gap EDH is heavily relying on Government subsidies. In 2012 alone, budgetary transfers to support the sector were above $200 million, which

equals 4% of the national budget.

The lack of reliable power is also costly for households and businesses, as they typically have to resort to alternative sources of power to cover their needs—either as a back-up or as the main power source. It is estimated that the cumulative capacity of individual diesel gen-sets in the country is more than 200 MW - much more than the 160 MW capacity supplied through EDH. Poorer households typically use kerosene or candles as their main lighting source. More recently, solar power has started to emerge as a new alternative to fossil fuel generation—with various companies supplying systems ranging from a few Wp (e.g. solar lanterns for rural households) to hundreds of kWp scale (e.g. for commercial and industrial clients).

The Rebuilding Energy Infrastructure and Access Project is assisting the Government and EDH to improve EDH performance—including rehabilitation of electricity grids in order to reduce technical losses, deployment of meters and management systems and other improvements in commercial performance. Progress, however, has been slow, and even if all activities are successfully implemented, it will take a long time before EDH is able to embark on a large-scale expansion in rural areas, considering the unmet demand in the metropolitan areas and surroundings.

Off-grid electricity

Investments in rural electrification in Haiti have remained scarce overall in the last 30 years, resulting in a rural electrification rate kept more or less constant 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 and businesses in rural areas. Over 30 smaller towns have diesel-powered mini-grids built by the municipal governments, but only a few of those are still in regular operation. For most people living in rural areas, a diesel gen-set is not affordable, and they rely on kerosene and candles for lighting, and charge their phones at commercial charging stations.

In the framework of the project preparation, a telephone survey of 1,400 households was conducted in collaboration with Digicel, Haiti's cell phone provider. The 2014 WBG/Digicel phone survey confirmed a fairly high level of electricity-substitutable expenditure of Haitian households (with at least one mobile phone). The survey found that these households spend more than 20$ per month on average on electricity or electricity-substitutable expenditures such as lighting, cell phone charging and batteries (compared to 7$ per month on cell phone payments). (2) This is in line with less robust energy expenditure estimates made by Haiti's private sector players.

More recently, renewable energy technologies, especially solar PV, have taken off as a new alternative for off-grid energy access. This reflects global trends, including falling costs of the solar PV technology, availability of more efficient LED lighting, and emergence of new business models aiming at serving the base of the pyramid customers (more details are given in the technical annex).

Paradoxically, the earthquake served as the catalyst for this new development in Haiti. With much of the electricity infrastructure destroyed, solar lanterns were brought into the country as a part of the post-earthquake assistance (including through an earlier World Bank project). Many of these lanterns, originally used by displaced people in the camps, have eventually found their way to rural areas and have in effect triggered demand for similar products. The four leading lantern distributors alone (mostly local SMEs) have cumulatively distributed well over 150,000 Lighting Global quality-certified lanterns, providing basic electricity services to more than half a million people. According to the 2014 WBG/Digicel phone survey of 1,400 households, the penetration of solar lanterns and small kits is extremely high in international comparison, at well over 20%. (3)

The post-earthquake assistance by the donor community has also triggered above-standard investments in solar street lighting. Originally started as a post-earthquake reconstruction effort, the program has eventually been expanded to rural areas, and has actively been supported by the Government. There are about 13,500 solar street lights installed in 140 'communes' of Haiti's 10 'departments'.

In addition, various donors and NGOs have been supporting electrification of schools, clinics and other public institutions (mostly with solar PV systems). The IDA Rebuilding Energy Infrastructure and Access Project also includes an off-grid electrification component ($7.83 million), which is primarily used to electrify schools and provide street lighting.

The increased involvement of the diaspora, NGOs and the private sector has led to the development of new, innovative approaches to support provision of sustainable energy services in off-grid areas. The technical annex describes examples of these Haiti-grown innovative business models—which range from micro-finance for women retailers of solar lanterns, to leveraging mobile payments platforms for providing off-grid energy services, to deployment of smart village micro-grids. Many of these diverse initiatives meet key attributes for replicability and scalability - but all suffer from the absence of supportive regulatory and financing frameworks that would allow them to grow faster and ultimately scale-up significantly.

The recent Haiti Rural Energy Forum, organized on November 24 and 25, 2014 by MTPTC, with support from the World Bank and IADB, gathered approximately 200 of the key governmental, private and NGO stakeholders involved in the planning, financing and provision of rural energy services. Participating energy experts commented on the unusually and remarkably high quality of stakeholder discussions during this event; and several real-time polls allowed efficient tracking of current stakeholder views. Amongst the findings, participants agreed on principal requirements for scaling up rural energy activities in Haiti (technical annex provides details) and indicated the following priority needs:

i. Establish a conducive regulatory framework and an institutional set-up with clear roles and responsibilities for rural energy,

ii. Facilitate access to 'less risk-averse' and commercial finance,

iii. Develop a National Electrification Strategy/Plan and provide other necessary 'doing business' information, and

iv. Support capacity building, including the creation of a pool of skilled technicians in rural areas.

Relationship to CAS

The proposed Project is fully consistent with the current World Bank Group's Haiti Interim Strategy Note for FY13-FY14 (Report No. 71885-HT) that was discussed by the World Bank (WB) Executive Directors on September 27, 2012. The Strategy defines the program of the second tranche of the $500 million allocated to Haiti in response to the 2010 earthquake from the IDA16 Crisis Response Window. Its overarching objective is to support the GOH in implementing sustainable post-earthquake reconstruction and shift from emergency response to development, with a focus on: (i) reducing vulnerability and increasing resilience; (ii) encouraging sustainable reconstruction; (iii) building human capital; and (iv) promoting inclusive growth.

The proposed Project will in particular help set conditions supporting the objective (iv) of inclusive growth in rural areas. In addition, under the strategic objective (iii), the proposed Project will also strengthen the capacity of both the Government and the off-grid electricity providers in rural areas.

II. Proposed Development Objective(s)

Proposed Development Objective(s) (From PCN)

The Project Development Objective is to jump-start renewable off-grid electricity market in order to facilitate the scale-up of access to modern energy services for rural households, enterprises and institutions.

Renewable energy-based off-grid electricity services will comprise a variety of technologies and business models, including individual systems, such as solar lanterns and solar home systems, and community-based systems, such as mini- and micro-grids, powered by renewable energy or hybrid sources (renewables with a diesel back-up and/or battery storage).

This objective will be achieved primarily through assisting the Government with the creation of an enabling regulatory framework and the provision of funding to the private sector (including NGOs and cooperatives) for commercially viable off-grid electrification investments with a potential for replicability and scale-up.

Key Results (From PCN)

The PDO indicators would include

Number of enterprises that started and/or scaled up their off-grid electrification activities with assistance of the project

People provided with access to electricity under the project by household connections- Other Renewable Energy—Off-grid (#)*

Enterprises provided with access to electricity under the project- Other Renewable Energy—Off-grid (#)

Number of direct beneficiaries of which are female

Jobs created

Financing leveraged through CTF funding ($ million)**

Installed capacity for power generation (MW)**

Tons of GHG emissions reduced or avoided**

* Core sector indicator; ** CTF core indicator

The intermediate outcome indicators will be developed during project preparation, but would include among others the enactment of the regulatory framework, progress in the development of the investment pipeline, progress in awarding and disbursing loans, and outputs of market development and capacity building activities.

The project will also apply the Multi-Tier Framework (as introduced by the SE4ALL Global Tracking Framework, World Bank, 2013) for measuring access to reflect different service levels provided by different off-grid electricity technologies and business approaches.

III. Preliminary Description

The project will have the 4 following components which are summarized hereafter:

(i) Enabling environment and program oversight

(ii) Access to finance facility

(iii) Quality premium grants

(iv) Technical support and capacity building

Component 1: Enabling environment and program oversight

(CTF $0.5 million)

The lack of a clear regulatory environment is considered the main bottleneck to scaling up rural energy activities. The legal framework is currently unclear, with several legislations contradicting each other. The component will contribute to GOH's effort to clarify the legislation, facilitate permitting process and work towards creating a level playing field between fossil fuels and renewable energy options in rural areas. In addition, this component will provide support to MTPTC to strengthen not only the existing structure but also to create a well-functioning supervisory structure—in order to oversee the investments channeled through the financial intermediary. MTPTC is currently expanding its capacity to manage the sector, and the project will provide further support to do this effectively.

Component 2: Access to finance facility

(CTF: $10 million)

The component will be managed by a competitively selected financial intermediary (FI), and will consist of a credit line or other access to finance facility channellng funds to private sector providers of renewable energy services and products (including NGOs, cooperatives, rural retailers and MFIs) for investment in off-grid renewable energy projects. The details of the credit line are under development with the assistance of a highly qualified consultancy team of financial experts.

To be eligible, the projects will need to demonstrate that

- the project uses renewable energy (including hybrid systems),

- the project will expand access to power to rural households, businesses and/or public institutions in rural areas (which will be subject to verification)

- the project has a viable business plan, demonstrating sustainability of investments, clear and workable O&M arrang ements, and showing replicability and/or scale-up potential,

- the renewable energy equipment and the system meets minimum technical standards, and

- the project sponsor is a legal entity and passes a credit risk assessment carried out by the financial intermediary (to be developed with the financial intermediary).

In addition, the credit line clients will be obliged to provide users with readily understandable information on the service levels provided by the solutions they offer, and make costs transparent upfront. Detailed eligibility criteria and procedures will be developed in Operating Guidelines.

Component 3: Quality premium grants

(CTF: $1 million)

High quality lanterns and other pico/micro PV products are currently facing significant regulatory and market constraints, which are threatening to reverse the recent Haiti market

progress. Not only are these products facing unfair competition from the subsidized fossil fuels (kerosene and diesel) - increasingly, they have also been threatened by an influx of very low quality off-grid lighting products, which are often channeled through the informal economy (thus mostly un-taxed), while the formal picoPV enterprises are subject to import duties and taxes that can be as high as 36%. There is a consensus that the current situation is contributing to market spoilage: uneducated users choose lower cost products, which turn out not to work as expected, creating a negative impression for other solar and off-grid renewable products. This worrying trend (which confirms the rationale behind early Lighting Global and GIZ quality assurance measures) seems to already affect 2014 Haiti sales of high quality solar lanterns, as per stakeholder reports during the 2014 Forum. To level the playing field for the products of appropriate quality, the project would consider offering quality premium grants for high quality off-grid products (Lighting Global certified or equivalent).

Component 4: Technical support and capacity building

(CTF: $1 million)

This component will provide technical support, capacity building and market development services to the various nascent off-grid renewable energy markets described in the technical annex. This component will finance a dedicated technical team to set up at the financial intermediary level; and will include:

i) setting up and enforcing quality standards required for accessing credit line funding for different system types and business models;

ii) TA to the FI credit officers for the evaluation of proposals;

iii) TA to service providers and users including TA for energy efficient use of off-grid electricity (including the use of smart technology, dissemination of energy efficient appliances, intelligent user communication and simple demand-oriented tariff solutions in village grids) and support for productive applications;

iv) verification of service provides

v) development and implementation of consumer awareness campaigns;

vi) promoting gender-sensitive approaches in off-grid electrification sub-projects;

vii) further pipeline development for credit line financing, including awareness building about the credit line opportunities among the potential local SMEs.

viii) implementation of South-South knowhow exchange for fast diffusion of emerging lessons on PAYG and similar disruptive business innovations.

IV. Safeguard Policies that Might Apply

Safeguard Policies Triggered by the Project	Yes	No	TBD
Environmental Assessment OP/BP 4.01	X		
Natural Habitats OP/BP 4.04			X
Forests OP/BP 4.36		X	
Pest Management OP 4.09		X	

Physical Cultural Resources OP/BP 4.11		**X**	
Indigenous Peoples OP/BP 4.10		**X**	
Involuntary Resettlement OP/BP 4.12	**X**		
Safety of Dams OP/BP 4.37		**X**	
Projects on International Waterways OP/BP 7.50		**X**	
Projects in Disputed Areas OP/BP 7.60		**X**	

V. Financing (in USD million)

Total Project Cost:	12.00	Total Bank Financing:	0.00
Financing Gap:	0.00		

Financing Source	**Amount**
Borrower	0.00
Clean Technology Fund	12.00
Total	12.00

VI. Contact point

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ANNEX VI
ADDITIONAL DEVELOPMENT ACTIVITIES

ANNEX VI. ADDITIONAL DEVELOPMENT ACTIVITIES

SREP will complement MDB current activities in the energy sector, as well as additional development activities supported by the development partners that can complement or supplement the SREP investments in grid-connected renewable energy and for rural electrification.

Agency	Projects
World Bank	
• Through the IDA-financed Rebuilding Energy Infrastructure and Access Project, the World Bank aims at strengthening energy sector institutions and increasing energy access. The project includes several components, including (i) technical assistance to the Government for power sector planning and reform, (ii) financial and TA support to EDH for reducing technical and commercial losses, (iii) rehabilitation of one small hydro plant, and rural energy component focusing primarily on off-grid electricity for schools and street lighting. • Additionally, the World Bank is preparing another project with co-financing from the Clean Technology Fund (CTF). The CTF-funded Modern Energy for All Project will (i) establish an access to finance facility for off-grid electrification enterprises, (ii) establish an access to finance facility (provision of working capital and medium-term credit) for commercially-driven and commercially-viable off-grid electrification projects, building on the existing market for solar lanterns and (iii) offers promising pilots with service-oriented approaches using pay-as-you-go SHS and retrofitting of municipal diesel grids with renewables. SREP will broaden this scope to additional areas, which may require larger public sector funding, but also promise higher socio-economic benefits. CTF will co-finance SREP off-grid electrification activities. See annex I Project Brief 3 for more information on SREP and CTF complementarity and synergies	
International Finance Cooperation (IFC)	
• In collaboration with the Haitian Government, the IFC has been exploring various renewable energy interventions in Haiti, including on-grid and off-grid. Thus, IFC has been in discussion with experienced RE developers to possibly support the financing greenfield IPPs, which would rely on an EDH off-take. The progress of IFC is somewhat slow and is constrained by the PPA payment capacity of EDH (standalone or with sovereign guarantee). IFC will continue pursuing these discussions with an understanding of the EDH's ability to take adequate steps to improve its operations and performance. • In parallel, IFC has been actively involved in assessing possibilities of implementing various off-grid schemes. In many cases, however, working directly with fragmented end-users involves significant transaction cost, which can be overcome by working through private sector aggregators who are pursuing innovative business models. Among the models IFC is currently developing are distributed generation schemes relying on leasing, providing financing to financial institutions for on-lending towards RE equipment, channeling financing towards certain mini-grid components,	

and others.

Inter-American Development Bank (IDB)

- Sustainable Energy Studies for Haiti. The Inter-American Development Bank (IDB) is supporting a US$3 million Technical Cooperation (TC) to help the Government of Haiti in achieving a sustainable energy matrix that promotes access to electricity through renewable energy (RE) sources and energy efficiency (EE) measures, as a way to reduce Haiti's dependency on fossil fuels, encouraging efficient use of this non-renewable resource. The resources for this TC come from the Haiti Reconstruction Fund (US$2 million), the IDB's Sustainable Energy and Climate Change Initiative (US$500,000) and the IDB-administered Korea Fund for Technology and Innovation (US$500,000). The TC has several components; they include studies and pilot projects in rural areas—a series of feasibility studies are currently being developed under the TC, including Distributed Generation Feasibility Studies, Solar/Wind Generation Feasibility Studies, and Overall Grid Potential for Intermittent Generation.
- Solar Energy. IDB partnered and hired SELF to install a variety of solar energy systems to serve the rural population of Haiti in a project designed to provide models for meeting Haiti's energy needs in the under-served rural areas of the country. The following types of solar systems will be installed: (i) Large Micro-Grid at Port-a- Piment, Coteaux and Roche-A-Bateau; (ii) Small Micro-Grid at Feyo Bien; (iii) Solar Cooking Demonstration; (iv) Solar Water Heater Demonstration in Port-a-Piment; and (v) Solar Lantern Distribution.
- Mini-Grid Hybrid System Solar and Diesel. Regarding the Large Micro-Grid at Port-a-Piment, Coteaux and Roche-A-Bateau, the IDB will co-fund this project together with UNEP. The lead implementing organization will be the National Rural Electrical Cooperative Association (NRECA) for UNEP's funding. SELF is the implementing organization on behalf of the IDB. The planned micro-grid will serve the three communities that have a combined population of approximately 53,000 people. The population initially served by the micro-grid will range from 1,000 to 2,600 people. The grid will make use of some existing power lines, left from a now non-functioning micro-grid, as well as some new lines and some upgraded existing lines. The micro-grid will be powered by a hybrid diesel generator/photovoltaic power plant.
- Mobile Money for Mini-Grid Hybrid System Solar and Diesel users. IDB is also partnering and hiring NRECA to perform a demonstration project intended to evaluate the benefits and operational impact of a Haitian mini-grid service provider offering its customers the option of paying for electricity service with mobile money payments
- Electricity System Assessment and GIS Map. IDB has partnered and hired Navigant Consulting (in association with HOMER Energy and JM Consulting) to create a GIS map for Haiti. The GIS Map will include among other things a great deal of detailed information on generation, transmission, substation, distribution and load.
- Rural Electrification Plan. IDB and Navigant will identify the "off-grid" areas with populations not served well by the existing or planned system, and to develop a plan for meeting those needs with renewable energy. This activity will concentrate primarily on plans for advancing Micro-grid Systems, while also developing an

approach that incorporates both Micro-grid Systems and Stand-Alone Systems where each modality makes sense based upon customer concentration, energy consumption, and local institutional capacity.

- Efficient use of fossil fuels—feasibility studies. The approach of this feasibility study would be to analyze the potential of incorporating natural gas into Haiti's energy matrix in order to reduce the country's dependency on diesel and heavy fuel oil.
- Solar PV programs for public facilities. In response to the 2010 earthquake, the Bank implemented 12 photovoltaic systems on health centers in the South Department of Haiti during March and April of 2012 and solar street lights in two refugee camps. This initiative was part of the Emergency Program for Solar Power Generation for Haiti, which was set up to support Haiti in the provision of clean energy through the use of photovoltaic panels

USAID

- USAID is currently carrying out wind studies at a site in the North of Haiti (the Caracol Industrial Park area). These studies are planned to commence by April/May 2015 and will collect wind data for at least one year. Subject to fund availability, the data may then be used to develop a small wind energy project.
- Solar energy. USAID might also develop a pilot project using solar energy to supplement the Power Plant at the Caracol Industrial Park.
- Household energy. The US$8.7 million USAID Improved Cooking Technology Program (ICTP), also known as Recho Paw, ran from February 2012 to January 2015 and benefitted more than 110,000 new beneficiaries with improved cooking technology.
- Agricultural waste to energy. In February 2014, USAID awarded a Development Innovation Ventures grant to B2D S.A. for its proposal of an innovative business model that increases access of rural Haitians to a reliable, cost-effective energy source. The ag-waste-to-energy project seeks primarily to test a business model that, if successful, B2D S.A. plans to expand in Haiti and beyond.

European Union

- Wind energy. The EU financed the preparation of two wind studies. The first one in 2006 supported the creation of a wind atlas. Terms of Reference for a feasibility study of three micro-wind systems for the North and North-East Province, namely Port-de-Paix, and Cap Haïtienet Fort Liberté. The 2010 wind study carried out in collaboration with the Bureau of Mines and Energy assessed the potential for the three sites in Cap Haïtien, Jacmel and LacAzuei. Both studies highlighted the opportunities for wind energy being integrated into the national grid.
- Household energy and renewable energy in rural areas. Since 2011, the EU financed the MLAL-MPP Project, an objective of which is to implement an energy efficient plan for the usage of wood energy in rural areas of the Hinche Community.
- Climate change. The AP3C Program supports the mainstreaming of climate change into the national development of Haiti between 2014 and 2019.

Canadian International Development Agency (CIDA)

- Canada has been active in the energy sector in Haiti since the 1970s in a variety of fields and invested approximately CAD$60 million. Early interventions ranged from hydroelectric resources mapping to direct technical assistance to EDH. The most recent projects include semi-autonomous centers (SAC) in Jacmel (2005-2011), which was the third phase of a Technical Assistance to EDH initiated in 1995, as well as in Les Cayes (2007-2013) to replicate the promising results achieved in Jacmel.
- The SAC projects amounted to CAD$28.9 million, focused on the following components: (i) Business component: improved customer management; optimizing meter reading; regularization of illegal consumers; increased levels of billing and collection, (ii) Technical component: increasing electricity production in Jacmel (a new diesel generator and repairing the Gaillard power station) and in Les Cayes (rehabilitation of Saut Mathurine hydropower station); rehabilitation/extension of Les Cayes electricity grid; installing a new switchyard in Bourdet old station, (iii) Financial component: increase in revenue through the trade and technical components, improving financial management and securing semi-autonomy of the centers. (iv) Capacity strengthening: training executives; technical and administrative staff in planning; management and operations; distribution and business management, accounting and accountability."

Norway

- Norway is supporting the Government with the development of grid-connected and off-grid renewable energy—either directly or through implementing partners (see activities' outline in UNEP and SELF sections below). The new budget cycle for the next three years is currently being prepared. Some recent activities in the energy sector include:
- The rehabilitation and construction of hydro power plants. Norway is supporting the planned rehabilitation of one hydro power plant and the construction of two other small-hydro power plants in the South Department. The Power Purchase Agreement is currently being discussed with the Government. Once consensus has been reached, Norway's Development Banks will make funds available to provide financing (AAA rating) to the Haitian company that is supposed to renovate, build and operate the power plants. In addition, Norway made available through an IDB administered escrow account, an amount of US$3 million as guarantee funds for renewable energy projects in the South, starting with the hydro power plants project mentioned above.
- Rural Electrification with renewable energy. Norway partnered with UNEP and SELF as the main implementing entities of their activities. Focus for the activities is mainly the South Department.
- Green Energy mechanism. The amount of funds potentially available has not been confirmed, but might involve a cooperation between UNEP, UNOPS and the UNDG Multi-Donor Trust Fund in order to create a new structure (potentially a temporary fund) for the competitive selection and support of promising small to medium projects and enterprises in the social and private sector. The potential fund could be easily supplemented by contributions from multiple other donors such as bilateral

agencies. As such, the Phase II of the NMFA project can be considered as a bridging solution between the Phase I pioneering work and the longer term entry of Government with SREP and CTF funds.

- Wind power/biomass. Norway, through UNEP will continue to assess the potential for windpower, after mixed results in a specific area of the South. Another area has been identified that, if successful, would be the basis for a mini-grid based on wind for an additional commune in the South Department. The potential for biomass in the South is being reviewed towards possible cooperation with the private sector.
- Crosscutting themes—training of skilled labor. Norway just provided US$ 1 million to SELF to establish the first training center on solar energy for technicians and engineers in Haiti. This center should be operational by 2016 and will support/complement SREP capacity building component.

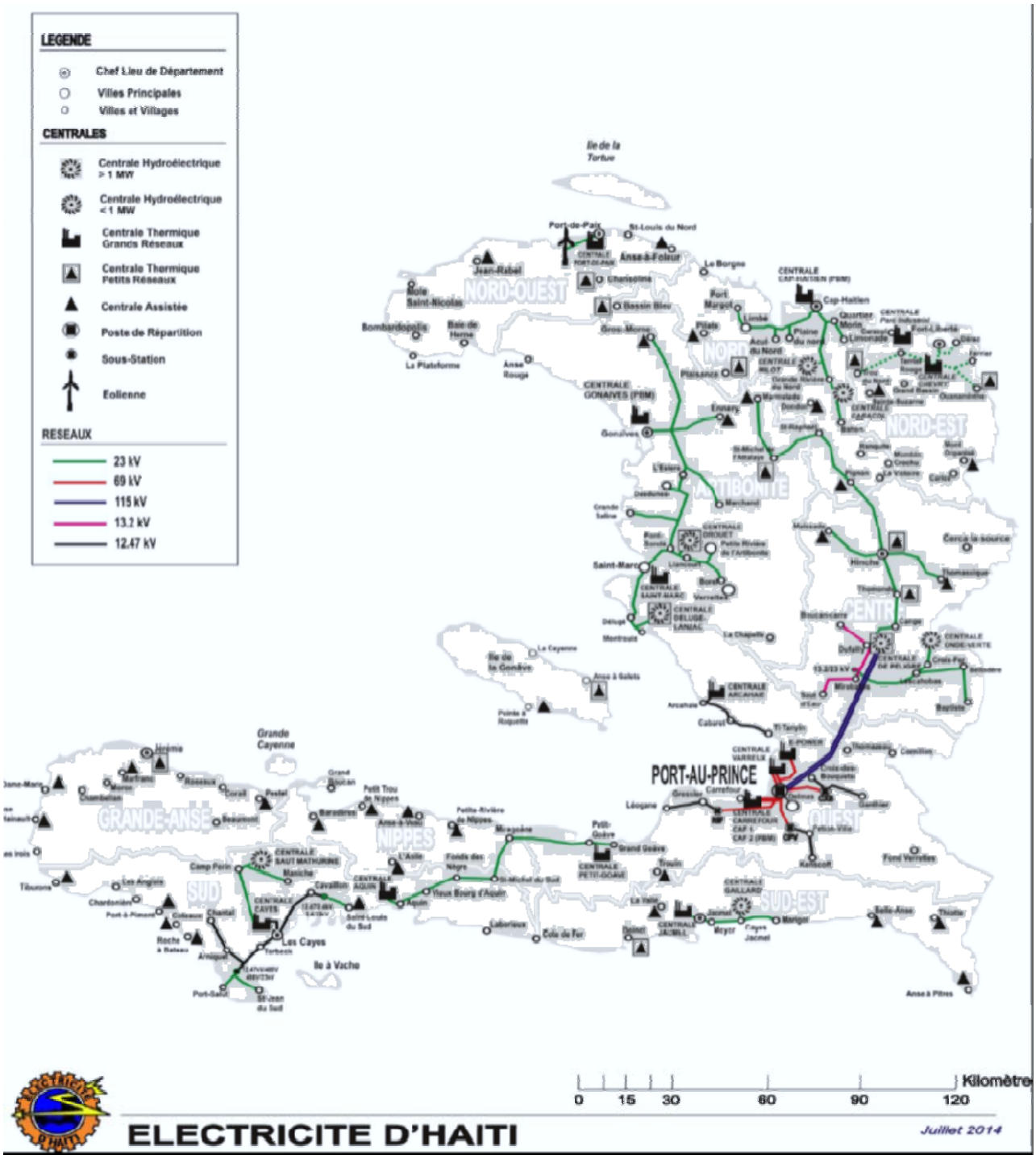
UNEP

- Household energy. UNEP has the implementing responsibility of the NMFA Project (described in Norway section).
- UNEP is financing capacity building of a Haitian social enterprise Eneji Pwop, developed by the USA NGO EarthSpark International. EP sells solar lanterns, solar home systems and efficient cook stoves. This support will be completed in 2015.
- UNEP is financing the rollout of a battery rental franchise scheme in the South Department by the USA NGO Sirona Cares Foundation. The scheme will entail up to 21 charging stations each servicing up to 100 households. The power supply used is a combination of solar PV and grid—where the Les Cayes grid is present and when it is active.
- Based on a technical UNEP study of the options for improved management of the forest energy sector in the South Department (as part of the NMFA Project Phase I), UNEP is currently investigating the relative costs of LPG and fuel wood for commercial use. In addition, the NMFA Project Phase II might finance a pilot for improved kilns for energy plantations.
- UNEP is now commencing a series of new small-scale partnerships for feasibility studies and the development of business plans. The USA Public Private Foundation for Rural Development will be financed for product development work on an ethanol stove and local distillation supply chain. The USA and Haitian NGO Carbon Roots International will be financed for a feasibility study on charcoal briquetting of vetiver roots for sale on the open market. The NGO EarthSpark will be financed for a business plan for a mini-grid in Tiburon.
- UNEP is developing a new partnership with the University of QuisQueya, the newly formed Haitian Institute for Energy (HIE) and the Haitian Education and Leadership Program (HELP) for the development of a national level energy communications platform. The scope of the partnership will extend to technical capacity building for civil society, business and the university sector.

Solar Electric Light Fund (SELF)
• SELF, founded in 1990, is a Washington, D.C.-based nonprofit whose mission is to design and implement solar energy solutions to assist those living in energy poverty with their economic, educational, health care and agricultural development. • Solar PV programs for public facilities and training center. The South Department now hosts 10 health clinics with solar PV battery power supplies. These were installed in 2012 by SELF using IDB post-earthquake reconstruction funds and all are still operating and delivering substantial benefits. SELF receives support from IDB to several of its PV programs. The PV programs include, inter alia, solar powered street lights, solar energy to power schools (lights and computers), fish farms, a solar powered market garden and a micro-enterprise center. Furthermore, SELF will establish Haiti's first vocational training center on solar energy for technicians and engineers (financed by Norway).
Pan American Development Foundation (PADF)
• Private sector empowerment. PADF successfully implements renewable energy related activities via the USAID-funded Leveraging Effective Application of Direct Investments (LEAD) Program since July 2011. By July 2015, the volume amounts to US$15 million. The rigorously implemented business plan competition, comprising a fund of US$5.5 million, provides matching grants to entrepreneurs and SMEs on a minimum 1:1 basis ranging from US$50,000 up to US$200,000. The four enterprises that received a grant from LEAD and operate in the field of renewable energy in Haiti are: SWITCH S.A., D & E Green Enterprises, PalmisEneji and Global Recycling S.A. LEAD funding is based on the assumption that the initial grant support will allow enterprises to grow to the next level which will allow them to access commercial sources of funding for expansion. LEAD-supported enterprises would therefore constitute a potential pipeline for CTF and SREP scale-up financing. • On-Grid Energy Access. PADF is further committed to electrification projects under the World Bank-funded via the Haitian Government's Bureau for Monetization (BMPAD) Urban Participatory Community Development Project (PRODEPUR). The objective of the project was to electrify the whole neighborhood of Delmas 32 and strengthen the capacity of the existing management committee (Comité de Gestion de Courant de Delmas 32, CGCED 32) originally set-up in 2002. A main meter was installed for the neighborhood from which the committee extends and sells electricity via cable to households and local businesses. The committee has a management contract with the EDH and is in charge of working with local technicians accredited by EDH to handle the connections. It is also in charge of maintenance, billing and collection.

ANNEX VII
EDH—MAIN GENERATION AND DISTRIBUTION ASSETS

ANNEX VII. EDH—MAIN GENERATION AND DISTRIBUTION ASSETS



Source: EDH, 2014.

ANNEX VIII
INDEPENDENT REVIEW

CLIMATE INVESTMENT FUNDS

SCALING-UP RENEWABLE ENERGY PROGRAMME (SREP)

INVESTMENT PLAN FOR HAITI

Review undertaken by
Dr Mike Allen
9th April 2015

INTRODUCTION

The review of the Investment Plan for Haiti has been undertaken ahead of the submission of the plan to the SREP Sub-Committee of the Strategic Climate Funds, within the Climate Investment Funds at the World Bank.

These notes are based on a review of the draft plan provided in late March 2015 and an update received on 8th April 2015.

It should be noted that the reviewer has not visited Haiti nor been involved in the preparation of this plan. The lack of a visit to Haiti and any contact with the ministries, agencies, institutions and various stakeholders necessarily limits the personal background knowledge but the nature of the situation is common to many such economies. The reviewer is familiar with the energy issues facing Haiti (in particular through involvement with the SREP Expert Panel in May 2014) and the wider energy situation in the region from other personal engagements.

The overall impression of the Investment Plan is that is thorough, well prepared and comprehensive.

A high level of detailed evaluation of options, including at least preliminary economic analysis of the potential projects being considered, provides a rational base for the technical and financial comparison and justification for these projects.

Recognising the unique situation that faces Haiti post the 2010 earthquake, it is however important that cognizance be given to a critical assessment of the capacity of the government and its relevant ministries and agencies to undertake what is clearly a demanding, and in places perhaps optimistic, programme.

The Investment Plan (IP) does explain the importance that renewables can make to the reconstruction and upgrading of the existing electric power system in Haiti; it does however also highlight the considerable challenges that have been faced within Electricité d'Haiti (EDH) given the financial stress that it has been under. The report notes:

> *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.*

In itself this situation should not be allowed to undermine the positive aspirations laid out in the IP but equally the pressure that this may bring against a significant private sector engagement needs to be acknowledged. Again the report notes:

> *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 GoH in case an attached sovereign guarantee), which is a result of EDH's high technical and commercial losses and low payment-collection efficiency.*

During the review correspondence with the team assisting in the preparation of the IP Has allowed an opportunity to discuss these issues and it is acknowledged that there has been some recent progress to address these concerns in light of the activities around SREP preparations and other parallel programmes.

As noted, the activities proposed under the IP are significant and will require a clear and well managed implementation plan. With limited knowledge of the current on-the-ground project activities in the sector, it is difficult to assess how those proposed under the IP will integrate with efforts by other donors. A number of projects are anticipating co-funding and/or are dependent on separately funded activities by others.

Challenges around donor collaboration are recognised as an issue in any development programme; these challenges are no doubt heightened given the breadth of donor activity within Haiti and may well be complicated within the electricity/energy sector by the concerns about EDH's capacity and performance and this influence on attracting private sector engagement. The report suggests that various electricity/energy support programmes are underway with support from, amongst others:

- *World Bank*
- *International Finance Cooperation (IFC)*
- *Inter-American Development Bank (IDB)*
- *USAID*
- *European Union*
- *Canadian International Development Agency (CIDA)*
- *Norway*
- *UNEP*
- *Solar Electric Light Fund (SELF)*
- *Pan American Development Foundation (PADF)*

What is apparent is from the summaries in the IP is that, although there are a large number of donor programmes underway, the themes highlighted for each do appear to demonstrate that there is limited overlap and a good coverage of the identified areas of key concern. It will however be important that the SREP programme includes a critical evaluation to ensure that its contribution is providing real additive value to the work being undertaken by others.

SPECIFIC COMMENTS ON INVESTMENT PLAN

The Country Energy Policy

It is noted in the IP that:

> *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 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 infrastructure and making sure that critical loads were supplied in short- and medium- term. The reconstruction now being mostly completed, the Government is moving to longer-term priorities embodied in the SPDH plan.

and

…… 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 technical and economic 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.*

Given the current situation, as planning proceeds for projects under the IP / SREP, it will be important that the effective integration of any projects within the national energy plans is clear before final commitments to their implementation. Part of the IP's justification for SREP support is that the proposed projects will assist as practical demonstrations of what could be achieved through the various SREP supported projects. This will need to be reassessed as each project is better defined.

Proposed SREP Programme

An abbreviated summary of the SREP programme rationale and design highlights a number of positive considerations and recognition of the challenges that will be faced:

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 universal access to electricity by 2030. This transformation will not happen through one program but will require long-term consistent support.……

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. ……..…*
- *Start small, but think big by reducing barriers to renewable energy investments.……..*
- *Complement SREP investment with other energy sector interventions. Both IDB and the WB are 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. ……

- *Complement investments with a strong TA and capacity-building program going beyond the needs of individual projects in order to build a nation-wide framework, capacities and skills to support more ambitious and sustainable renewable energy scale-up (during and after the SREP time frame)……..*
- *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. …….. SREP will focus on filling the gaps that these organizations are not covering.……*

Overall, the development of the energy sector in Haiti will be a long-term process, in which SREP can play an important role. In order to lift Haiti's electricity sector from the current emergency situation, investments in additional generating capacity for the grid will have to be sequenced with adequate policy reforms, which in Haiti—similarly to other fragile/post-conflict-disaster contexts—will be an adaptive and incremental process. The combination of IDA/IDB/IMF support for EDH technical, financial and commercial performances, alongside SREP support to start decreasing the gap between tariff and cost of production, is currently the only viable approach for setting the stage for the electricity sector growth, as well as for liberating the current subsidies to EDH for better uses in the Government poverty eradication efforts, including for rural electrification.

This outline provides reassurance that the issues around the need for, design and proposed implementation of interventions with SREP support have been carefully considered.

Proposed Projects

The table that follows is extracted from the IP to summarise the understanding of the 5 projects being proposed.

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** 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- Crosscutting—essential complement of projects 1, 2, and 3 and for the scaling-up beyond the SREP projects

Financing

The table that follows summarises the anticipated SREP financing, co-financing and potential private sector financing leverage. Overall the wider SREP programme is seen as requiring funding as follows:

> *The total estimated budget for the Haiti SREP Program is US$173.5 million with a SREP contribution of US$30 million for Components 1,2,3 and 5 (Component 5 is a part of the SREP program package but will seek additional financing from other sources). The program is seeking co-financing from the participating MDBs and other development partners, including US$28.5 million from the World Bank to support all five components and US$10 million from the IFC to support Component 3. In addition, it is expected that a parallel Modern Energy Services for All project, eligible for CTF financing, will also complement and co-finance SREP activities (pending CTF approval). Finally, the SREP Haiti program is expecting to mobilize about 80 million from private sector. The overall SREP leveraging factor is expected to fall between 1:3 and 1:4, mainly depending on the final design and the deal structure of the on-grid component (Component 1).*

It is understood that the commitments to co-financing are at different stages and that some will only be confirmed once the SREP funds are available. As is often the case, this may mean that both SREP and co-financing may be conditional on the confirmation of matching sources.

The assumption has been made that the SREP funds will be disbursed through the World Bank and IFC, as indicated in the attached table. This will influence procedures for final applications, timing and delivery of funds but, given the current activities of both organisations under existing (or planned) programmes, this should help the efficiencies around disbursement and programme management.

In both components 1 and 3 implementation will be dependent on a substantial private sector investment and the challenges around securing such financing has already been recognised in this review and throughput the IP.

SREP Financing Summary:

	SREP financing			Co-financing (excl. private)				Total co-financing	Private sector financing leveraged
SREP IP Project	SREP	Via WB	Via IFC	WB-IDA	WB-CTF	IFC	Others		
RE for the metropolitan area	10	9	1	6				6	30
RE for Port-de-Paix remote grid	4	4		8				8	4
Off-grid electricity for productive, social and household uses	15	8	7	8	11.5	10		29.5	45
Rehabilitation small-hydro	0			4			14	18	0

Building enabling framework, capacities and skills for RE scale-up	1	1		2.5	0.5			3	0
Total	**30**	**22**	**8**	**28.5**	**12**	**10**	**14**	**64.5**	**79**

Comments on Components

Overall the five components proposed for SREP support, and summarised in 2.3 above, appear to offer a balanced approach to the overall programme.

The IP notes that it is planned that there will be consolidation and sequencing of components:

> *In order to have an efficient and effective SREP Haiti rollout, the 5 components will be sequenced. Components 3 and 5 are natural expansion of activities already carried out by the IDA project (and IFC in case of the IFC-managed activities under Component 3) and can therefore be developed quickly.*
>
> *Components 1 and 2 are new and will require further studies and preparation efforts, and are therefore likely to be implemented only in the second round.*
>
> *Component 4 will be implemented in the third round, as additional financing for its implementation is mobilized.*
>
> *To facilitate project processing and implementation, the World Bank-supported components are likely to be bundled into two projects. The First Project will include Components 3 and 5, and the Second Project will include Components 1 and 2.*

This approach should allow an early start, building on existing activities, providing the SREP programme the opportunity to test the base from which to launch subsequent components. Again it will be important that there is a critical assessment of progress as each new component is being considered.

Renewable energy for the Port-au-Prince metropolitan area

The IP suggests that the preferred option for this project is that it be implemented through a PPP arrangement. Recognising the tensions that this may create given the current financial status of EDH, if such a project can be undertaken successfully it must provide a valuable pilot for public private collaboration for future power generation developments.

At this stage the likely structure of the project financing and ownership has to be determined; it is suggested that SREP funds may be used either to buy down the initial cost and/or provide some form of guarantee against payments under any PPA with EDH. While the market may seek guarantees it is understood that to date all payments under existing PPAs have been met despite the financial weakness of EDH.

Whatever structure is chosen it is recommended that the replicability of such a scheme be carefully considered to ensure that the demonstration value of this first RE PPP can be realised. It is understood that IFC will provide advisory services to assist in the design and execution of the financing for this component.

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

This project is similar to component 1 but will address the opportunity to explore private sector engagement, possibly through a PPP, on an isolated grid. The suggestion of a solar/wind hybrid would test not only the ability of EDH to implement such a project (after a poor record on an earlier small scale wind development in the same location) but again could provide an opportunity for private sector participation, if not at an ownership level, at least under an O&M contract.

Again the structure of this project has yet to be defined but its replicability will be of key importance if EDH and the electricity market are to gain real value from the SREP intervention.

Off-grid electricity for productive, social and household uses

This component will help reinforce existing programmes in off-grid situations where EDH has no presence (nor current interest). It will support IDA and IFC efforts and has the potential to provide the most substantive impact in terms of delivering electricity to those who have limited access to power today.

During the IP preparation the team has explored a wide number of business models and it is the intention that this component will draw on significant private sector input and investment. The predominant use of solar PV is anticipated; it is fortunate that there are already many examples of successful business models around the sale, financed supply and/or leasing of solar facilities. IFC's existing involvement and commitment to provide significant co-financing will be a key to the success of this programme.

Rehabilitation of existing small hydro plants

While the benefits that could be derived from the rehabilitation of existing hydro plants and the potential development of new facilities are noted, it is understood that this component is heavily dependent on additional funding. While it is being promoted under an SREP umbrella, this component appears to be of lower priority and subject to further analysis and funding.

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

The IP recognises that this work is a key element of the overall intervention by SREP:

> *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 crosscutting 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.*

In reviewing the IP and the work being undertaken by others it is clear that these issues permeate all efforts to support the growth of energy investments in Haiti. This component is important, but although a modest investment, it will be important that there be a careful balance between efforts directed into this component and the implementation of projects under others. We all recognise that there is no "quick fix" for many of these concerns; the declared intent of the IP that it is seeking to move quickly to demonstrate solutions is important. The cross cutting nature of the issues has been identified and needs to be effectively managed through a mix of stakeholders to ensure equitable progress can be made while avoiding unnecessary programme delays.

COMPLIANCE WITH SREP GOALS

Key focuses within the SREP programme can be summarised under the following headings; the response of the IP to each of these aspects is noted in the following comments.

Catalyse increased investments in renewable energy

The plan outlines how it is anticipated that SREP investments and programme support will help attract other donor and private funding. The engagement with the private sector is recognised as a significant challenge given the current financial situation of the electricity sector in Haiti. It is however believed that the IP sets out appropriate and reasonable strategies as to how this will be attempted.

Enabling environment

The IP acknowledges that there are a considerable number of unaddressed hurdles to renewable implementation; there are strategies and an allocation of responsibilities to particular agencies to address these. Without prior engagement with these agencies it is hard to assess whether these tasks can reasonably achieved by these entities. This process will require close monitoring as the success in establishing a sound enabling environment will be a key control on the value of the SREP investments.

Increase energy access:

Access to energy in Haiti is very low. The work being proposed under the IP, in collaboration with other donors active in Haiti, is seeking to start to build a more robust model to address this issue. The historical access to energy has been poor and this has been exacerbated by the 2010 earthquake, although this has provided some much needed focus on accelerating programmes to increase access.

Implementation capacity

The track record of EDH in implementing power developments has not been strong. There are however a number of current initiatives being promoted by the government to address serious shortcomings. Within the Ministry of Public Works, Transportation and Communications a specialised Energy Cell has been established and is tasked with managing energy access programmes. Recent reports suggest that institutional capacity and capabilities are being reinforced and there is a clear commitment to remove a number of obstacles to project implementation. Private sector capacity is believed to be reasonable and this will be key in building the off grid market.

Improve the long-term economic viability of the renewable energy sector

The renewable energy sector in Haiti is clearly at a very early stage. The SREP funded activities are therefore more focused on establishing a strong and sustainable basis for future growth; there may be limited private sector engagement initially but the market strength is growing and appropriate legal and regulatory changes and enhancement of the enabling environment should help ensure future growth in the sector.

Transformative impact

The targeted nature of the proposed SREP investments in Haiti is seen as pragmatic given the current energy market status, limited electricity access and a need to enhance the enabling environment. Given the renewable sector is relatively immature it is not to be expected that there will be major transformations in the market through SREP alone but if well managed and executed the proposed programme should help further develop the renewable energy sector in the country.

COMMENTS AND RECOMMENDATIONS

As noted earlier, a considerable amount of effort has gone into the background research, stakeholder consultation and evaluation of potential options that could be supported under SREP funding in Haiti.

The Investment Proposal in itself is thorough and comprehensive. To the extent possible, initial economic evaluations of proposed projects has been undertaken to give a sense of the relative benefits of the various components being proposed.

The project implementation capacity within The Ministry of Public Works, Transportation and Communications and EDH is of concern particularly as there are a number of parallel energy programmes underway. Discussion with the SREP team suggest that there are a number of major efforts underway to help strengthen these organisations and the calibre of staff is high and there is a good level of engagement amongst them.

The attraction of the private sector into larger grid connected projects is recognised as challenging but part of the SREP programme is to test the practicality of PPP projects and this experience can only be of value in determining the best models for future expansion of the energy sector.

Off grid activities appear to be better supported by the private sector and there seems to be a good level of sharing of experiences with other countries with nascent renewable off grid markets. If this segment of the market can be well catalysed by SREP and others then it may well help address some of the reluctance to participate in grid connectehd activities.

While component 5 of the SREP programme notes close engagement with academic stakeholders, the oversight of the SREP programme may benefit from the inclusion of private sector representatives on any Steering Committee. Engaging the private sector at this level may bring longer term benefits as they become more actively involved in the renewable energy sector.

Haiti SREP Investment Plan Matrix of Comments and Answers Comments received from peer reviewers: Mike Allen (Independent Reviewer)	
General	
It should be noted that the reviewer has not visited Haiti nor been involved in the preparation of this plan. The lack of a visit to Haiti and any contact with the ministries, agencies, institutions and various stakeholders necessarily limits the personal background knowledge but the nature of the situation is common to many such economies. The reviewer is familiar with the energy issues facing Haiti (in particular through involvement with the SREP Expert Panel in May 2014) and the wider energy situation in the region from other personal engagements.	Noted.
The overall impression of the Investment Plan is that is thorough, well prepared and comprehensive. A high level of detailed evaluation of options, including at least preliminary economic analysis of the potential projects being considered, provides a rational base for the technical and financial comparison and justification for these projects.	Thank you.
Recognising the unique situation that faces Haiti post the 2010 earthquake, it is however important that cognizance be given to a critical assessment of the capacity of the government and its relevant ministries and agencies to undertake what is clearly a demanding, and in places perhaps optimistic, programme	Under the IDA Energy project, we have initiated in 2014 a broad assessment of the training needs for the Haiti Energy sector, and plan to have a specific focus on capacity strengthening for RE development co-financed by IDA and SREP.
The Investment Plan (IP) does explain the importance that renewables can make to the reconstruction and upgrading of the existing electric power system in Haiti; it does however also highlight the considerable challenges that have been faced within Electricité d'Haiti (EDH) given the financial stress that it has been under.	Yes, as noted, this we have addressed in the IP.
In itself this situation should not be allowed to undermine the positive aspirations laid out in the IP but equally the pressure that this may bring against a significant private sector engagement	

needs to be acknowledged.	
With limited knowledge of the current on-the-ground project activities in the sector, it is difficult to assess how those proposed under the IP will integrate with efforts by other donors. A number of projects are anticipating co-funding and/or are dependent on separately funded activities by others. Challenges around donor collaboration are recognised as an issue in any development programme; these challenges are no doubt heightened given the breadth of donor activity within Haiti and may well be complicated within the electricity/energy sector by the concerns about EDH's capacity and performance and this influence on attracting private sector engagement.	Agreed. Thus the reason for the consistent collaboration with the private sector during the entire IP preparation process (which will continue during implementation), and as a result, we are confident that as the SREP program is designed it will be done in a way that the private sector is able to support. Agreed. However, from our experience, donor collaboration in Haiti is much more congruent than in many other developing countries, and during the IP preparations the MDBs have been very collaborative, thus, with continued effort, we expect the collaboration to continue. Donors and NGOs (e.g., UNEP or USAID) already active in energy access and renewable energy warmly welcomed the SREP initiative in Haiti, because of the potential positive impacts linked to market scale-up.
What is apparent is from the summaries in the IP is that, although there are a large number of donor programmes underway, the themes highlighted for each do appear to demonstrate that there is limited overlap and a good coverage of the identified areas of key concern. It will however be important that the SREP programme includes a critical evaluation to ensure that its contribution is providing real additive value to the work being undertaken by others.	The coordination between WB and IDB projects is also very close. These projects are coordinated on the Haitian authorities' side by a unique coordination unit, which experience and efficiency has progressively increased since the first projects in 2007. This Electricity sector Project Implementation Unit (PIU) is now composed with 8 staff and consultants, experts in energy project management, procurement and fiduciary management; financed mainly by the World bank and IDB projects, this team has benefited from the institutions' training throughout the years (on Safeguards, Procurement, Monitoring and Evaluation, and Communication), and has been considered in 2014 as the best Government's team for financial reporting of donor funded projects, all sectors wide. Agreed. And as the SREP program is further designed (post-approval), a robust evaluation assessment will be carried out, including application of the SE4ALL multi-tier framework. The program-wide M&E activities

	have been included and budgeted for in Component 5.
Technical quality of the Investment Plan (IP)	
As noted earlier, a considerable amount of effort has gone into the background research, stakeholder consultation and evaluation of potential options that could be supported under SREP funding in Haiti. The Investment Proposal in itself is thorough and comprehensive. To the extent possible, initial economic evaluations of proposed projects has been undertaken to give a sense of the relative benefits of the various components being proposed.	Thank you.
Prioritization / fit with country conditions/priorities	
Given the current situation, as planning proceeds for projects under the IP / SREP, it will be important that the effective integration of any projects within the national energy plans is clear before final commitments to their implementation. Part of the IP's justification for SREP support is that the proposed projects will assist as practical demonstrations of what could be achieved through the various SREP supported projects. This will need to be reassessed as each project is better defined. [The IP] provides reassurance that the issues around the need for, design and proposed implementation of interventions with SREP support have been carefully considered.	Agreed. Furthermore, Government plans are to release the New energy Master Plan by the end of 2015, and as SREP will work closely with this plan it will ensure compatibility. At the same time, the Plan will build on the initial least-cost planning assessment already carried out for this IP. And continual assessment of project viability and appropriateness will be designed into the implementation plan. Thank you.
Approach	
Overall the five components proposed for SREP support, appear to offer a balanced approach to the overall programme. This approach should allow an early start, building on existing activities, providing the SREP programme the opportunity to test the base from which to launch subsequent components. Again it will be important that there is a critical assessment of progress as each new component is being considered. The targeted nature of the proposed SREP investments in Haiti is seen as pragmatic given the current energy market status, limited	Agreed. And as noted above, as the SREP program is further designed (post-approval), a robust evaluation assessment will be included that will ascertain the viability and appropriateness of each component. We agree, and thus the reason for submitting

electricity access and a need to enhance the enabling environment. Given the renewable sector is relatively immature it is not to be expected that there will be major transformations in the market through SREP alone but if well managed and executed the proposed programme should help further develop the renewable energy sector in the country. During the IP preparation the team has explored a wide number of business models and it is the intention that this component will draw on significant private sector input and investment. The predominant use of solar PV is anticipated; it is fortunate that there are already many examples of successful business models around the sale, financed supply and/or leasing of solar facilities. IFC's existing involvement and commitment to provide significant co-financing will be a key to the success of this programme.	to SREP. We agree and have been favorably working closely with the IFC throughout IP preparations.
RE for the Port-au-Prince metropolitan area	
The IP suggests that the preferred option for this project is that it be implemented through a PPP arrangement. Recognising the tensions that this may create given the current financial status of EDH, if such a project can be undertaken successfully it must provide a valuable pilot for public private collaboration for future power generation developments. At this stage the likely structure of the project financing and ownership has to be determined; it is suggested that SREP funds may be used either to buy down the initial cost and/or provide some form of guarantee against payments under any PPA with EDH. While the market may seek guarantees it is understood that to date all payments under existing PPAs have been met despite the financial weakness of EDH. Whatever structure is chosen it is recommended that the replicability of such a scheme be carefully considered to ensure that the demonstration	We have decided to go with the PPP option, and this is now reflected in the IP. Initial market sounding was done, which confirm that there are potential investors if the right conditions can be put in place. The final feasibility and the structure of the PPP option, however, needs to be considered by the time the project is being developed, and will also depend on the status of the EDH loss reduction program. However, the PPP option can only be pursued if feasible from both the private sector and Government side (e.g. the final tariff needs to be acceptable to the private sector, but also beneficiary to EDH). Agreed. The project will thus pay a strong attention to developing a regulatory framework under PPAs. It is expected that the PPP option will include public investment to buy down the cost of the project for the private sector, as well as a guarantee or other risk mitigation instrument for the private sector. The exact nature of the PPA and these instruments will need to be developed during

value of this first RE PPP can be realised. It is understood that IFC will provide advisory services to assist in the design and execution of the financing for this component.	the project preparation. Agreed. The project will pay keen attention to ensuring replicability, thus a reason for Component 5. The PPP Division in the Ministry of Economy and Finance will also provide feedback from PPP in other infrastructure sectors, to fully benefit from best practices.
RE for the Port-de-Paix remote grid	
This project is similar [Port-au-Prince remote grid] but will address the opportunity to explore private sector engagement, possibly through a PPP, on an isolated grid. The suggestion of a solar/wind hybrid would test not only the ability of EDH to implement such a project (after a poor record on an earlier small scale wind development in the same location) but again could provide an opportunity for private sector participation, if not at an ownership level, at least under an O&M contract. Again the structure of this project has yet to be defined but its replicability will be of key importance if EDH and the electricity market are to gain real value from the SREP intervention.	Agreed. This is our anticipation as well. Agreed. And as said above, the project will pay keen attention to ensuring replicability, thus a reason for Component 5.
Off-grid electricity component	
This component will help reinforce existing programmes in off-grid situations where EDH has no presence (nor current interest). It will support IDA and IFC efforts and has the potential to provide the most substantive impact in terms of delivering electricity to those who have limited access to power today. Off grid activities appear to be better supported by the private sector and there seems to be a good level of sharing of experiences with other countries with nascent renewable off grid markets. If this segment of the market can be well catalysed by SREP and others then it may well help address some of the reluctance to participate in grid connected activities.	Agreed. Agreed. The private sector involvement and interest during IP preparations strongly supports this.

Rehabilitation of existing small hydro plants	
While the benefits that could be derived from the rehabilitation of existing hydro plants and the potential development of new facilities are noted, it is understood that this component is heavily dependent on additional funding. While it is being promoted under an SREP umbrella, this component appears to be of lower priority and subject to further analysis and funding.	Due to the level of expertise in hydropower engineering and operation in Haiti and the GOH willingness to use optimally the SREP resource to scale-up untapped renewable energy sources, rehabilitation of small hydro plants priority has been lowered for SREP funding. Other reason is also potential availability of other funds for this task, including IDA and Norway (both are being explored now). Unlike the other components, this component can also be developed in phases, starting with available funding while fundraising for additional funds.
Building enabling environments for RE scale-up	
In reviewing the IP and the work being undertaken by others it is clear that these [technical assistance] issues permeate all efforts to support the growth of energy investments in Haiti. This component is important, but although a modest investment, it will be important that there be a careful balance between efforts directed into this component and the implementation of projects under others. We all recognise that there is no "quick fix" for many of these concerns; the declared intent of the IP that it is seeking to move quickly to demonstrate solutions is important. The cross cutting nature of the issues has been identified and needs to be effectively managed through a mix of stakeholders to ensure equitable progress can be made while avoiding unnecessary programme delays. The IP acknowledges that there are a considerable number of unaddressed hurdles to renewable implementation; there are strategies and an allocation of responsibilities to particular agencies to address these. Without prior engagement with these agencies it is hard to assess whether these tasks can reasonably achieved by these entities. This process will require close monitoring as the success in	Agreed. Thus the reason for including a TA/enabling environment aspect under each component. Although investment in this component is modest, it is expected that it will be complemented by joint efforts from all donor partners and good coordinated dialogue in the sector. Agreed. During IP preparations stakeholder involvement has been remarkably high. This is anticipated to continue through implementation ensuring the avoidance of unnecessary delays due to the programs cross-cutting nature. Agreed. The strategies and allocation of responsibilities to particular agencies to address potential hurdles as outlined in the IP

establishing a sound enabling environment will be a key control on the value of the SREP investments. While component 5 of the SREP programme notes close engagement with academic stakeholders, the oversight of the SREP programme may benefit from the inclusion of private sector representatives on any Steering Committee. Engaging the private sector at this level may bring longer term benefits as they become more actively involved in the renewable energy sector.	was put forth after many in depth consultations with the respective agencies, thus we feel the suggested mitigation approach is appropriate and viable. Thanks for the ideas. We agree it is worth exploring.
Financing plan /allocation across components	
It is understood that the commitments to co-financing are at different stages and that some will only be confirmed once the SREP funds are available. As is often the case, this may mean that both SREP and co-financing may be conditional on the confirmation of matching sources. The assumption has been made that the SREP funds will be disbursed through the World Bank and IFC, as indicated in the attached table. This will influence procedures for final applications, timing and delivery of funds but, given the current activities of both organisations under existing (or planned) programmes, this should help the efficiencies around disbursement and programme management. In both components 1 and 3 implementation will be dependent on a substantial private sector investment and the challenges around securing such financing has already been recognised in this review and throughput the IP.	The IDA co-financing is confirmed as it is from an already approved Haiti Infrastructure Rebuilding and Access Project (PRELEN), activities of which has now been re-prioritized to fit the SREP prioritized components. All indentified co-financing can be legally carried out under the existing project. In case PRELEN project is restructured based on the mid-term review results (June 2015), the amount of co-financing may even increase, in particular for Component 3. IFC co-financing is also very likely to materialize as it is based on the existing project IFC is pursuing. Noted.. Yes, our active dialogue during the SREP consultations provided promising signals on private sector participation.

Key risks	
The plan outlines how it is anticipated that SREP investments and programme support will help attract other donor and private funding. The engagement with the private sector is recognised as a significant challenge given the current financial situation of the electricity sector in Haiti. It is however believed that the IP sets out appropriate and reasonable strategies as to how this will be attempted.	Thanks. We emphasize again here the necessary conditions that have to be in place (progress in the implementation of EDH loss reduction plan) to allow engagement with the private sector on on-grid RE.
Access to energy in Haiti is very low. The work being proposed under the IP, in collaboration with other donors active in Haiti, is seeking to start to build a more robust model to address this issue. The historical access to energy has been poor and this has been exacerbated by the 2010 earthquake, although this has provided some much needed focus on accelerating programmes to increase access.	Agreed. In addition, GOH clearly made the link between its vow to be an emerging nation and the implication in terms of acceleration of the energy access agenda.
The track record of EDH in implementing power developments has not been strong. There are however a number of current initiatives being promoted by the government to address serious shortcomings. Within the Ministry of Public Works, Transportation and Communications a specialised Energy Cell has been established and is tasked with managing energy access programmes. Recent reports suggest that institutional capacity and capabilities are being reinforced and there is a clear commitment to remove a number of obstacles to project implementation. Private sector capacity is believed to be reasonable and this will be key in building the off grid market.	Since the development program of the existing hydropower plants, EDH has not been building new generation capacity, which was left up to the IPPs. However, EDH active role in the SREP task force awoke willingness to be proactive on sector planning and training on new technologies.
The renewable energy sector in Haiti is clearly at a very early stage. The SREP funded activities are therefore more focused on establishing a strong and sustainable basis for future growth; there may be limited private sector engagement initially but the market strength is growing and appropriate legal and regulatory changes and enhancement of the enabling environment should help ensure future growth in the sector.	Capacity building will be an essential component of the SREP program, and will benefit all key governmental and non-governmental stakeholders.

The project implementation capacity within The Ministry of Public Works, Transportation and Communications and EDH is of concern particularly as there are a number of parallel energy programmes underway. Discussion with the SREP team suggest that there are a number of major efforts underway to help strengthen these organisations and the calibre of staff is high and there is a good level of engagement amongst them. The attraction of the private sector into larger grid connected projects is recognised as challenging but part of the SREP programme is to test the practicality of PPP projects and this experience can only be of value in determining the best models for future expansion of the energy sector.	The capacity has already been strengthened under the PRELEN project, with an introduction and strategic staffing of the Energy Cell, and this process will continue in the future—supported both by IDA and SREP. Agreed. That is why SREP support is sought—to establish a viable model that could be replicated also for future transactions.

ANNEX IX
MDB REQUEST FOR PAYMENT OF IMPLEMENTATION SERVICES COSTS

SCALING UP RENEWABLE ENERGY PROGRAM IN LOW-INCOME COUNTRIES **MDB Request for Payment of Implementation Services Costs**			
1. **Country/Region**:	Haiti/Latin America and the Caribbean	2. **CIF Project ID#**:	*(Trustee will assign ID)*
3. **Project Title:**	Renewable Energy for the Metropolitan Area		
4. **Request for project funding (USD millions:**	*At time of country program submission (tentative): Grant of* US$8-10 million	*At time of project approval: n/a*	
5. **Estimated costs for MDB project implementation services (USDmill.):**	*Initial estimate - at time of Country program submission:* US$428,000 *Final estimate - at time of project approval:*	*MDB: IBRD* *Date: April 2015*	
6. **Request for payment of MDB Implementation Services Costs (USD.mill.):**	❖ First tranche: US$128,000 ☐ Second tranche: *n/a*		
7. **Project/program financing category:**	a - Investment financing - additional to ongoing MDB project ☐ b- Investment financing - blended with proposed MDB project ❖ c - Investment financing - stand-alone ☐ d - Capacity building - stand alone ☐		
8. **Expected project duration** (no. of years):	5 years		
9. **Explanation of final estimate of MDB costs for implementation services:**	***If final estimate in 5 above exceeds the relevant benchmark range, explain the exceptional circumstances and reasons:*** n/a		
10. **Justification for proposed stand-alone financing in cases of above 6 c or d:** n/a			

SCALING UP RENEWABLE ENERGY PROGRAM IN LOW-INCOME COUNTRIES **MDB Request for Payment of Implementation Services Costs**			
1. **Country/Region**:	Haiti/Latin America and the Caribbean	2. **CIF Project ID#**:	*(Trustee will assign ID)*
3. **Project Title:**	Renewable Energy and Access for All		
4. **Request for project funding (USD millions:**	*At time of country program submission (tentative): Grant of* US$11-14 million	*At time of project approval: n/a*	
5. **Estimated costs for MDB project implementation services (USDmill.):**	*Initial estimate - at time of Country program submission:* US$428,000 *Final estimate - at time of project approval:*	*MDB: IBRD* *Date: April 2015*	
6. **Request for payment of MDB Implementation Services Costs (USD.mill.):**	❖ First tranche: US$128,000 ☐ Second tranche: *n/a*		
7. **Project/program financing category:**	a - Investment financing - additional to ongoing MDB project ☐ b- Investment financing - blended with proposed MDB project ❖ c - Investment financing - stand-alone ☐ d - Capacity building - stand alone ☐		
8. **Expected project duration** (no. of years):	6 years		
9. **Explanation of final estimate of MDB costs for implementation services:**	***If final estimate in 5 above exceeds the relevant benchmark range, explain the exceptional circumstances and reasons:*** n/a		
10. **Justification for proposed stand-alone financing in cases of above 6 c or d:** n/a			

SCALING UP RENEWABLE ENERGY PROGRAM IN LOW-INCOME COUNTRIES **MDB Request for Payment of Implementation Services Costs**			
1. **Country/Region**:	Haiti/Latin America and the Caribbean	2. **CIF Project ID#**:	*(Trustee will assign ID)*
3. **Project Title:**	Off-grid Electricity Services for Productive, Social and Household Uses Project		
4. **Request for project funding (USD millions:**	*At time of country program submission (tentative): Grant of* US$7-9 million	*At time of project approval: n/a*	
5. **Estimated costs for MDB project implementation services (USDmill.):**	*Initial estimate - at time of Country program submission:* US$440,000 *Final estimate - at time of project approval: n/a*	*MDB: IFC* *Date: April 2015*	
6. **Request for payment of MDB Implementation Services Costs (USD.mill.):**	❖ First tranche: zero (the full amount of US$440,000 will be requested at the time of SREP Sub-Committee approval of the IFC Program proposal)		
7. **Project/program financing category:**	a - Investment financing - additional to ongoing MDB project ❖ b- Investment financing - blended with proposed MDB project ☐ c - Investment financing - stand-alone ☐ d - Capacity building - stand alone ☐		
8. **Expected project duration** (no. of years):	5-10 years		
9. **Explanation of final estimate of MDB costs for implementation services:**	***If final estimate in 5 above exceeds the relevant benchmark range, explain the exceptional circumstances and reasons:*** n/a		
10. **Justification for proposed stand-alone financing in cases of above 6 c or d:** n/a			

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[28] World Bank: Creating Opportunities for Poverty Reduction in Haiti, 2015
[29] Fonkoze was founded in 1994–95. Its name is an acronym for the Haitian Creole phrase "Fondasyon Kole Zepòl" meaning "Shoulder-to-Shoulder Foundation." In 2012, Fonkoze's "Solid Women" video won a Do-

Gooder award for its story of five Haitian women who used Fonkoze microloans to help rebuild their community after the 2010 earthquake. https://www.youtube.com/watch?v=tq8uSiP6_lQ.
[30] World Bank esitmates, 2015
[31] Worldwatch, 2014
[32] Except a pilot project launched in Port-de-Paix in 1978 with support of German Development Cooperation. It stopped running in 1991 due to lack of maintenance and of operational skills by local EDH staff. See Project Brief 2.
[33] http://www.indexmundi.com/energy.aspx?country=ht&product=hydro&graph=production
[34] EDH, 1977 and Soleo, 2012
[35] EDH, 1977 and Soleo, 2012
[36] UNEP, 2006. Report: Background Data Collection on Bio-energy in the Caribbean and Central America
[37] Winrock International, 2008. Presentation: Diversifying the Energy Matrix: The Role & Opportunities for Biofuels
[38] According to a study by Belgian Company 3E in 2010. Potential was estimated for three sites in Haiti: Cap Haïtien, Jacmel, and Lac Azueï (Etude de vent dans trois sites en Republique d'Haiti. E3, 2010).
[39] <http://www.bme.gouv.ht/Carte%20des%20vents/PR_PR101252_Final_report_part2_PotentielDeProduction_final.pdf>
[40] http://irena.masdar.ac.ae/
[41] Worldwatch (2014) lists other potential sites
[42] The location of the 150 kW wind farm pilot project.
[43] Commercial and industrial users partly or fully self-supplying given grid unreliability, and wishing to complement current expensive diesel generation with PV as a cogeneration "fuel saver."
[44] Nexant. 2010. Report: Caribbean Regional Electricity Generation, Interconnection, and Fuels Supply Strategy
[45] GIZ 2013 & 2014a, IEA 2014, RMI 2014
[46] WEC 2014
[48] GIZ/ESMAP 2014
[49] Similar benefits are illustrated for the case of Brazil, Germany and Italy in GIZ (2014b)
[50] The results of this study are available in separate background documents on Digicel/iiDevelopment 2014 energy survey analysis with 1,400 respondents, including detailed analysis of the costs (cash-flow analysis) and benefits (consumer surplus).
[51] Tiers are defined in the Multi-tier Framework introduced in the World Bank/SE4ALL Global Tracking Framework (2013) and updated in the 2015 edition.
[53] Based on Reiche, Rysankova, Fraatz 2015
[54] For example, preliminary wind speed estimates suggest that a 10 MWp wind generator at Lac Azueï or a biomass cogeneration IPP in Port-au-Prince would have lower higher returns than a 10 MWp PV plant.
[55] For example, an investor in a solar fuel-saver scheme would price in less off-take risk than a solar IPP.
[56] With output held constant, for comparability.
[57] For instance, once the best wind or hydro sites have been commissioned, costs per MWh for additional capacity will rise, while capex per MWh stays stable for PV for a practically unlimited cumulative capacity.
[58] For example, average fuel savings per MWh injected variable renewables from wind and PV usually increase from 0% capacity share to a certain plateau (GIZ 2013 and 2014) and then start falling beyond a country-specific tipping point.
[59] For example, wind capex remained largely stable over the last few years, while solar capex kept falling fast.
[60] Consultants and experts were asked to prepare independent scores because score cards inherently have a subjective element due to the (implicit or explicit) need to weight each subsidy performance indicator for a total score (Teplitz et al. 2009).
[61] It maps RE resources to villages and infrastructure, similar to the current RE mapping efforts of ESMAP and IRENA.
[62] Rather than including a TA or capacity-building component in each project. This would be more usual, but could fragment efforts and lead to inconsistencies.
[63] An overview of the SE4ALL Multi-tier Framework is at http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/05/24/000445729_20130524104654/Rendered/PDF/778890v20GTF0o0Official0Use0Only090.pdf

[64] The Task Force consists of the Ministry of Environment, Ministry of Economy and Finance, Ministry of Agriculture, Natural Resources and Rural Development, Ministry of Planning and External Cooperation, EDH, CIAT, and BME.
[65] The type of RAP will depend on the number of persons affected by resettlement effects experienced as a result of the project.
[66] 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-World Bank London Investor's Conference on Private Sector Led Off-Grid Electrification: Executive Summary, The World Bank Group, 2013
[67] International Monetary Fund: "Haiti: Eighth Review Under the Extended Credit Facility and Request for Waiver of Nonobservance of Performance Criterion-Staff Report; Press Release; and Statement by the Executive Director for Haiti", Country Report No. 15/3, Washington, DC, 2004.
[68] International Monetary Fund. 2014c. "Haiti: Ex Post Assessment of Longer-Term Program Engagement", Country Report No. 15/4, Washington DC.
[67] The final capacity depends on technology (mix), final deal structures and result of ongoing wind studies. The technology mix, in turn, will depend on final grid absorption studies and in-depth vRE value calculation by substation, which will be finalized at project start.
[68] iiDevelopment 2015
[69] 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 transforming 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 health, education, agriculture, and fair trade, as well as three "*grannacional*" projects related to energy resources.
[70] EDH 1997, Soleo 2012, Worldwatch 2014
[71] As described in GIZ 2014b for PV markets in Brazil, Germany, and Italy.

APPENDIX 1. ECONOMIC ANALYSIS AND RATIONALE FOR SREP SUPPORT

A1.1 HOW ECONOMIC AND FINANCIAL ANALYSIS HAS INFORMED THE SREP IP

The steps that have been taken for ranking and selecting SREP priorities are explained in this document's main text. This section provides background on the ECONOMIC AND FINANCIAL ANALYSIS that was performed as a main input to these steps.

This analysis has to be performed separately (a) for the off-grid market (but covering all relevant segments) and (b) for the on-grid market (again covering all relevant segments), because:

(a) the most appropriate method for off-grid cost-benefit analysis is to calculate the benefits on household- and firm-level (and then on aggregate project and market level) by way of consumer surplus analysis,[1] while

(b) on-grid renewables are assessed based on the network-level costs and benefits resulting from injecting (variable) amounts of (intermittent) renewables to the power grid.[2]

We have been able to perform both (a) and (b) in large part as a quantitative analysis already at SREP IP stage, thanks to the ECVMAS (2012) and Digicel/iiDevelopment (2014) surveys, as well as a pragmatic application of vRE cost (Navigant/IDB) and benefit (iiDevelopment/WB) analysis as outlined in Heising et al. (2013).

In part due to the different viewpoints of (a) and (b), comparing the relative merit of these two RE market segments—for the transformational scale-up (aka market development) objectives SREP seeks *jointly* in one quantitative metric does not make much sense.

Therefore, we have applied the scorecard approaches proposed in GIZ (2009) and SREP (2014) in order to identify the RE market segments that have been identified as the most promising for SREP (the 12 business cases on the next page, as described in the main text). The final version of the economic and financial analysis for each of the SREP projects proposed in this IP will be done at PAD stage.

The following two tables outline *The Total Universe of RE market segment* ("Long List") and *The Most Promising 12 SREP Cases* ("Short List") selected for detailed analysis.

[1] World Bank IEG 2012 and 1995
[2] World Bank 2013 and 2015 and GIZ 2013

TABLE 1. THE TOTAL UNIVERSE OF RE MARKET SEGMENT

HAITI SREP FRAMEWORK

TABLE I.B Example Cases and Typical Technologies

System Types # 1-7:		pilot case examples in Haiti & typical pipeline candidates	International Pilot Case Examples	typical generation technology	other typical technology features
A. SINGLE USER (mostly offgrid & no LV)***	1 pico	SAFICO / MICAMA	WBG Lighting Africa; EnDev Rwanda, Tanzania; GIZ Peru ICS; HERA ICS	PV; ICS1	led+fon
	micro	digicel	WB Bangladesh; Bolivia GPOBA	PV; ICS1	N LEDs/Fons + small TV
	2 mini**			PV; ICS2+	+large TV+fan
	small			PV (may have genset)	+Laptop + X (small fridge?)
	3 large	Haiti Futur; fonseca branches; Enersa	WB Solar SU Toolkit; EnDev Ethiopia; Ulm PV Symposium	PV or BM cum diesel (hydro? wind?)	size & appliances higly dependent on User
B. MULTI USER (mostly connected to LV)***	4 pico	digicel street lights cum (free) community cell phone charging; earth spark Les Anglais 2013	Sierra Club "Skinny Gids"; GIZ Nepal; Nicaragua ATDR-BL	PV, possibly pico Hydro	mostly DC
	micro	earth spark Les Anglais '15& Tiburon	GIZ Kenya and Rwanda; WB Sri Lanka; PERMER; PERZA; AFR INENSUS systems; TTA/ISE Hybrids; etc.	typically Hybrid Systems - pv, hydro, bm, diesel, batt	with battery, "24h access, not 24h use"
	5 mini**	earth spark Les Anglais 2017			<24h? Can be with our w/o battery
	small	SELF/NRECA (Port-a-Piment)			FIRR best without battery
	6 large	Mirebalais hospital	GIZ Island & Carecom programmes; OTTI island case studies; Guadeloupe RE	pv, hydro, diesel, bm (wind?)	Connect (later/now) to EdH?
	7 XL RE	Lac Azuei; HER	GIZ vRE programme; IEA RE planning guidance; DLR ReMix	pv, hydro, diesel, wind (bm?)	connected to EdH

TABLE 2. *THE MOST PROMISING 12 SREP CASES*

SREP CASE #:		Customer segment / Scale / Owner of RE / Seller (SPV Owner)	GENERIC SREP BUSINESS CASE	RE Resource	Example Cases
A. OFFGRID Single User	**1**	stand alone / W / Household or Lease/PPA / business/NGO	SUPPLY RESIDENTIAL SOLAR PRODUCTS	**solar**	Enersa TOTAL Micama
	2	stand alone / kW / Enterprise or Lease/PPA / business/NGO	SUPPLY PRODUCTIVE PV (PPV) SYSTEMS	**solar**	Drip Irrigation (LAC) Rural Stores Refrigeration (in LAC) Rural Community Tourism Enterprises
	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
	4	stand alone / kW / Government / business/NGO	SUPPLY COMMUNITY SOCIAL PV SYSTEMS	**solar**	L'Hôpital de Port-à-Piment School in Port-a-Piment (Electronic Learning Board)
B. OFFGRID Village Grids	**5**	remote grid / kW / Seller / muni/coop	SMALL SCALE PUBLIC REMOTE GRID	**solar**	Companies starting in Africa: PowerHive, TTA, etc..
	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?)
	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

	8	remote grid MW TBD business/NGO	LARGE SCALE [PRIVATE/PRIVATIZE/EdH] REGIONALGRID	**hydro**	Pichon/Belle Anse?
				wind	Port de Paix?
				solar	Proposed Caracol. Other countiries (Australia?).
C. ONGRID RE (EDH GRid)	**9**	main grid MW Government govt	LARGE SCALE GOV'T DG	**hydro**	Saut Mathurine (rehab)
					Guayamouc (new)
	10	main grid MW Seller business/NGO	LARGE SCALE Public or Provate	**wind**	Lac Azuei/Étang Sautmâtre
				solar	may be part of virtual utility pv + wind
	11	stand alone/main grid hybrid kW Customer or Lease/PPA business/NGO	BEHIND-THE-METER SOLAR	**Solar:** a = fuel saver + feed-in. b = fuel saver no feed-in	Hôpital Universitaire de Mirebalais
					L'Hôpital Bernard Mevs (Port au Prince)
	12	stand alone/main grid hybrid MW Customer or Lease/PPA business/NGO	BEHIND-THE-METER BIOMASS	**Biomass:** a = fuel saver + feed-in. b = fuel saver no feed-in	Darbonne Sugar Mill (Léogâne)
					Unikode Distllery
					Barbancourt Distillery (La Plaine du Cul-de-Sac)

It is key to understand that both the quantitative and qualitative performance of SREP project alternatives depends on the funding volume of that SREP alternative (against SREP performance criteria, which include most traditional Aid performance criteria) and the (related) net increase in market share this alternative aims to achieve. Therefore, any prioritization process (that is, the underlying analysis of the absolute and the relative merit of each project alternative) also needs to determine optimal volume ranges for each intervention/market segment cluster that SREP targets. The latter determines the former, so that both have to be done iteratively in practice.

While we have taken the most probable estimates for scalable RE business models, their cost structures and growth constraints (informed by in-depth consultant analysis of Haiti's off-grid sectors and in comparison with international lessons—Navigant et al. and iiDevelopment), it should be noted that the SREP vehicles will leave the final design of business models, sales strategies and type of pre-financing and user financing open to the

private sector providers who shall apply for funding / participation (technology neutral and business model neutral approach), inside the prequalification boundaries defined during final preparation of each project, so as to assure good practice and sustainability. Therefore, the results of our economic and financial analysis, and the spatial data we have generated during preparation (such as the data on RE resources, and WTP distributions by Department) will be made available publicly, so private sector can use them to their own device. The GIS under preparation by IDB, linked in with a "living web page" will serve as a one stop shopping point for this data. In addition to (i) the direct private sector use of this valuable marketing data (as demonstrated in the WB Bolivia IDTR and GPOBA projects), it will also (ii) allow other stakeholders to enter additional data during implementation, and at the same time, (iii) allow users and co-funders of off-grid projects to track progress, thus increasing sustainability via multiple peer pressure effects.

A1.2 ECONOMIC ANALYSIS OF ON-GRID RENEWABLES: SREP MARKET SEGMENTS 9-12

OBJECTIVES AND TOOLS FOR RE NATIONAL PLANNING

Planning the scale-up of private sector-led on-grid renewables (RE) in any given country is a challenge, because appropriate methods and instruments have started to emerge only recently (GIZ 2013, IEA 2014, RMI 2014). 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 unfavorable PPAs lead to inefficiencies.

In absence of readily applicable optimization software, it is best to work in a phased approach (Table on next page), by starting a pragmatic mix of methods and planning tools, and add more advanced planning tools on the way (GIZ/ESMAP 2014 and GIZ 2015):

1. **Starting** with relatively simple tools (such as the RE Supply Curve and scorecards used as the current SREP standard), some quick RE planning results can usually be derived in a matter of only a few months. Typically, this early phase could result in initial estimates for the maximum amounts of PV and wind that can safely be absorbed by the grid as is (say, 10% of capacity);[3] quantifies how much hydro can help improve grid absorption capacities and dispatch; and/or identifies self-consumption "fuel saver" cases (say, for large social users) which pose no ramping risks and can be done fast; etc.
2. In parallel, to prepare **RE planning phase 2**, wind, hydro and biomass data is collected and in-depth quantitative national RE absorption studies are started for steady-state and dynamic modeling of economically optimal and technically feasible scale-up, based on existing expansion plans. A growing number of tools for this phase is currently emerging (GIZ 2014). Simulations in this phase often indicate where investments in problematic parts of the grid can be deferred.
3. In the **final planning phase**, RE planning is fully integrated into the existing national power planning software, and grid expansion plans and generation investments are planned in an integral way.

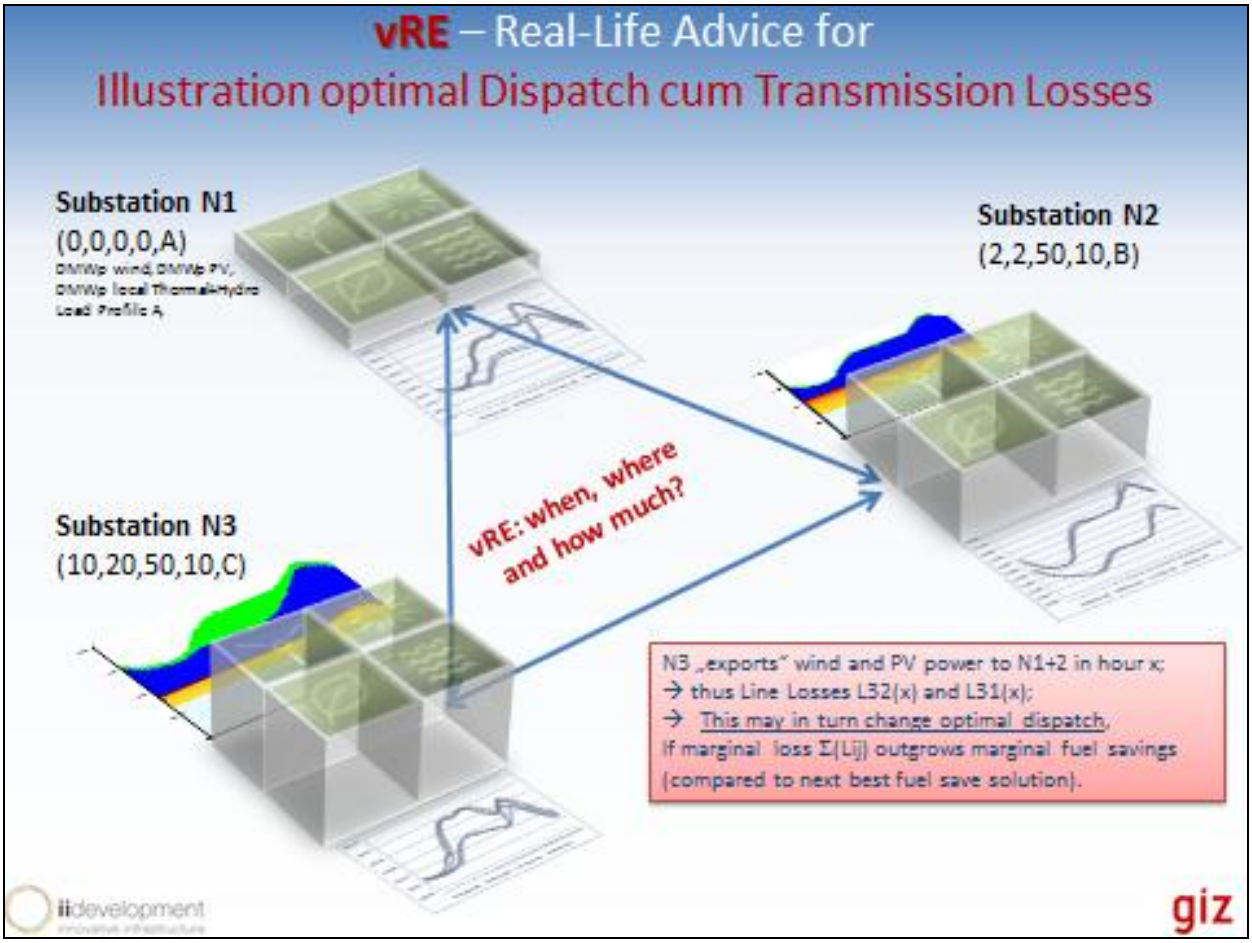
[3] If fast initial investments are desired in years 1-3 of a new national RE program, these are often easier to achieve with PV and/or biomass than wind, due to the shorter lead time (no measurements needed) and the smaller effect of scale economies (compared to wind). By contrast, the subsequent phase, wind is usually the more interesting technology for fast ramp-up, because once the best sites (for LCOE as well as network benefits) have been identified based on solid wind measurements, the best wind sites usually allow for better net benefits than all other technologies. The initial "quick PV investments" are often triggered by simply, capped net-metering or partial feed-in schemes.

TABLE 3. A TYPICAL MENU OF NATIONAL RE PLANNING OPTIONS

0. Tool Mix: Timing → Tools!	Short Term = Small	Medium	Long	Xlong / Xlarge
Implementation time:	1-3	2-10	5-20	10-50
Planning time:	**1-2:** Gov Learns! (Caps)	**1-3:** Gov Guides! (Corridors)	**1-5:** Gov Plans! (Pricing)	**1-10**
Typical Step:	**Quick PV** reduces emergency & shedding	**Best Wind** saves fuel & defers grid & thermal invest	**All vRE →** integral, optimal pathway (s,t)	Smart Grid 2.0 with storage, power2gas, etc.
vRE Toolbox	**S: check roughly** CBA and 99% OK with Power System as is	**M: Add-on** vRECalcs shifts timing of original power sector plan	**L:** Seamless optimization of vRE & Thermal	XL
Planning Cost [M$]	0.1-0.5	0.5-1	>1	?
Typical share capacity (energy)	<5% (1%)	30% (10%)	100% (25%)	
Typical FAQ	Safe cap? Fair Cost? Specs? Tender docs?	Guide? Optimize Cost+Benefit? Regional Distribution?	Integrate into National Planning Software & Process	

Source: GIZ/ESMAP (2014)

FIGURE 1. NATIONAL RE SCALE-UP PLANNING: HOW MUCH RE SHOULD BE COMISSIONED AT DIFFERENT SUBSTATIONS AND TIMES?



Source: GIZ (2014c)

The main objective of all National RE Planning Phases is the same: to optimize the total net benefit (welfare gain) – that is, the properly discounted benefits minus costs over system lifetime - from all on-grid RE sources which are added over time, by choosing one out of many possible national scale-up pathways. The objective function is illustrated in the figure above: How much of each RE alternative should be added to which part (node, substation) of the national power system at which point in time?!

Answering this main question of national RE planning requires the actual quantification of RE costs and benefits (IEA 2014, RMI 2013, GIZ 2013). This attention to RE benefits (as opposed to costs only) is of major import for national SREP planning: an overall economic scale-up has to optimize not only costs at t0 (as done in many past RE programs), but total Net Benefits of project alternatives over time and (IEA 2014, WEC 2014). We have taken this into account for SREP prioritization.

Optimizing vRE costs and benefits should be done with robust, quantitative methods during later planning phases (vRE National Planning Phases 2 and 3 above) by use of advanced planning methods such as WASP, or the methods used for the next section.

However, as early as RE Planning Phase 1, it is often possible to identify an initial planning horizon based purely on a relatively simple analysis of the typical patterns by which costs (see financial analysis section) and benefits (see below) of different RE technologies change over time:

The distinctly different dependencies of wind and solar COSTS and BENEFITS on (i) TIME, (ii) SITE AVAILABILITY and (iii) RE SHARE strongly influence the optimal scale-up path in a given country. This is because

1. **Net Present Value** of vRE = **F1 (Costs and Benefits)**, with the main determinants (cum grano salis) as follows:
2. Costs = F2 (hardware delivery time t, site) and
3. Benefits = F3 (time t, site s, vRE Share or volume v).

The differences between these dependencies influences optimal national "RE pathways" in typical ways, as summarized in the table below:

TABLE 4. DIFFERENCES BETWEEN WIND & SOLAR DEPENDENCIES INFLUENCES OPTIMAL NATIONAL "RE PATHWAYS

	Solar	**wind**	*Re-marks:*
Costs (t)*	Capex fall fast with time	Capex fall slowly	*1*
Costs (s)*	Capex virtually site independent: usually unlimited supply of sites	Capex depend strongly on site: usually limited supply of sites with good wind speeds and close to doable feed-in spot	*2*
Benefits (s)*	can go up or down with site	can go up or down with site	*3*
Benefits (v)*	initially up, then down	initially up, then down	*4*
Benefits (t)*	depends on power planning for t-1	depends on power planning for t-1	*5*

* with other variables held constant
Source: GIZ 2015 (forthcoming)

EXPLANATION OF THE MAIN EFFECTS SUMMARIZED IN THE TABLE ABOVE:

1. PV Capex depend more on time than on site: 2015 Capex of wind and PV are roughly at par (US$2/Wp), but the strong decline of PV Capex is expected to continue over the next 5-10 years, while wind Capex will remain almost stable. Therefore, the ratio of viable PV and wind sites in any given country is shifting over time.

2. At the same time, wind Capex depend much more on the site than PV Capex (because wind speeds vary more, and wind energy depends on wind speeds in a cubic correlation). The LCOE of good wind sites in most nascent RE markets is better than PV LCOE, because the wind capacity factor (say, 20-50%) varies extremely between sites, while the capacity factor of PV is roughly stable at 20-25%. However, PV sites are virtually unlimited, while the best wind sites (which usually have much better LCOE than PV) start getting scarce at some point, with growing wind shares. It depends on the country and on time, at which share of national energy demand the tipping point is reached at which wind LCOE rise above PV LCOE - it may be well beyond reachable vRE shares, or well below.

As the actual vRE share beyond which all of "best wind sites" Si have been realized and wind LCOE rise beyond PV hurdle LCOE depends on the exact wind speed of the “best sites”, in situ wind measurements are often needed to tell exactly at which wind installed capacity this point would be reached. In that case of Haiti, available wind estimates for the best wind sites (Lac Azuei and North) vary considerably. In addition, LCOE at these sites depends on the exact wind capacities from which on additional investments in dispatch and network would be needed.

3. The benefits of wind and PV feed-in also depend strongly on WHERE the variable renewables are fed in. Note that this comes on top of the site-dependent cost issue above! The pivotal role of guiding vRE investments in such a way that they actually occur at those power grid substations and lines which profit most from the "line benefits" (Reiche et al. 2014) distributed generation can provide, especially in emerging countries with weak power grids, has all too often been neglected in past national RE efforts. This has led to unnecessary welfare losses, because wind and PV have been installed at the wrong sites, at the wrong time - for instance because tenders or FIT schemes only focused on least cost procurement, instead of maximum net benefit procurement (which is easily doable). For Haiti, this is somewhat less of an issue, because the system is so small and line benefits are so obvious.

4. As shown by (GIZ 2013 and Teplitz 2014), the pattern in which vRE economic benefits rise and/or fall with growing vRE shares depends on the country; but in countries with available hydro storage (which serves like a "battery" by shifting solar and wind power to load peaks under optimal dispatch) such as Haiti, the benefits from saved fuel (as

well as the related carbon benefits) are falling only towards very large vRE shares (well beyond SREP target) but typically rise initially.

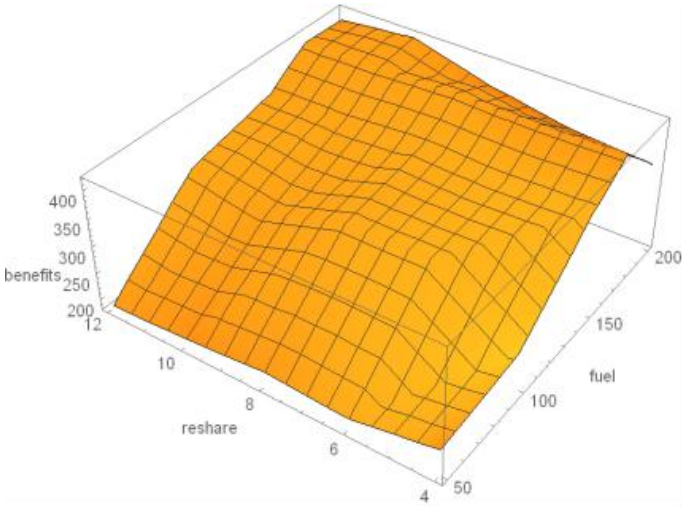
5. The benefits that result from adding Capacities *Ci* of wind and/or PV at the time *t* depend strongly on the investments in network and generation mix (both thermal and renewable) at *t-1*. This path dependency does NOT necessarily require full dynamic planning (though this would be ideal), but can be done in incremental steps - but it needs to INCLUDE vRE planning over time, for each step.

Due to the effects described above, it often makes sense to start with a small amount of PV and/or biomass cogeneration in year 1 of a new national program, while studying the optimal way to procure the (usually massive) potential of "best wind" sites in years 2-5 of said program. While doing so, Capex of PV will keep falling (not for wind or biomass), and larger amounts of solar can be ramped up in the 3rd phase. Obviously, the actual quantities and scenarios have to be analyzed for each country, as done in the next sections.

ON-GRID RE BENEFITS (SREP CASE 9-12)

Preliminary simulation (iiDevelopment 2015) of the actual Haiti Operational Benefits from injecting growing amounts of wind and PV into EDH's power grid has been performed as recommended in Teplitz (2013), without considering costs (including investments in dispatch). Full simulation will be done for PAD stage. Emerging results based on actual Port-au-Prince generation mix and demand suggest an optimum around 6-8 % of annual energy demand (figure below), which roughly equals a capacity of 20-40 MWp combined PV+wind.

FIGURE 2 SAVED FUEL EXCLUDING CARBON BENEFITS, COMPUTED WITH A MIXED INTEGER ALGORITHM AS PER TEPLITZ (2013)

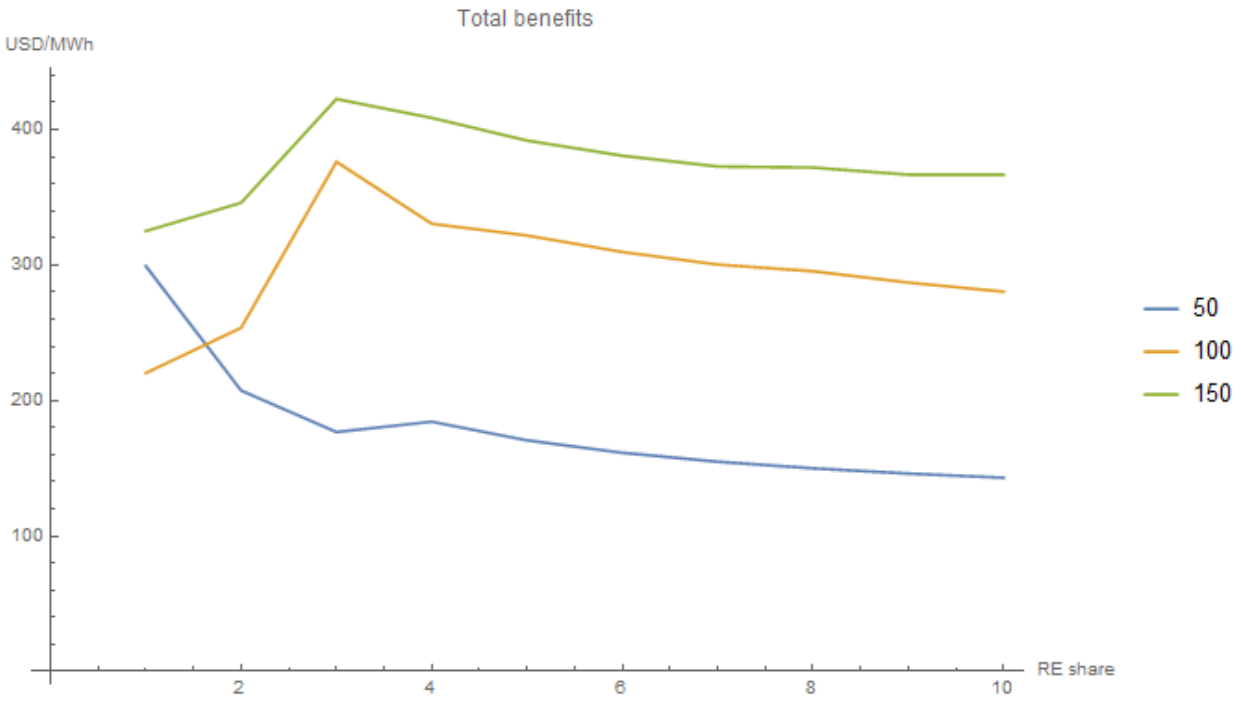


Source: iiDevelopment (2015)

When factoring in the jump in wind cost when going above 10 MWp (which is roughly the maximum amount that can be absorbed without significant investment in dispatch capabilities), and the comparative financial analysis of biomass, wind and PV (lower risk and dispatch impact of behind the meter distributed solar and biomass), this corresponds to the SREP target of mixing 1-2 wind IPPs at Lac Azeai with several smaller solar and biomass plants for DisGen, totaling around 15-30 MWp.

The figure below shows the Operational Benefits of injecting growing amounts of wind and PV energy into EDH's PaP grid (as is), at the same point in time, but for different fuel costs (colored lines for y (x) - including carbon benefits). For US$50 and US$100/BBL, there is an optimum (in today's generation mix) around 3-4 % of annual energy demand.

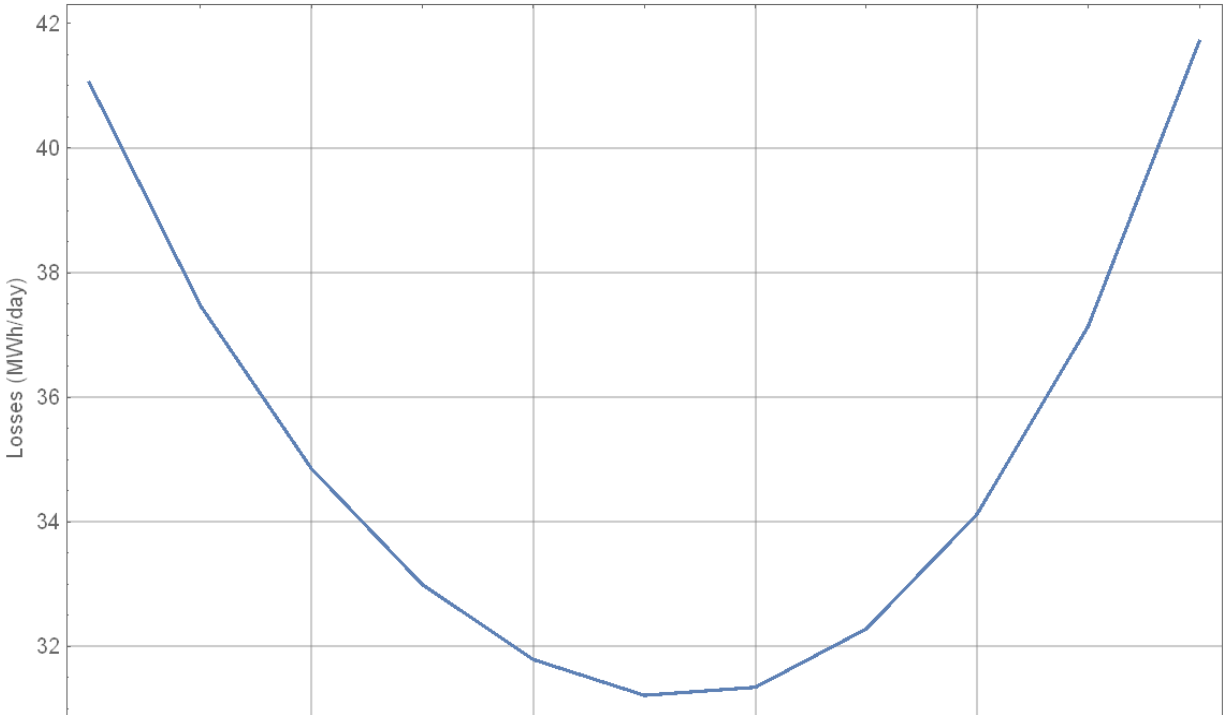
FIGURE 3. THE OPERATIONAL BENEFITS (Y AXIS, IN US$ M) OF INJECTING GROWING AMOUNTS OF WIND AND PV ENERGY (X AXIS) INTO EDH'S PORT-AU-PRINCE GRID



Source: iiDevelopment (2015)

The next figure shows initial results for the benefits from reduced line losses when injecting growing amounts of wind in Port-au-Prince system. Initially, the wind power injected at the Delmas station reduces the heavy load on this part of the grid, but from a certain capacity on, line loads increase due to the growing wind injection, so the contribution of wind to "line induced fuel savings" dwindles again (final simulations will be done for PAD).

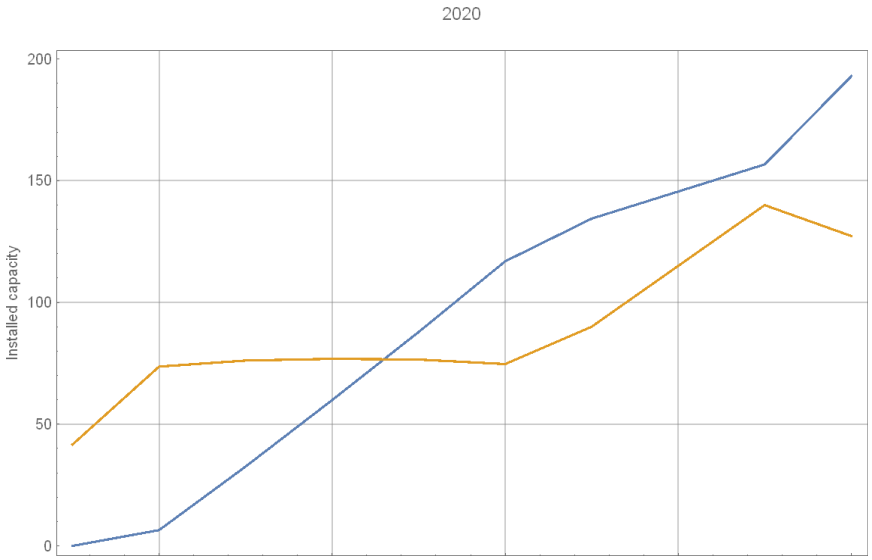
FIGURE 4. ILLUSTRATIVE GRAPH WITH THE INITIAL RESULTS FOR THE BENEFITS FROM REDUCED LINE LOSSES WHEN INJECTING GROWING AMOUNTS OF WIND IN PORT-AU-PRINCE SYSTEM



Source: iiDevelopment (2015)

In the last figure of this section, we have simulated the optimal mix of PV and wind for growing vRE shares in Port-au-Prince if wind and PV had already reached parity at this site (say, in 2025): one can see that initially PV has the higher benefits (because it is distributed and can alleviate different substations), but from a certain capacity (quantities indicative, final results will be calculated at PAD stage) on a mix of the two will be optimal. Actual wind measurements at Lac Azuei will be needed to decide the optimal time and capacity for wind at this – best – site in Haiti. Available estimates (3Tier, Meteonorm, several studies for GOH) vary by a factor of almost 2 in usable wind power for sizes >20 MWp, and PV Capex will keep falling while wind Capex will not.

FIGURE 5. THE OPTIMAL MIX OF PV AND WIND FOR GROWING VRE SHARES IN PORT-AU-PRINCE IF WIND AND PV HAD ALREADY REACHED PARITY AT THIS SITE (SAY, IN 2025)



INITIAL ANALYSIS BY AN INDEPENDENT CONSULTANT (NAVIGANT ET AL. 2015) OF POSSIBLE ON-GRID RENEWABLE ENERGY BUSINESS MODEL COST, MARKET VOLUMES AND SUBSIDY NEEDS

The SREP Preparation Team identified six alternative on-grid renewable energy business models for Haiti. As shown above, RE business models vary across several dimensions, including customer segment, scale, financing, legal structure, product, seller, owner, resource, etc. The initial FINANCIAL ANALYSIS of the main business cases identified as the most promising ones for SREP was performed by Navigant et al. 2015 during SREP preparation, together with initial estimates of MAXIMUM MARKET VOLUME for each of these business cases, and the related probable SUBSIDY NEEDS, based on the framework of market segments established by the joint SREP preparation group, as indicated in the main IP text.

Next, we have examined one or more (existing or planned) examples of each business model in Haiti. There are, of course, other potential business models. But these six are a highly representative and comprehensive set.

We then performed a simple discounted cash-flow analysis for each of the six business models using data and judgment from our experience in Haiti and elsewhere. For each case, we developed baseline, as well as more favorable and less favorable cases. All assuming "business as usual" with no specific renewable energy interventions from IDB, World Bank or IFC.

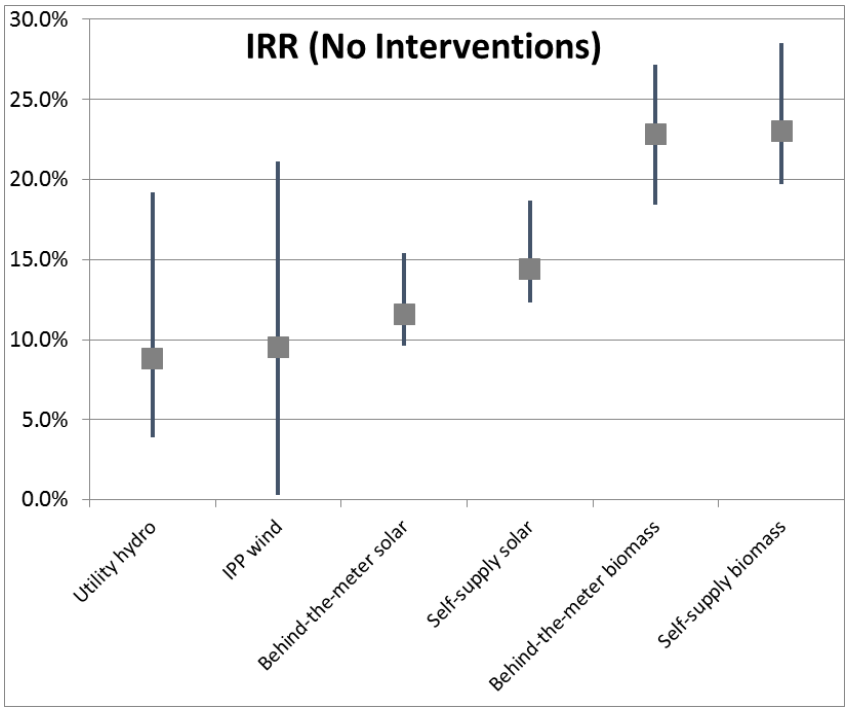
The results of the summary financial analysis in the table and figure below show a range of unlevered IRRs for each business model. Utility hydro and IPP wind business models show IRRs around 10% with substantial variation, behind-the-meter and self-supply solar business models have IRR's between 10% and 15% with modest variation, and behind-the-meter and self-supply biomass business models have IRRs between 15% and 20% with substantial variation. The nature and magnitude of the variation is different for each business model.

It should be noted that the resulting unlevered IRRs might not be acceptable to early stage equity investors and/or debt providers in these early stage RE market segments in Haiti, in absence of additional incentives and/or partial risk or credit guarantees.

TABLE 5. IRR RESULTS TABLE OF EACH BUSINESS MODEL ASSESSED

Label	IRR		
	Bad Case	Good Case	Baseline
Utility hydro	3.9%	19.2%	8.8%
IPP wind	0.3%	21.1%	9.5%
Behind-the-meter solar	9.6%	15.4%	11.6%
Self-supply solar	12.3%	18.7%	14.4%
Behind-the-meter biomass	18.4%	27.2%	22.8%
Self-supply biomass	19.7%	28.5%	23.0%

FIGURE 6. IRR RESULTS GRAPH OF EACH BUSINESS MODEL ASSESSED



A1.3 OFF-GRID RE ECONOMIC AND FINANCIAL ANALYSIS

BENEFITS OF *SREP MARKET SEGMENTS 1-8*

As described in a separate background document (iiDevelopment 2015), we have used the ECVMAS (2012) and Digicel (2014) surveys to estimate the income-compensated electricity demand function for Haiti, and then used it to calculate the minimum benefits from an SREP-induced switch of households from their current energy mix (say, Tier 0, 1 or 2) to an improved energy mix (say, Tier 2, 3 or 5). The figures at the end of this section illustrate some of our results.

Suppose it is planned to electrify off-grid households by means of solar lanterns, solar home systems (SHS) and solar-powered mini-grids with generation capacities in the range of 2 Wp - 400 Wp per household, corresponding to a monthly per-household electricity supply of 0.37 kWh - 73 kWh. Since demand will be constrained by supply (depending on the installed Wp/household), the monthly WTP of a household can be estimated by integrating the compensated demand function over [∞, P(X)], with P(X) ranging from pso=pn/.{Y->10000, q->73} = 3.28142 HGD to ps1=pn/.{Y->10000, q->0.37} = 101.51 HGD.

For instance, in the case of a 5 Wp Solar Lantern or Small Kit with a monthly output of 0.9 kWh, the annual WTP (benefit) amounts to HGD 810.799. Hence, the present value of this benefit over a period of 20 years (10% discount rate) would be HGD 6,902.79. Whether it is worthwhile buying this solar system depends on its cost. With estimated present value of lifetime costs of HTG 3,450-6,440 (US$75-140), the system would be economically viable.

The same holds true for a mini-grid with an installed solar capacity of 0.400 kWp/household. The present value of benefits per household would be HGD 13,499. This is more than the estimated minimum present value of lifetime costs of HTG 110,000-190,000; thus, the village grid system would be economically viable only if it is installed at very cost per user, or if SME anchor clients exist in situ, with higher willingness to pay (compare US$0.50-2 /kWh in Port-au-Prince cogeneration).

Therefore, it is key to determine the exact costs and benefits of different SREP village grid cases at PAD stage and during SREP implementation, because for some cases (typically of the type small greenfield case 6) may be better served by means of 1-2 hybrid systems without LV grid for the anchor client (productive or social user) who then provides the villagers with PicoPV- or Solar Home System-based basic services (Tier 2-4, depending on size).

FIGURE 7. DEMAND FUNCTION FOR DIFFERENT LEVELS OF INCOME

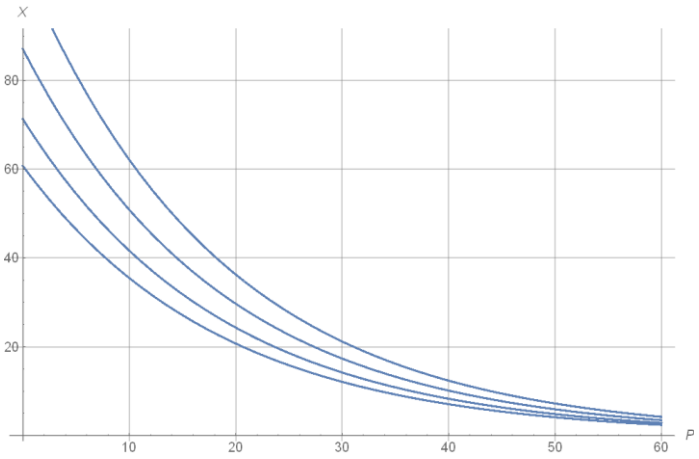


FIGURE 8. TOTAL WTP AS A FUNCTION OF INCOME

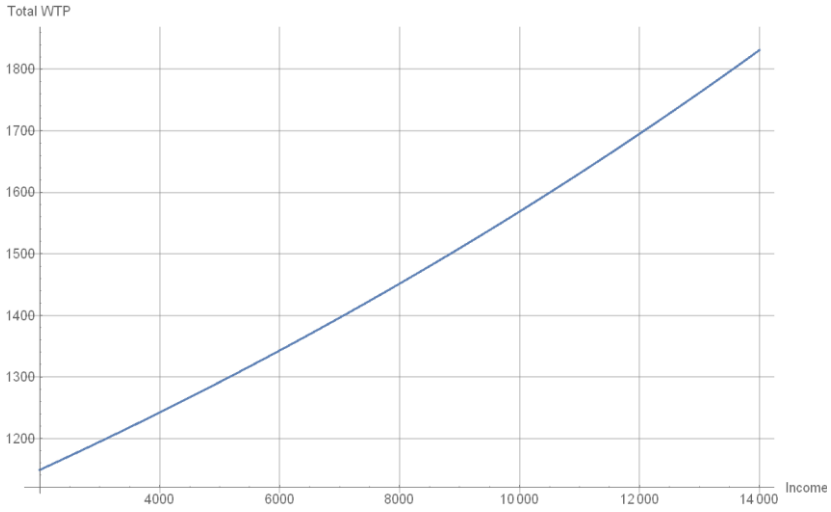
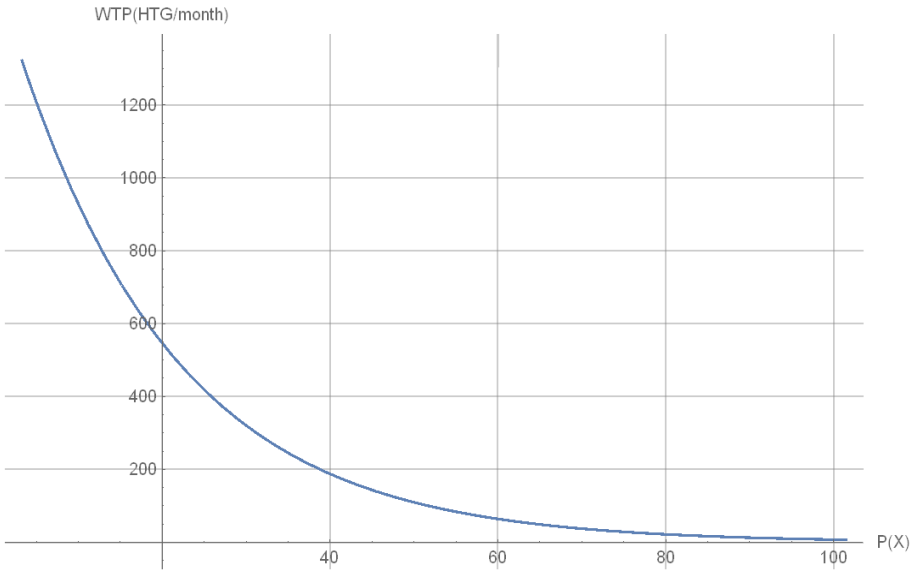


FIGURE 9. WTP AGAINST P(X)



SREP MARKET SEGMENTS 1-5: FINANCIAL ANALYSIS ON PROVIDER-LEVEL

Stand-Alone Solar Systems: Results of Initial Financial Analysis: Cost, Income, Market Volumes & Subsidy Estimates with and without Project.

Summary:

Estimates informed by WTP data

Electricity Solution Demand Calculations: Stand-Alone Solar

Location								Access Calculations			
Year	Population Growth	Country of Haiti	Department	Urban	Peri-Urban	% Rural	Rural	Grid Access	# HH with access	Off-Grid	# HH w/o access
								People	Ppl/HH	People	Ppl/HH
2015	Baseline	10,606,350				44%	4,648,976	10%	4.55	90%	4.55
								464,898	102,175	4,184,078	919,578
2020	7%	11,348,794				40%	4,576,452	15%	4.55	85%	4.55
								686,468	150,872	3,889,984	854,942
2030	21%	12,833,683				33%	4,275,198	20%	4.55	80%	4.55
								855,040	187,921	3,420,159	751,683

Stand-Alone Demand:

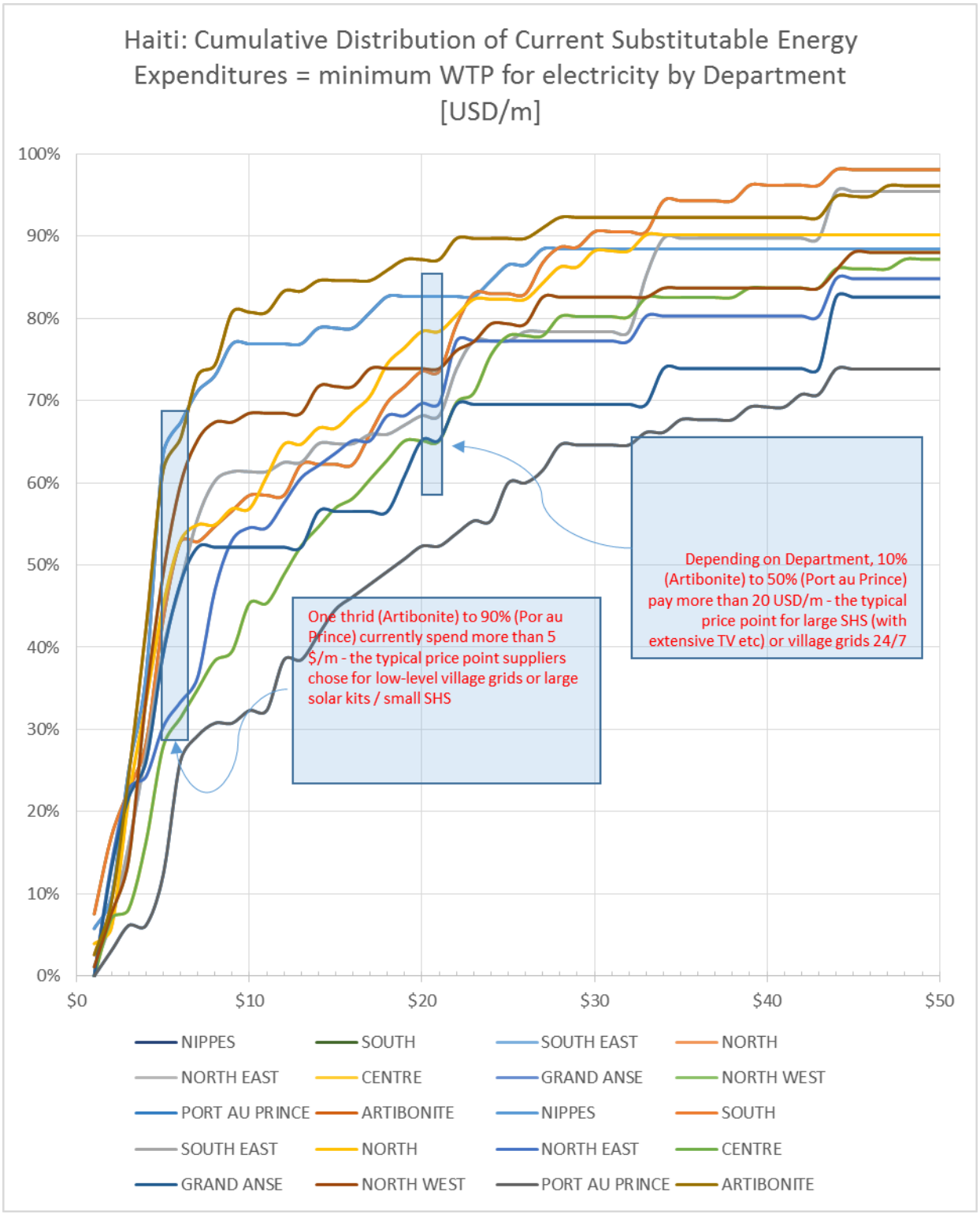
All of Haiti - Schools

\	Communes	Sections Communals	TOTAL of all Schools	3rd grade through High School			Preschool to 2nd grade				
				Total 3rd to HS	Public	Non-public	Number of Preschools	Public	Non-public	Preschools Exclusively	Preschool to 2nd grade
Ouest	20	112	5602	1758	63	1695	3844			589	3255
Sud-Est	10	50	645	157	38	119	488			73	415
Nord	19	82	1162	282	54	228	880			198	682
Nord-Est	13	36	417	91	28	63	326			60	266
Artibonite	15	63	1900	396	59	337	1504			57	1447
Centre	12	35	778	175	37	138	603			10	593
Sud	12	47	941	244	41	203	697			97	600
Grand-Ans	18	69	312	112	42	70	200			27	173
Nord-Oue	10	39	683	173	39	134	510			49	461
Nippes	11	37	392	89	27	62	303			15	288
Total	**140**	**570**	**12832**	**3477**	**428**	**3049**	**9355**	**601**	**8754**	**1175**	**8180**
Urban			**6306**	**2354**	**210**	**2144**	**3952**	**177**	**3775**		
Rural			**6526**	**1123**	**218**	**905**	**5403**	**424**	**4979**		

Available Infrastructure - Schools (not preschools)

	Category	Total		Public		Non Public	
		Number	% With Electricity	Number	Wit	Number	Percentage (%)
Electricity	Urban	645	27.4	23	#	622	29.01
	Rural	167	15%	10	5	157	17.35

Category of Health Facility	Type of Operation									3 Categories		
	Community	Military	Mixed operation	NGO	Private	Public	University	Unknown	Grand Total	Dispensary	Health Center	Hospital
Dispensary	27		66		181	164		62	500	500		
Field Hospital								17	17			
Field Team								5	5			
Health Center		1		1	1			163	166		166	
Health Center (Temporary Facilities)								6	6			
Health Center with beds			19		20	27			66		66	
Health Center without beds			35		150	42		10	237		237	
Hospital			9		26	23		114	172			172
Hospital (Temporary Facilities)							1	9	10			
Mobile Facilities								6	6			
Mobile Facilities (Temporary Facilities)								4	4			
Other								41	41			
Specialized Hospital			1		1	3			5			
Unknown								38	38			
Grand Total	**27**	**1**	**130**	**1**	**379**	**259**	**1**	**475**	**1273**	**500**	**469**	**172**


Haiti: Cumulative Distribution of Current Substitutable Energy Expenditures = minimum WTP for electricity by Department [USD/m]
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
$0
$10
$20
$30
$40
$50
One thrid (Artibonite) to 90% (Por au Prince) currently spend more than 5 $/m - the typical price point suppliers chose for low-level village grids or large solar kits / small SHS
Depending on Department, 10% (Artibonite) to 50% (Port au Prince) pay more than 20 USD/m - the typical price point for large SHS (with extensive TV etc) or village grids 24/7
NIPPES
SOUTH
SOUTH EAST
NORTH
NORTH EAST
CENTRE
GRAND ANSE
NORTH WEST
PORT AU PRINCE
ARTIBONITE
NIPPES
SOUTH
SOUTH EAST
NORTH
NORTH EAST
CENTRE
GRAND ANSE
NORTH WEST
PORT AU PRINCE
ARTIBONITE

Residential Solar Product	Typical Energy Expense Before ($/month)					Investment Analysis				Expected Penetration	
	kerosene lamps & candles	Cell Phone remote charging	CD Player Radio Dry Cells	TV Car Battery	TOTAL	Product Cost	Payback Period (months)	6 payment plan	12 Payment plan	2020	
High Quality Solar Lantern LED Only	$ 3.00				$ 3.00	$ 20	6.67	($3.57)		30%	60%
High Quality Solar Lantern LED & Cell Charging	$ 3.00	$ 2.00			$ 5.00	$ 40	8.00	($7.14)		30%	
Pico PV 5-6W with 3 LEDs	$ 6.00	$ 2.00			$ 8.00	$ 100	12.50		($9.46)	10%	
SHS 40W with 5 lights, cell phone, radio, TV	$ 6.00	$ 2.00	$ 5.00		$ 13.00	$ 400	30.77		($37.82)	3%	
SHS 80W with 5 lights, cell phone, radio, TV	$ 6.00	$ 2.00	$ 5.00	$10	$ 23.00	$ 800	34.78		($75.65)	2%	
									Total	75%	
						Interest	2%	per mth			

NOTES:	
	This chart draws on WTP to identify affordability with limited credit for solar products.
	This chart helps to supports the estimates made in the **Residential PV Market Tab**

RESIDENTIAL BASELINE:

Base Case-Business as Usual:

Lantern, Pico PV and SHS supplier

# Biz	# Biz	Pico PV (self install)			Installed SHS		Total Access
		Lantern-$20	Lantern/Charger-$40	5-10W SHS-$120	40W SHS-$400	80W SHS-$800	% or HH
		10%	5%	0%	0%	0%	15%
3		91,958	45,979	-	-	-	137,937
		20%	15%	5%	0%	0%	40%
6	10	170,988	128,241	42,747	-	-	341,977
		25%	25%	20%	0%	0%	70%
1	17	187,921	187,921	150,337	-	-	526,178

RESIDENTIAL CTF

MDB Intervention Case (with CTF):

Business Line of Credit, Modest Pico PV Quality Payments (Tax Offset),

MFI Consumer Credit for SHS/PPV (12 months), perhaps some PAYGO for pico SHS and grants for Social Systems

# Biz	# Biz	# Biz	Pico PV (self install)			Installed SHS		Total Access
			$2 Grant	$5 Grant	$20 Grant	Consumer Credit		
			Lantern-$20	Lantern/Charger-$40	5-10W SHS-$120	30W SHS-$400	80W SHS-$800	% or HH
			10%	5%	0%	0%	0%	15%
3	3	3	91,958	45,979	-	-	-	137,937
			20%	20%	10%	3%	2%	55%
5	8	14	170,988	170,988	85,494	25,648	17,099	470,218
			30%	30%	20%	5%	5%	90%
8	13	13	225,505	225,505	150,337	37,584	37,584	676,515

RESIDENTIAL-RBF BOOST

TRANSFORMATIONAL CASE TO MEET SE4ALL 2030 100% ACCESS (with SREP and IDA):

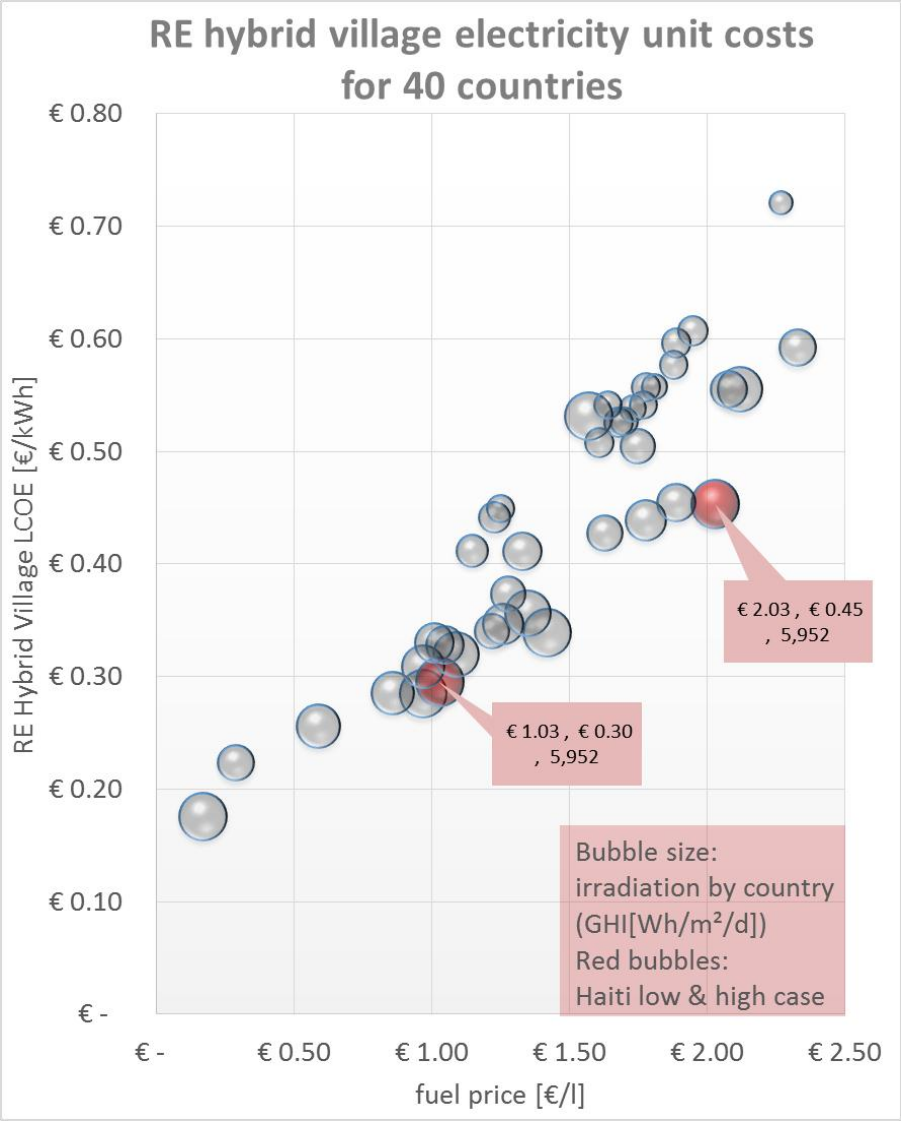
RESULTS BASED FUNDING (RBF) CONTRACTS: QUALITY/PERFORMANCE/*CAPACITY BUILDING*

Large Credit Line for Supplier Financed for PAYGO/Rent-to-Own 12-24 months

# Biz	# Biz	# Biz	Pico PV (self install)			Installed SHS		Total Access
			$10 Contract		$20 Contract	$100 Contract		
			Lantern-$20	Lantern/Charger-$40	5-10W SHS-$120	30W SHS-$400	80W SHS-$800	% or HH
			10%	5%	0%	0%	0%	15%
3	3	3	91,958	45,979	-	-	-	137,937
			25%	20%	10%	5%	5%	65%
6	8	11	213,735	170,988	85,494	42,747	42,747	555,712
			30%	25%	25%	10%	10%	100%
0.3469	5	9	225,505	187,921	187,921	75,168	75,168	751,683

SREP Market Segments 6-8: Financial Analysis on Village -Level

Village Power Systems: Key Results of Initial Financial Analysis: Costs, Provider Income, Village Tariffs, Market Volume & Subsidy Estimates with and without Project.



Source: iiDevelopment (2015)

Residential EE in Haiti for 1000 households	Old average power (W/appliance)	New, efficient average power (W/appliance)	Percent time operating	Energy saved annually per EE appliance (kWh/yr)	Percent HHs with technology	Number appliances in each HH that uses appliance (#)	Program cost per unit ($/appliance)	Appliance Lifetime (yrs)	Energy saved per 1000 HH (kWh/yr)	Energy saved per 1000 HH (kWh/day)	Program cost per 1000 hh ($/1000HH)	Negawatt-hour program cost ($/kWh)
Televisions (~20")	100	30	25%	153	10%	1	$150	5	15,330	42	$15,000	$0.196
Refrigerators (~6 CF fridge)	50	20	100%	263	5%	1	$150	5	13,140	36	$7,500	$0.114
Lighting	60	10	20%	88	100%	3	$10	10	262,800	720	$30,000	$0.011
							TOTAL per 1000 HH		***291,270***	***797***	***$52,500***	***$0.019***

		Monthly cost / HH								
	Tariff	$0.20	$0.30	$0.40	$ 0.50	$ 0.60	$ 0.70	$ 0.80	$ 0.90	$ 1.00
3 LEDs and cell phone 1 kWh / month	1	$0.20	$0.30	$0.40	$ 0.50	$ 0.60	$ 0.70	$ 0.80	$ 0.90	$ 1.00
5 LEDs, cell phone, radio, TV 5 kWh/month	5	$1.00	$1.50	$2.00	$ 2.50	$ 3.00	$ 3.50	$ 4.00	$ 4.50	$ 5.00
10 LEDs cell phone, TV & Refrig 20 kWh / month	20	$4.00	$6.00	$8.00	$10.00	$12.00	$14.00	$16.00	$18.00	$20.00

MG Case	Cost Case	Scenario name	Efficiency retrofit?	Grid status?	# of systems rehab'd (or built)	Average number of connections per MG	Aggregate # of connections (active & inactive)	Cost per watt (generation)	Operating cost per watt (generation)
6	**Low**	Small systems with efficiency	Yes	Needs new grid	325	100	32,500	$ 6.00	$ 0.82
	High	Small systems with efficiency, high admin and dist costs	Yes	Needs new grid	325	100	32,500	$ 6.00	$ 0.82
7	**Low**	Medium systems with efficiency	Yes	Minor rehab	35	741	25,946	$ 6.44	$ 0.80
	High	Medium systems with efficiency, extensive grid rehab needed	Yes	Extensive rehab	35	741	25,946	$ 6.44	$ 0.80
8	**Low**	Large systems with efficiency retrofit	Yes	Minor rehab	9	36,667	330,002	$ 5.38	$ 0.67
	High	Large systems without efficiency retrofit	No	Minor rehab	9	36,667	330,002	$ 4.96	$ 0.63

Key considerations (selected)

A major value proposition of MGs in Haiti is to bring customers up to Tier 5 service in areas away from Port-au-Prince. SHS/PPA/lanterns provide lower Tier service. Main Port-au-Prince grid is too far away for extension, and has ongoing operational & institutional issues that will be further complicated by interconnecting with more customers.

This analysis is agnostic about system operator, whether a special business unit within EDH, a municipal grid, a cooperative, or a business model. However, it does assume a functional manager/operator.

The MGs must be operated with full-cost recovery to be sustainable. The cost recovery can include subsidies from external entities, grants & other funding mechanisms, or higher tariffs than the national EDH tariff.

Recommendations (selected)

Focus on larger grid rehabilitation, since many of these have existing assets that can be leveraged. Hybrid-izing and reforming the management of these grids will be the highest impact in terms of expanding access to Tier 5 service.

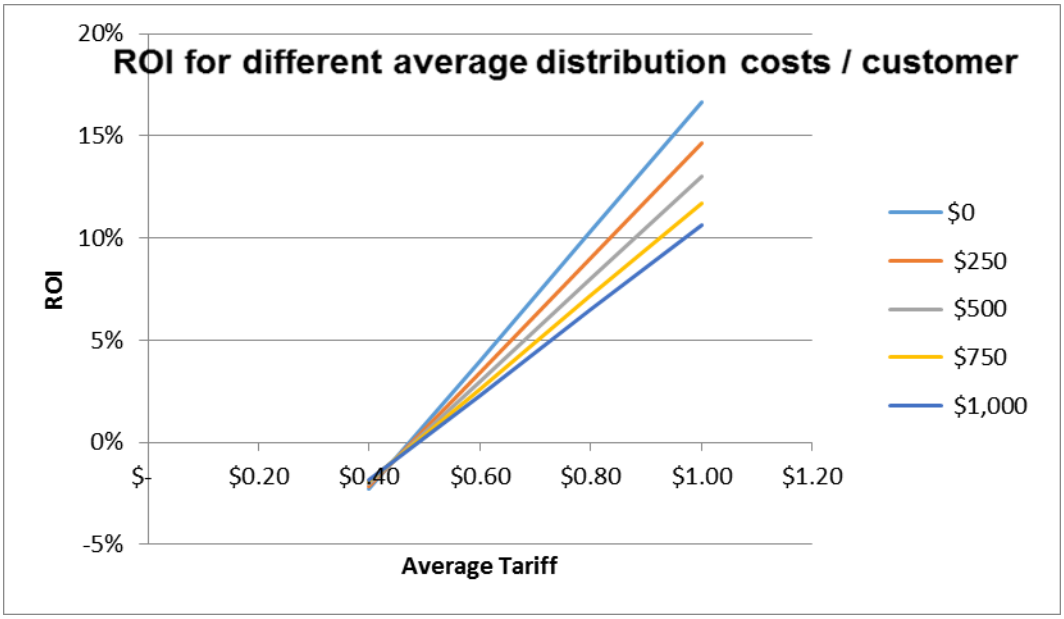
Supporting the Case 6 small grids (similar to Les Anglais) is more ambitious. The benefit of establishing MGs in these areas is that there is no expectation in the local populace of "free" EDH power. This was identified as a barrier in rehab'd areas that had prior EDH service.

The admin startup costs were roughly estimated based on the cost for starting a single micro-grid. We expect that there would be substantial economies of scale in the startup costs for multiple systems managed by a joint entity. We did not try to estimate these economies of scale.

SREP Market Segment 6:

Small Systems (Case 6)*		
Urban residents living in sections more than 2km from known electrical assets	300,000	persons
Urban households living in sections more than 2km from known electrical assets	65,000	hh
Assumption of those in dense enough areas for MGs	50%	
Households that can be served by small MGs	32500	hh
Number of MGs	325	MGs

*See map MapForEstimatingPotentialNewCase6MGs_HaitiElectPop_3-3-15_dept_x.pdf



Business Case 6: Small anchor tenant microgrid (typical)

Assumptions			
Parameter	*Value*		*Units*
Total number consumers		100	
Density (Pop / km^2)		1000	
Pop/HH		5	
$/ meter for distribution system		5	
$/ customer for billing meter		100	
Average distribution cost / customer	$	453.55	$/customer
Distribution maintenance per year		1%	%/$ distribution setup cost
MG administration setup costs	$	100,000	$/microgrid
MG administration annual costs		10%	of setup costs
Required investor ROI		10%	
Peak load		20	kW
Capacity factor		35%	
Average load		7	kW
Average daily energy		168	kWh/day
Annual energy		61320	kWh/yr
Real interest rate		4.00%	

Revenue			
Parameter	*Value*		*Units*
Average tariff	$	0.80	$/kWh
Annual revenue	$	49,056	$/yr

Expenses				
	Capital		Ongoing	
PV	$	62,500	$	-
Battery	$	18,000	$	-
Diesel	$	12,500	$	-
Inverter & Controls	$	1,500	$	-
Fuel	$	-	$	12,152
Maintenance	$	-	$	3,160
Sinking fund for replacements	$	-	$	3,669
Administration	$	100,000	$	10,000
Distribution	$	45,355	$	454
TOTAL	$	239,855	$	29,434
Cost per watt (generation)	$	4.73	for estimate verficatio	

Gross Income			
Contribution to Capital cost recovery	$	19,622	$/yr
ROI		8%	
Tariff required to cover ongoing costs	$	0.48	
Tariff required to achieve required investor ROI (existing distribution)	$	0.80	
Tariff required to achieve required investor ROI (new distribution required)	$	0.87	Covers op costs + ROI% of capital costs annually

SREP Market Segment 7:

Business Case 7: Medium remote microgrid (typical)			
Assumptions			
Parameter	*Value*		*Units*
Total number consumers		1000	
Density (Pop / km^2)		1000	
Pop/HH		5	
$/ meter for distribution system		5	
$/ customer for billing meter		100	
Average distribution cost / customer	$	453.55	$/customer
Distribution maintenance per year		1%	%/$ distribution setup cost
MG administration setup costs	$	200,000	$/microgrid
MG administration annual costs		10%	of setup costs
Required investor ROI		10%	
Peak load		205	kW
Capacity factor		35%	
Average load		71.75	kW
Average daily energy		1705	kWh/day
Annual energy		622325	kWh/yr
Real interest rate		4.00%	
Revenue			
Parameter	*Value*		*Units*
Average tariff	$	0.65	$/kWh
Annual revenue	$	404,511	$/yr

Market potential for Case 7: medium remote microgrids								
Town	Schnitzer**	EdH*	Department	Installed capacity (kW)	Effective capacity (kW)	Grid (kV)	Manager	Status†
Ennery	X	X	Artibonite	100	85	?	CA	working
Gros Morne	X	X	Artibonite	250	200	23	CA	working
Marmelade	X	X	Artibonite	300	250	23	CA	working; fed by Peligre
Dondon	X	X	Nord	150	100	4.16	CA	not working
Pilate	X	X	Nord	100	85	4.16	CA	not working
Plaisance	X	X	Nord	60	50	?	CA	working
Pignon		X	Nord	300	?	23	CA	working; fed by Peligre
Capotille	X	X	Nord-Est	100	85	23	CA	working
Mont Organisé	X	X	Nord-Est	175	150	23	CA	working
Ste Suzanne	X	X	Nord-Est	80	60	4.16	CA	working?
Anse à Foleur	X	X	Nord- Ouest	150	100	23	CA	not working
Bassin Bleu	X	X	Nord- Ouest	350	300	23	CA	not working
Bombardopolis	X	X	Nord- Ouest	200	?	23	CA	not working
Chansolme	X	X	Nord- Ouest	350	300	23	CA	not working
Jean Rabel	X	X	Nord- Ouest	500	400	23	CA	not working
Mole St Nicolas	X		Nord- Ouest	N/A	?	?	?	not working
Casale	X	X	Centrale-Ouest	175	?	?	CA	not working
Pointe à Raquettes	X	X	Centrale-Ouest	60	50	4.16	CA	not working
Anse d'Hainault	X	X	Grand'Anse	150	130	23	CA	not working
Dame Marie	X	X	Grand'Anse	225	185	23	CA	not working
Marfranc	X		Grand'Anse	300	?	?	?	?
Pestel	X		Grand'Anse	85	?	?	?	?
Anse à Veau	X	X	Nippes	100	85	4.16	CA	not working
Baradères	X	X	Nippes	100	85	12.47	CA	not working
Grand Boucan	X		Nippes	100	?	?	?	?
L'Asile	X	X	Nippes	240	200	23	CA	not working
Petit Trou de Nippes	X	X	Nippes	150	100	12.47	CA	not working
Pte Rivière de Nippes	X	X	Nippes	150	100	12.47	CA	not working
Coteaux	X	X	Sud	125	100	4.16	CA	not working; CEAC
Port à Piment	X	X	Sud	200	150	23	CA	not working; CEAC
Roche à Bateau	X	X	Sud	100	85	23	CA	not working; CEAC
Tiburon	X	X	Sud	150	100	23	CA	not working
St Louis du Sud		X	Sud	100	85	?	CA	working
Anse à Pitre	X	X	Sud-Est	150	100	12.47	CA	not working
Arnaud	X	X	Nippes	150	100	23	CA	not working
Belle Anse	X	X	Sud-Est	100	85	12.47	CA	not working
Côte de Fer	X		Sud-Est	200	?	?	?	?
Thiotte	X	X	Sud-Est	132	100	12.47	CA	not working
Borgne		X	Nord	?	?	?	EdH	not working
St Raphaël		X	Nord	?	?	23	EdH	working; fed by Peligre
St Michel de l'Attalaye		X	Artibonite	635	?	23	EdH	working; fed by Peligre
St Louis du Nord		X	Nord-Ouest	?	?	23	CA	?
Bainet		X	Sud-Est	150	130	23	EdH	not working
La Vallé de Jacmel		X	Sud-Est	?	?	?	EdH	not working
Onde-Verte (hydro)		X	Ouest	650	500	23	EdH	not working
Anse à Galets		X	Ouest	425	380	12.47	EdH	working

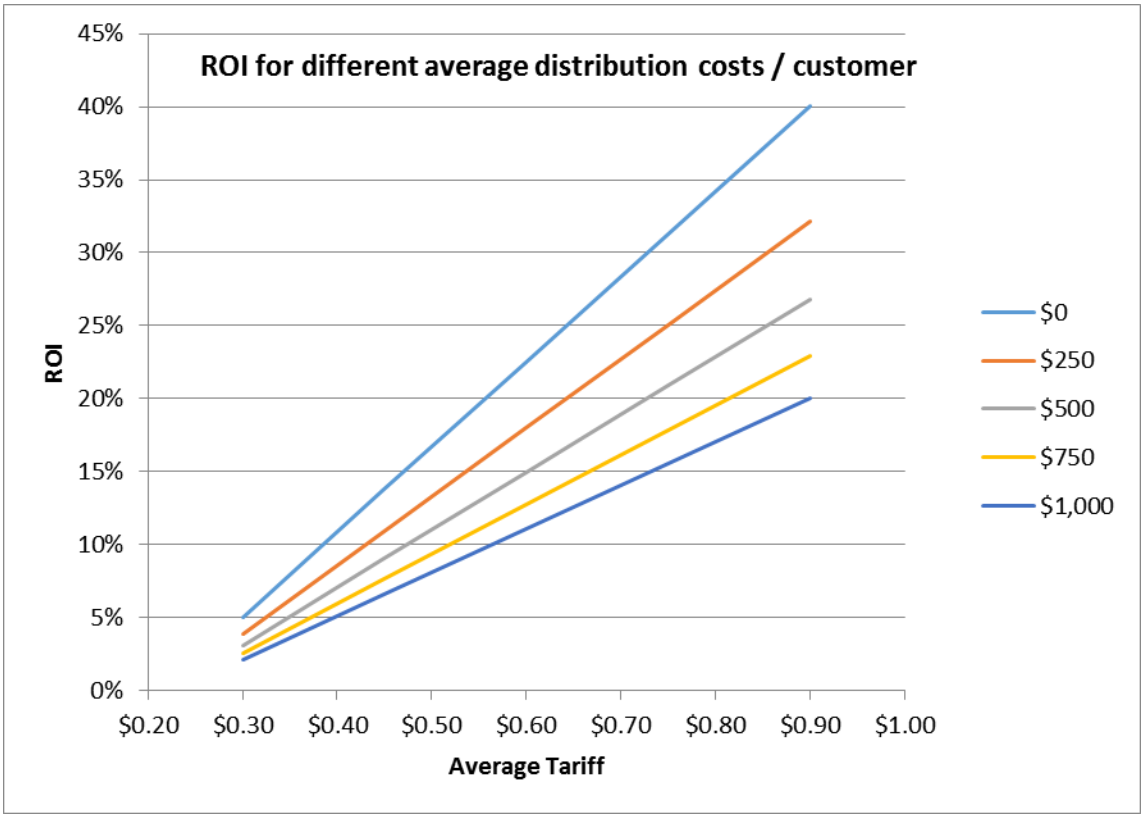
* Derived from spreadsheet provided by EDH

**Included in 36 EDH Centrale assistée MGs from the Schnitzer thesis

†from conversations with EDH

SREP Market Segment 8:

Market Potential for Case 8: Large remote microgrid								
Town	Grid name	Department	Installed capacity (kW)	Effective capacity (kW)	Peak load (kW)	Active Customers	Inactive Customers	Total Customers
Cap Haitien	Cap-Haïtien	Nord	14400	11500	16500	16,050	19093	35143
Chevry	Nord-Est	Nord-Est	7090	3000	4000	3658	770	4428
Gonaives	l'Artibonite	Artibonite	19200	13200	16000	13,523	16284	29807
Les Cayes	Cayes	Sud	11600	7200	8000	18,546	16574	35120
Jacmel	Jacmel	Sud-Est	5150	4450	5000	10,719	7355	18074
Jérémie	Jérémie	Grand Anse	3650	2800	1700	3,181	3557	6738
Port-de-Paix	Port-de-Paix	Nord-Ouest	3700	1100	2500	4,107	4908	9015
Petit Goave/ Aquin/ Miragoane	Petit Goave	Ouest/Sud/ Nippes	10600	6000	7500	9,942	8321	18263
Arcahaie	l'Arcahaie	Ouest	2000	1700	2500	2,556	5857	8413
* Derived from spreadsheet provided by EdH								



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