Illuminer Project

for Haiti

by Hyperion Team

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Introduction to the problem:

Energy Poverty in Haiti

01 — 8 million people in Haiti remain without electricity access

02 — According to the World Watch Institute, Haiti's installed capacity for 2014 ranged from 250 to 400 MW

03 — However, operational installed capacity is estimated of just 244 MW

What is Energy Poverty?

Lack of access to modern energy services

04 — The estimated peak power demand is 500 MW and significantly exceeds the supply.

05 — Peak power demand is projected to an annual growth at 5% until 2028 when it reaches 750 MW

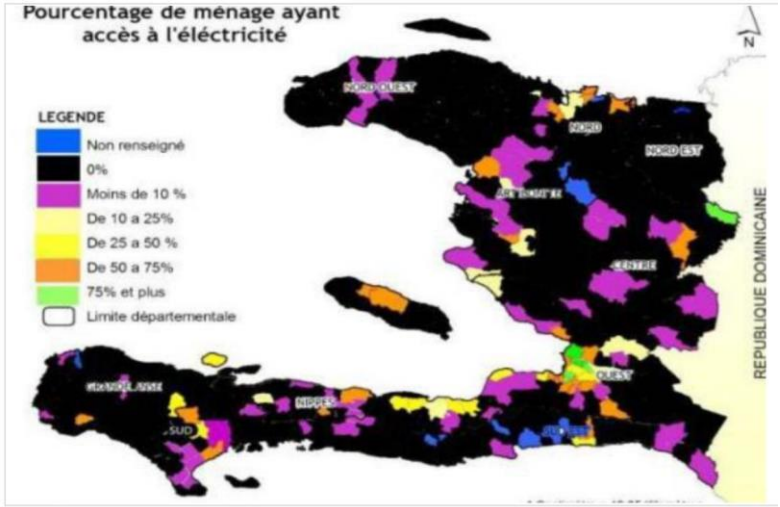
06 — Per capita consumption in 2011 was estimated in only 21 KWh and only produced 875 GWh in the same year

Background and previous actions

1. Electricité d'Haiti (EDH) is the national utility company that provides 15% of the energy produced in the country
2. 85% of EDH's electricity comes from oil-based thermal generation and the other 15% from hydropower plants
3. In the country exist independent power producers and 30 municipal mini-grids
4. EDH operates one main interconnected grid (Port-au-Prince) and nine smaller isolated grids
5. The average tariff is 0.30 $/kWh
6. Recently in 2017, World Bank Group conducted a project powering 5 of 9 Isolated EDH grids with 1-12 MW PV solar plants

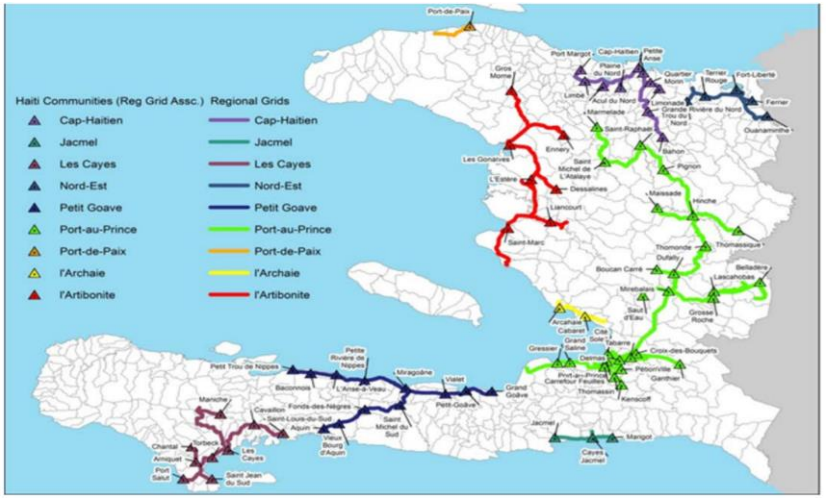
Haiti's energy current view

Haiti current energy access by zone



Source: "Renewable energy for all project", Report No: PAD1704, document of The World Bank, October 3, 2017

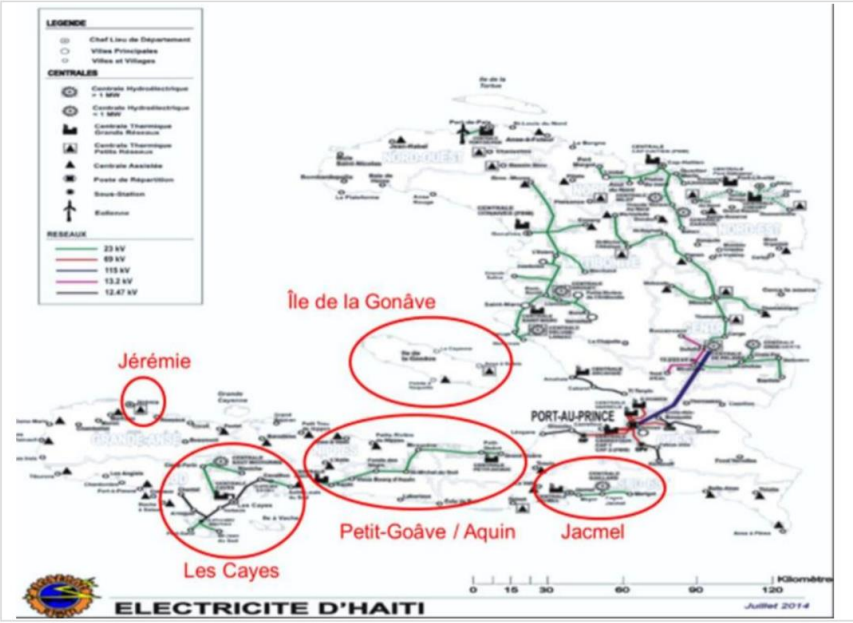
Regional isolated grids



Source: "Electrifying Haiti With Intelligent Investment in Community Solar Minigrids", presentation by Navigant at Haiti Sustainable Energy Forum", June 12-13, 2017

Haiti's energy current view

WBG and SREP map zones project



Source: "Renewable energy for all project", Report No: PAD1704, document of The World Bank, October 3, 2017

- The World Bank Group budget for the six-year Project was estimated at 138.27 million USD[1].

- In order to give continuity to the previous actions and boost the scalability of the project, we present the "Illuminer" project.

1. Dana Rysankova, (2017). Energy for All project. World Bank Group

Illuminer Project

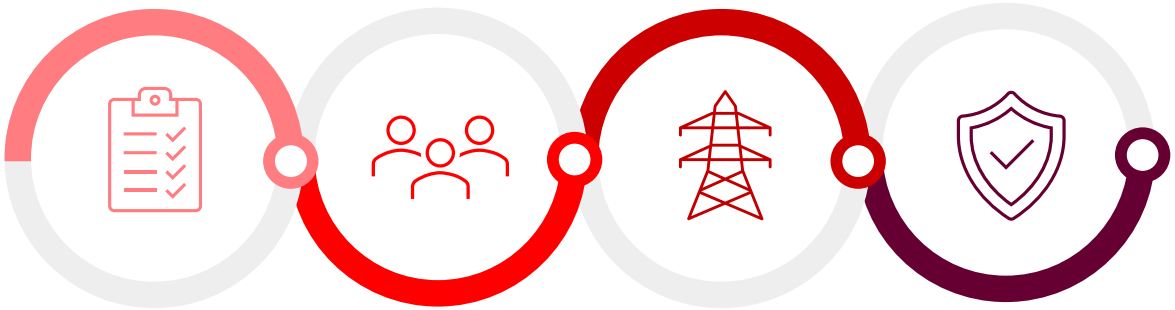
for Haiti

Stage 1. Design

Mission, vision and objectives

Short to medium-term
Generate local electricity through renewable energies in rural communities

Finally
Centralize and give some reliability to the electrical system in Haiti.



Illuminer Project
Has 2 main objectives

Long term
Boost the WBG project by powering the four missing isolated regional grids at the north side of the country

Stage 1. Design

Mission, vision and objectives

To be successful and achieve our goals, it is important to consider the following aspects.

- Promote the alliance between the SEA[1] and the MTPTC[2] Energy Cell
- The network should be made up of students and professionals from different Haitian universities
- The alliance will approach the communities to which they want to bring access to electricity
- Respect all those communities that, for various reasons, do not wish to receive help

SEA = Switch Energy Allience

MTPTC = Ministry of Public Works, Transportation and Communication

Stage 1. Design

Financing and technical partners

Financing support can be requested from institutions such as SREP, USAID and WBG. Also, technical support can be asked from WWI, General Electric and UNEP.

SREP = Scaling up Renewable Energy in low income countries Program
USAID = U.S. Agency for International Development
WBG = World Bank Group

WWI = World Watch Institute
UNEP = United Nations Environment Programme

Stage 2. Implementation

By generating electricity near rural populations of Haiti with distributed generation, we can increase the efficiency with a reduction of carbon pollution without the need for new transmission lines investments. Decentralized generation allows the supply of electricity when and where is needed.

With an estimate of 3 KWh per day for household, we can build a decentralized grid system between the communities to improve the life quality and boost the local economy with a low cost/benefit

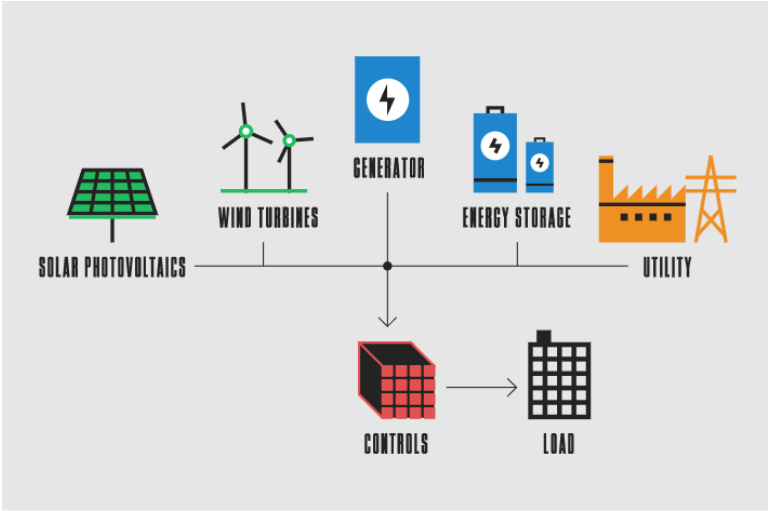
3 000 Wh/day per household

↓

90 000 Wh/month per household

↓

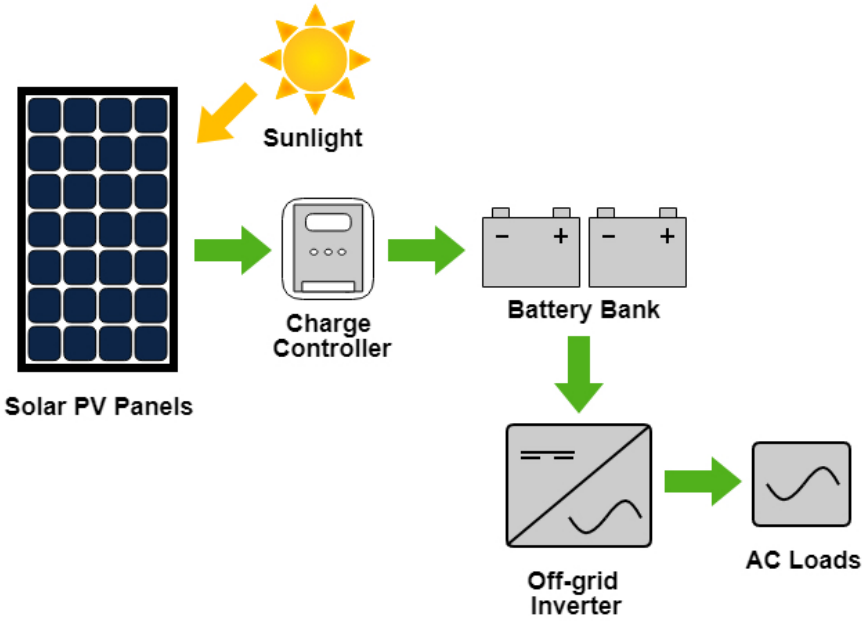
1 080 000 Wh/year per household



Source: https://www.simson-maxwell.com/power-generation/simmax-power-solutions/distributed-energy/

Stage 2. Implementation

Solar Photovoltaic Power



Source: https://www.indiamart.com/proddetail/solar-pv-system-21557158155.html

SOLAR KIT 5KVA 48V

1 off-grid invertir
1 Structural support
1 Servomotor
4 batteries
8 Solar Modules 300 Wh

With only 300 kits, more than 5 thousand people will benefit from electricity in Haiti

with an investment of 1.2 million dollars.

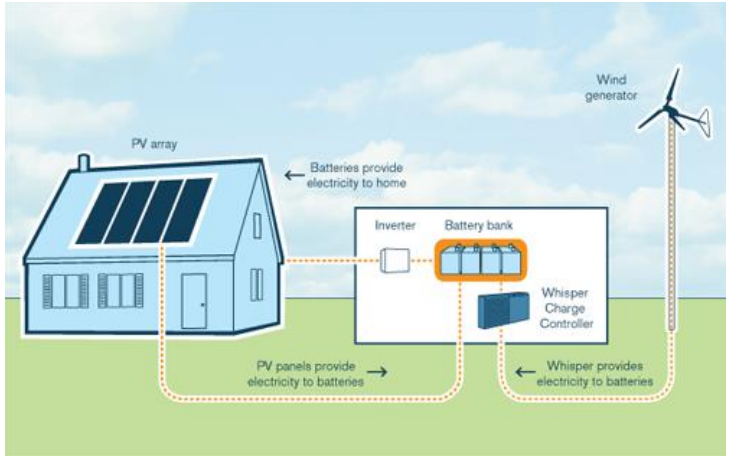
Stage 2. Implementation

Wind Turbine off-grid system

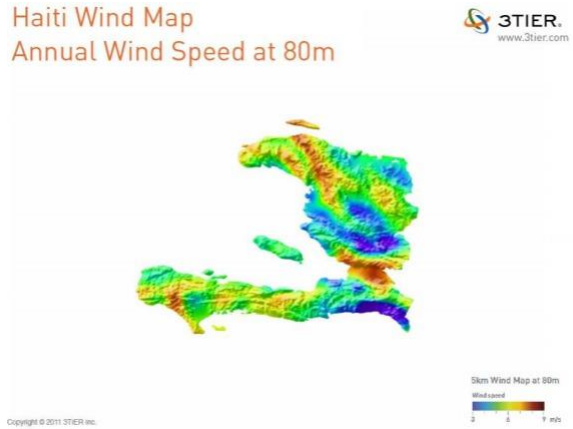
Only in the Cul-de-Sac region of Haiti, with 15 wind turbines of 50 KWh each, we can supply energy to more than 100 communities with the regular wind

In a strategic position close to the town, wind turbines are sustainable at a minimum cost. Besides, it doesn't affect the bird population in the area

The meridional and northern regions of Haiti also have strong wind potential. This can grant a sustainable wind distributed generation



Source:https://lh3.googleusercontent.com/proxy/OgG9WkfcJUh4WMukPBW989W2jRm8cSH30qAXysdXrY-EqBmk2L8hZZRgOGYOb63SVt7ZIrCrGNe2eWuppNcks39joWZ4nWM3sw

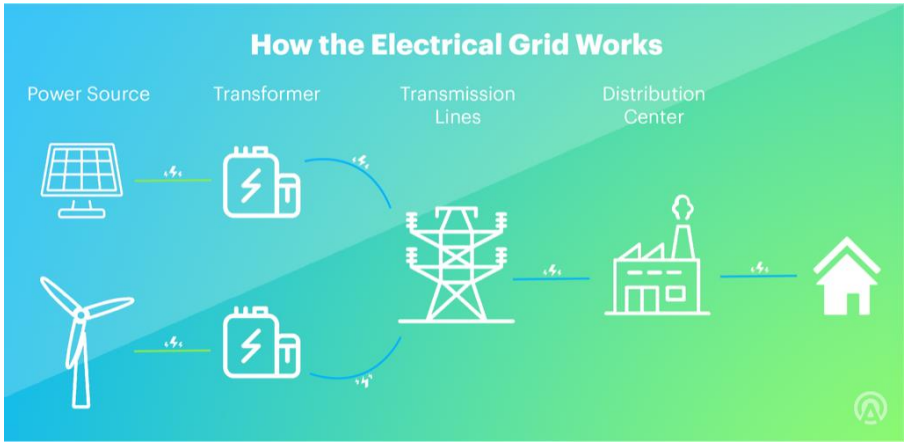


Source: 3TIER, from Haiti's Energy Roadmap.

Stage 3. Integration and centralization

Based on Stage 2 of Illuminer Project
Green and renewable energy grid integration system

- Sustainability
- Reliability
- Persistent growth

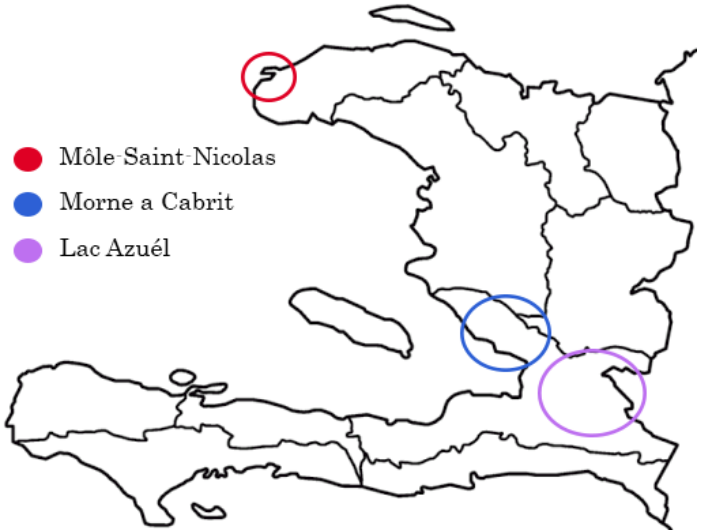


Source: https://blog.arcadia.com/assets/2018/02/Electric-grid-v.7-1.png

Stage 3. Integration and centralization

Haiti's Wind Energy Potential

Several of Haiti's zones have a lot of wind potential. The most important ones are:



Source: Illuminer Project for Haiti. Caracas, Hyperion Team (2020).

Table 3.3 Average Wind Speed and Capacity Factor in the Six Haitian Zones

	Wind Speed			Gross Capacity Factor			Net Capacity Factor		
Zone Name	80m	90m	100m	80m	90m	100m	80m	90m	100m
	m/s			percent			percent		
Lac Azuél	8.13	8.24	8.34	62.6	63.5	64.3	53.2	54.0	54.7
Morne à Cabrit	7.32	7.41	7.50	50.1	51.1	52.0	42.6	43.4	44.2
Môle-Saint-Nicolas	6.55	6.63	6.71	43.8	44.7	45.5	37.2	38.0	38.7
La Gonâve	5.62	5.67	5.72	30.7	31.3	31.8	26.1	26.6	27.0
Tiburon	5.33	5.38	5.43	30.4	30.9	31.3	25.9	26.3	26.6
Morne Vent	5.08	5.16	5.23	26.5	27.4	28.2	22.5	23.3	24.0

Note: Assessment reflects a 25-year period.
Source: See Endnote 28 for this chapter.

Table 3.4 Summary of Wind Energy Potential in Haiti

Site	Average Net Capacity Factor*	Annual Generation per 1.5 MW Turbine	Annual Generation per Square Kilometer†	Total Area Needed to Meet Haiti's 2011 Power Generation	Share of 2011 Generation from One-Square-Kilometer (30 MW) Wind Farm	Total Area Needed to Meet Haiti's Projected Net Generation in 2030
	percent	GWh		km^2	percent	km^2
Lac Azuél	53.2	7.0	139.8	6.3	16.0	46.5
Morne à Cabrit	42.6	5.6	112.0	7.8	12.8	58.1
Môle-Saint-Nicolas	37.2	4.9	97.8	9.0	11.2	66.5
La Gonâve	26.1	3.4	68.6	12.8	7.8	94.8
Tiburon	25.9	3.4	68.1	12.9	7.8	95.5
Morne Vent	22.5	3.0	59.1	14.8	6.8	109.9

** At an 80-meter hub height. Assumes estimated 15% loss to account for wake (slowed wind speed due to interruption from other turbines), electrical losses, etc.*
† Assumes 20 wind turbines in a one-square-kilometer area.
Source: See Endnote 29 for this chapter.

Source: Alexander Ochs, (2014). Haiti Sustainable Roadmap. Washintong DC, Wold Watch Institute

Stage 3. Integration and centralization

Long-term Vision

Costs

Decreases in the price of wind energy allow the feasibility of the project cost-effectively

Two cents per KWh is the low price to pay for the generation of wind energy

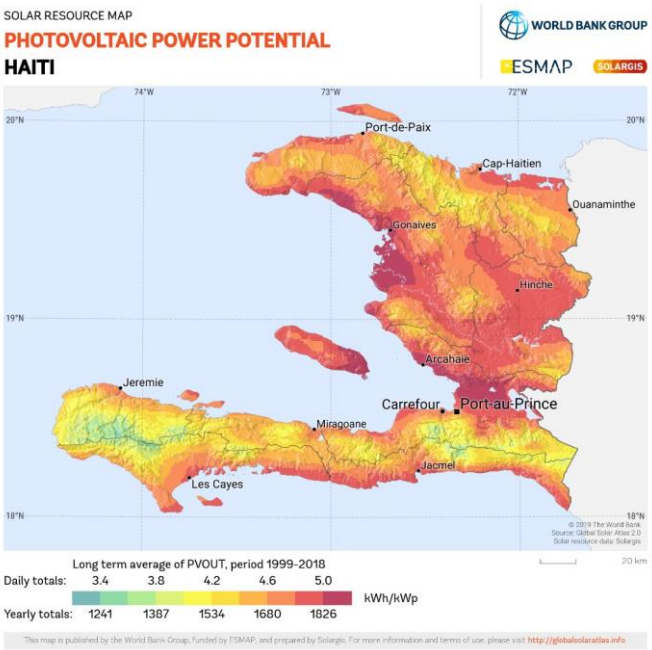
Future

This interconnected grid could lead to sustainable and persistent growth for the whole country

Illuminer Project could allow a steady increase in the standards of living to achieve a cleaner and safer future

Annexes

Map of solar energy potential



Source: 3TIER, from Haiti's Energy Roadmap.

1. The Global Horizontal Irradiance in the most zones in Haiti ranges from 5KWh/m² to 7KWh/m² per square meter per day, and even in some regions reach the 8KWh.

2. By comparison, Germany which has the half of the worlds installed capacity has fewer locations with GHI of just 3KWh/m² per day.

3. The zones with most potential reach their peak GHI from April to August and are very strong even in the winter months.

Annexes

Solar energy potential

Table 3.1 Potential Gross Annual Solar PV Module Yields in the Six Haitian Zones

Site	Annual Generation per 175 Watt Module*	Annual Generation per Square Kilometer†	Total Solar Panel Area Needed to Meet Haiti's 2011 Power Generation	Share of 2011 Generation from One Square Kilometer of PV Modules
	kWh	GWh	km^2	percent
Cul de Sac	413.2	149.9	5.59	17.1
Parc Sonapi	405.5	147.1	5.70	16.8
Port-de-Paix	403.7	146.5	5.72	16.7
Les Cayes	397.0	144.0	5.82	16.5
Péligre	392.3	142.3	5.89	16.3
L'Île de la Tortue	391.8	142.2	5.89	16.2

** Includes effects of wind and temperature.*
† Assumes that energy production per meter is cut in half to account for maintenance, the prevention of shading, and construction of other equipment.
Source: See Endnote 18 for this chapter. *© Worldwatch Institute*

Source: Alexander Ochs, (2014). Haiti Sustainable Roadmap. Washintong DC, Wold Watch Institute

Effects on solar energy

Table 3.2 Effects of Wind and Temperature on Solar PV Module Yields in the Six Haitian Zones

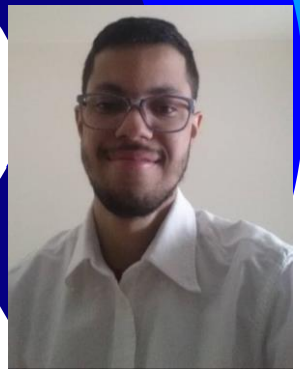
Site	Average GHI	Average DNI	Average DIF	Average Wind Speed	Average Temperature	Estimated Gross Annual Yield
		$(W/m^2) \cdot day$		m/s	°C	kWh
Cul de Sac	5,796	5,602	1,909	4.9	25.7	413.2
Parc Sonapi	5,707	5,436	1,949	5.1	26.1	405.5
Port-de-Paix	5,578	5,258	1,943	6.6	25.8	403.7
Les Cayes	5,645	5,304	1,935	3.3	25.9	397.0
Péligre	5,707	5,472	1,860	1.8	25.1	392.3
L'Île de la Tortue	5,472	5,057	1,967	4.7	24.2	391.8

Source: See Endnote 19 for this chapter. *© Worldwatch Institute*

Source: Alexander Ochs, (2014). Haiti Sustainable Roadmap. Washintong DC, Wold Watch Institute

“There has not been another most accurate moment like today to “illuminer” days, nights, lives and dreams.”

-Hyperion Team



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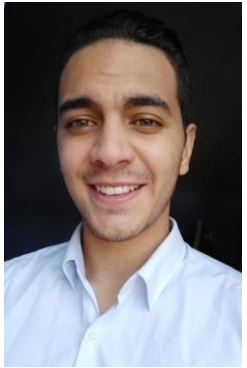

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