

Energy Justice and the Stakeholders Involved
A Case Study of Solar Power in Rural Haïti

A thesis submitted by:

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Abstract

This paper explores and analyzes energy justice and the stakeholders involved. Energy insecurity, specifically the lack of access to electricity affects over 1.3 billion people worldwide and energy justice is a way to address it. This paper is supported by a case study with data collected in the southern rural regions of Haïti regarding energy justice communities. Three cities were studied: Les Cayes, Anse-à-Veau, and Les Anglais. It examines how solar businesses can aid energy justice communities seeking access to electricity. Stakeholders such as the communities themselves, solar businesses, and nonprofits in the region are studied and analyzed. The paper concludes solar businesses are helping said communities but needs participation from other stakeholders to be successful. Finally, there are five recommendations to build capacity, develop infrastructure in the region, explore the possibility of solar cooperatives, strengthen the solar economy in Haïti, and demand reparations.

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List of Acronyms

CARICOM	Caribbean Community
CCCCC	Caribbean Community Climate Change Centre
ECOWAS	Centre for Renewable Energy and Energy Efficiency
EDH	Electricité d’Haïti
FiTs	Feed-in Tariffs
GDP	Gross Domestic Product
GNH	Gross National Happiness
IEA	International Energy Agency
IMF	International Monetary Fund
kWh	kilo-watt hours
PAYG	Pay-as-you-go
PPP	Public Private Partnership
PV	Photovoltaic
SA	Société Anonyme
RE	Renewable Energy
RES	Renewable Energy Source
REDP	Renewable Energy Development Project
R2O	Rent to own
UN	United Nations
USD	United States Dollar

Key Terms

Department: A political region in Haïti similar to a state or province.

Energy Insecurity: Inadequate access to energy services such as household access to electricity and clean cooking facilities (e.g. fuels and stoves that do not cause air pollution in houses).

Energy Justice: seeking to apply justice principles to energy policy, energy production and systems, energy consumption, energy activism, energy security and climate change. A global system fairly distributes both the benefits and costs of energy services as well as having representative and impartial decision-making. Energy justice raises awareness regarding vulnerable groups via energy access and affordability.

Energy Justice Communities: a designated group of people that are energy insecure.

Just Sustainabilities: improving quality of life and wellbeing; intragenerational and intergenerational equity; justice and equity in terms of recognition, process, procedure, and outcome; and living within ecosystem limits

Microgrid: A microgrid is a localized grouping of electricity sources and loads that normally operates connected to and synchronous with the traditional centralized grid (macrogrid), but can disconnect and function autonomously as physical and/or economic conditions dictate.

Pay-as-you-go (PAYG): PAYG models are primarily for customers with low or variable income. Customers pay directly for the service they use; they do not receive any service for which they have not first paid. As a result, payments often can be made in smaller amounts than would otherwise be possible, and customers have greater control over their consumption and thus their spending.

Photovoltaic (PV) System: a power system designed to supply usable solar power by means of photovoltaics.

Public Private Partnership (PPP): is a cooperative arrangement between one or more public and private sectors, typically of a long-term nature.

Renewable Energy: energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.

Solar Home Systems (SHS): SHS are widely accepted as a mature and practical product, for home electrification of the hundreds of millions of families living in the poorest villages of the developing world (roughly two billion people). Said group having in common little or no prospect of gaining access to a conventional source of electricity supply within their lifetimes.

Stakeholder: a person, group, or organization or entity involved in or affected by a course of action.

Energy Justice and the Stakeholders Involved:
A Case Study of Solar Power in Rural Haïti

Chapter 1: Introduction

The International Energy Agency, IEA, defines energy access as providing modern energy services to everyone around the world (IEA 2017). These services are defined as household access to electricity and clean cooking facilities (e.g. fuels and stoves that do not cause air pollution in houses). In turn, energy insecurity is inadequate access to clean energy services. Numbers in 2012 indicate there are about 1.3 billion people worldwide lacking electricity (Bhattacharyya 2012). Energy access begets the issue of energy insecurity, what some refer to as energy poverty. The primary energy source for forty percent of the world's population is wood, coal, charcoal, or animal waste for cooking food (ibid), none of which are clean energy.

Issues that arise from energy insecurity involve lack of access to electricity and technology, dependence on traditional solid fuels for cooking, and time-intensive fuelwood and water collection and processing of food in emerging economies, borne mostly by women and children (Sovacool and Dworkin 2015). In many cases the term “energy poverty” is interchangeable with “energy insecurity”. However, it is in the opinion of the author that this term presents a negative connotation to those people living in energy insecure conditions.

There are emerging ways in which different communities are dealing with energy problems. Some of these solutions include social pricing and assistance programs as well as pro-poor public private partnerships, PPP, for

microhydro units, solar home systems, improved cook stoves, biogas digesters, and small-scale wind turbines, mechanical energy for pumping, irrigation, and agricultural processing (ibid). The issue of energy insecurity has created an energy justice movement to rectify the problems facing communities across the planet. Energy is the “lifeblood” of global economies and the existence of humans; it is entrenched in international and policy contexts. A group of governance scholars has recently referred to it as a “mega-issue” (Goldthau and Sovacool 2012).

Energy Justice is one particular area that is a subset of climate and environmental justice. Energy Justice does not have one set definition but various researchers have defined it as: seeking to apply justice principles to energy policy, energy production and systems, energy consumption, energy activism, energy security and climate change (Jenkins et al. 2016). Further defining of the term describes it as: a global system that fairly distributes both the benefits and costs of energy services as well as having representative and impartial decision-making (Sovacool and Dworkin 2015). Energy justice raises awareness regarding vulnerable groups via energy access and affordability (Hernández 2015).

Procedural justice is one aspect of energy justice. This aspect means achieving just outcomes through local knowledge mobilization, greater information disclosure, and better institutional representation. Researchers tout that local knowledge has been a critical motivating factor raised in the

literature for seeking the inclusion and engagement of affected publics (Jenkins et al. 2016). The notion is most closely linked to indigenous peoples. This pattern of overlooking indigenous knowledge on the environment emerges within several energy contexts to the detriment of communities and the sustainability of decision-making.

In addition to energy access, there needs to be an innovative approach to solve energy problems that is also less carbon intensive (Alstone et al. 2015). Finding cleaner alternatives is especially important when energy insecure communities are searching for just ways to solve energy equity issues. Solar power is but one method to aid communities in the fight for energy justice. In many cases, it is either aid organizations, nonprofits, private businesses, the government, or some combination of said stakeholders that work with communities to address energy justice issues (Bhattacharyya and Palit 2016).

The focus of this thesis is at the intersection of community mobilization and the different stakeholders that work with them. Communities all over the world from Dorchester, Massachusetts to Les Cayes, Haïti are dealing with energy justice issues. Chapter 2 is a literature review that explores energy insecurity and energy justice.

Over the last couple of years, independent journalists have covered protests over lack of electricity in Haïti. Two in particular occurred in Les Cayes and Forte Liberte (Dantò 2014; Sérizier 2014). There is a clear public

outcry for energy justice although the term “energy justice” is not expressly used by Haitian communities. It is the author’s decision to frame the issue as an energy justice issue in the respective communities.

In Chapter 3 the thesis is supported by a case study of the southern region of rural Haïti. An island state in the Caribbean, Haïti shares the island of Hispaniola with the Dominican Republic. The country’s name means “land of high mountains” keeping the name given by the Arawak Taíno indigenous people (Edmond 2010). Haïti also prides itself in being the second country in the western hemisphere that gained its independence (CNN 2017). Unfortunately, years and years later after being indebted to France, American occupations and embargos, and corrupt politicians, many of Haïti’s citizens find themselves impoverished. This economic status translates to its poor infrastructure. This results in many Haitian citizens’ dependence on unreliable electricity and insufficient ways of getting it. A country that relies on a lot of “dirty” technology can benefit from solar energy being close to the equator. Not only is proximity great for solar but it can also help the environment.

The country does not have a single centralized transmission and distribution system but rather 10 isolated regional grids, all operated by Electricité d’Haïti, EDH (NREL 2015). Haitians pay more for their electricity than surrounding countries. Haïti’s utility rates are roughly \$0.35 U.S. dollars (USD) per kilowatt-hour (kWh), the Caribbean regional average is \$0.33

USD/kWh (ibid). Despite the unfavorable conditions, energy justice communities in the regions are active in addressing the problems. Whether it is protesting, creating lending circles to pay for solar home systems, or a whole village packing into a church to learn about solar power, the communities were engaged. Providing solar energy to low income communities across the world may take various forms, but they address the same issue.

The case study examines energy justice from the peoples' perspective, the business perspective and the nonprofit perspective. The peoples' perspective includes a feasibility study conducted by two solar companies, 10Power and DigitalKap. The author joined the study to research the feasibility of a pay-as-you-go, PAYG, model (Romulus 2016). A for-profit company that regards itself as a social enterprise called 10power, has invested in a Haitian owned and staffed company called DigitalKap to launch their PAYG program. The program is called Energy24 (ibd). During the study the group traveled to various villages in the rural south and surveyed villagers to see if they could finance, and manage solar home systems. People in the rural mountainous regions would travel miles back and forth to charge their cellphones. Anglers in small fishing villages complained of the need for better lighting in their vessels when they went off to fish forcing them to operate in daylight.

The business perspective includes interviews of CEOs of 10Power and DigitalKap. The nonprofit perspective includes an interview with the executive director of EarthSpark International, the organization that implemented a microgrid primarily powered by solar power in a nearby region to the feasibility study.

The case study is followed by an analysis in Chapter 4 to answer the research questions this thesis asks. In addition to the case study analysis Chapter 5 expands the questions answered in the case study analysis with a discussion, lessons learned, and limitations of the research. Chapter 6 provides policy recommendations for the stakeholders in energy justice communities. Chapter 7 concludes the thesis.

1.1 Significance, Objectives & Research Questions

The research conducted in this thesis aims to understand how energy justice communities are working with various institutions and stakeholders to identify strategies that are effective in achieving shared goals. This will then lend itself to formulate recommendations. If the research can accelerate the rate at which affordable and clean electricity becomes available to people in rural Haïti who currently have limited or no access to electricity in the slightest, it is worth it. Energy insecurity is not specific to Haïti. In the United States there are many communities suffering as well and if this research can help one of the poorest nations in the world it can certainly help

communities in anguish here as well. The thesis will be guided by the following questions:

1.1.1 Main research question

In what ways might a social enterprise and business partnership between DigitalKap and 10Power address the problem of energy insecure areas throughout rural parts of southern Haïti?

1.1.2 Sub Research Questions

1. What are the aspirations of energy justice communities?
2. What are the problems energy justice communities are facing?
3. What agencies/organizations/businesses are aiding energy justice communities?

1.2 Methodology

The thesis examines energy justice communities with a case study in Haïti. The case study is preceded by a comprehensive literature review on energy, energy insecurity, and energy justice. Energy justice is correcting the lack of access to affordable safe and clean energy. The subject population includes people that are on the ground and working in energy justice communities. Their work and experience will provide insight into how energy providers might work effectively with people living in energy justice communities and can lead to recommendations as to how society can alleviate the effects of energy insecurity whether it is through a nonprofit or for profit entity.

The recruitment process targeted nonprofit and for-profit institutions that have engaged in the energy justice communities in the case study area. In addition said institutions have work in the same region of Haïti. Three people from for-profits and a nonprofit were interviewed via skype and by phone. With regards to the consent process, prior to all interviews. Interviewees were asked for permission to include the contents of the interview in an academic publication.

1.3 Positionality

Some background on the author can provide context to the reader of this thesis. I am the American born son of Haitian immigrants that fled the country during the dictatorships of Papa Doc and Baby Doc Duvalier. I find this thesis to be my contribution to the progress of the country of Haïti. I grew up in Brockton, MA where there is a large Haitian community and have an undergraduate degree in mechanical engineering technology from Rochester Institute of Technology. I have worked at various solar companies prior to and throughout my graduate work in urban planning and environmental policy at Tufts University. Furthermore, the feasibility study I partook in was the first trip to the country of Haïti in my lifetime. I can speak Haitian Creole so it was a great help in data collection for the feasibility study. This thesis serves as another viewpoint and narrative of the country using energy justice and just sustainabilities as the lens.

Chapter 2: Literature Review: Energy Security and Energy Justice

2.1 Introduction

This chapter is a literature review that overviews energy justice. Energy justice is a subset of environmental/climate justice issues. In defining energy justice and the problems it addresses, it is the author's opinion that better solutions will arise from doing so. The case study in the thesis focused primarily on microfinancing for solar home systems (SHS). This is one method for helping energy justice communities in rural regions of developing countries and so this literature review explores microfinancing as well.

This chapter is divided into six main sections. The first looks at energy acquisition it to delivery including sources such as fossil fuels to wind power. The following section defines energy justice, a solutions-based approach to energy justice issues, and framing energy justice. The sections that follow look at; the availability and affordability of energy; technology development; environmental and social sustainability; regulation and intervention.

2.2 Methodology

The research method for the review was a combination of methods. It started out as a Boolean search using amalgamations of terms including but not limited to "Energy Justice," "energy poverty," "Pay-as-you-go," and "solar." Search engines used included Google Scholar, Web of Science, and Environment Complete. Google scholar pulls from a broad swath of material from scholarly articles to theses and court opinions. Google Scholar does not

guarantee that findings are peer reviewed however; it discovered essential sources. Web of Science has a peer-reviewed database consisting of the world leading scholarly literature in the sciences, social sciences, etc. Environment Complete has a data based dedicated to environmental research in addition, has full text of over 650 journals. Further research came from searching references sections in reports and shared knowledge from colleagues, professors, and professionals.

2.3 Understanding Energy

Understanding the base energy framing is the best starting point to understanding the energy justice issue in whole. This energy framing breaks into four categories: vertical complexity, horizontal complexity, high entailed costs, and strong path dependency (Goldthau and Sovacool 2012). Vertical complexity speaks to the top-down vs. bottom-up approach for production. Energy production and use requires various technological systems within any given nation. A choice example is a coal system that involves the coalmine and railway as well as the power plant and transmission and distribution network.

In the same manner, a wind farm, which requires the production of aluminum, copper, concrete, and fiberglass “upstream” to make the turbines and other components as well as switching stations and interconnection to the electricity network “downstream” from the turbines themselves. Furthermore, an easily identifiable system implicated in energy production and use is electricity supply (ibid).

On the other hand, the research explains: horizontal complexity defines the involvement of many states and actors across geographic scales. At the macro and international scale, modern economies rely heavily on oil, natural gas, coal, and uranium, which are often imported. A significant amount of oil reserves around the planet are concentrated in a handful of considerably volatile countries – the Middle East, Russia, Nigeria, and Venezuela – whose governments often use their control of this vital resource for political ends (ibid).

Not only is energy complex in its scope, energy entails higher costs than other sectors. Economic growth is inseparably related to energy consumption. Industrializing economies or developing nations tend to be characterized by an over-proportional energy use compared to their GDP before exhibiting flattening energy consumption patterns once the economy matures. Likewise, the cost for energy infrastructure is exorbitant. For example, “modernizing the US power grid is widely regarded to be a task of 30–40 years. For these investments to happen, a strong and reliable regulatory environment is the key, as are clear expectations on energy prices,” (ibid, 234). This may be the case for a more developed country. However, unless an innovative approach is taken, it shows the financial investment needed would be exponentially higher for a developing country.

2.4 Energy Justice

The ability to frame the energy justice narrative is crucial. Moreover, it helps relate it to climate justice and environmental justice while at the same time

distinguishing itself. Several research articles help frame energy justice, evidenced in the following section. Additional literature splits energy justice into three categories: distributional, recognition, and procedural justice (Jenkins et al. 2016).

2.4.1 A Solutions-Based Energy Justice Framing

Sovacool and Dworkin were able to frame energy in order to set up a case for justice. In framing a solutions based approach research explained this framing in four categories: virtue, utility, human rights, and energy poverty (Sovacool and Dworkin 2015).

For each category within this framework the researchers presented the injustice occurring and the solutions to address the problem. In regards to virtue, the injustice manifests itself in inefficiencies involved in energy supply, conversion, distribution, and end-use. Inefficiencies such as poor maintenance of grid infrastructure (supply) can lead to an overburdened grid (distribution) resulting in higher electrical costs and rolling blackouts (end-use). Potential solutions include fuel economy standards, energy efficiency labeling, industrial retrofits, utility-scale demand side management, ascending block rate pricing, advanced metering and smart grids, training and capacity building, and consumer education and awareness (ibid).

When examining matters of utility, the injustice that occurs involves the imposition of negative social and environmental costs on society such as traffic congestion, the extractive industries affiliated with energy production, the resource curse, nuclear waste, air pollution, greenhouse gas emissions,

and water consumption. Several solutions include passage of a carbon tax, accurate price signals and tax shifting, and environmental bonds (ibid).

When a matter of injustice occurs the issue of human rights is most likely involved; this is no different when looking at energy justice. Injustices surrounding human rights issues include the violation of civil liberties—in some extreme cases death and civil war—undertaken in pursuit of energy fuels and technology, as well as the contribution of energy production to military conflict. Academics suggest these solutions: extractive industries transparency initiatives, energy truth commissions and inspection panels, improved social/ environmental impact assessments for energy projects, and availability of legal aid to vulnerable groups (ibid).

The research addresses injustices and solutions related to energy insecurity. The infractions involve lack of access to electricity and technology, dependence on traditional solid fuels for cooking, and time-intensive fuelwood and water collection and processing of food in emerging economies, borne mostly by women and children. Remedies include social pricing and assistance programs as well as pro-poor public private partnerships (PPP) for microhydro units, solar home systems, improved cook stoves, biogas digesters, and small-scale wind turbines, mechanical energy for pumping, irrigation, and agricultural processing (ibid).

2.4.2 Framing Energy Justice Categorically

The previous framework was successful in not just framing the problem but also framing the solution. The literature search revealed energy justice

framing could alternatively break into three categories deemed essential: distributional, recognition, and procedural justice (Bickerstaff 2013, Jenkins et al. 2016).

Distributional Justice is defined as exploring justice issues in both energy production and consumption. Distributional injustice is associated with wider established concerns over inequality, poverty and the interests of the least disadvantaged. Researchers appraised the equity of energy use in El Salvador, Kenya, Norway, Thailand, and the United States. Even in the most equitable country, Norway, half of all residential electricity in the country was used by 38% of its residents (Sovacool and Dworkin 2014). While this residential usage may have benign explanations for the use pattern, it does present an opportunity for further exploration to the root cause. Table 1 displays the rest of the countries:

Country	Percentage of Customers
Norway	38%
United States	25%
El Salvador	15%
Thailand	13%
Kenya	6%

*Table 1: Half of all Nationwide Residential Electricity Usage
Created by Elijah Romulus April 26, 2017
Source: Sovacool and Dworkin 2014*

An example of distributive justice is found in Germany. The nation is attempting a transformation in energy strategies called “energiewende” it entails the decarbonization of the energy sector and replacement of large-scale nuclear power plants. One method in doing so has been to increase support in renewable energy. The German government has initiated this attempted transition through feed-in tariffs (FiTs). FiTs guarantee priority access and profitable electricity prices for producers of renewable electricity (ibid).

Recognition Justice refers to the non-recognition and disrespect of ethnic and indigenous minorities in regards to energy. Researchers argue that internationally, government-sponsored programs have typically treated the “energy poor” as suffering from a “knowledge deficit.” This has been addressed with initiatives focused on the provision of objective information, economic subsidies and other incentives for increasing the energy efficiency of the housing stock and electrical appliances. It would be beneficial to understand the needs of energy justice communities and aim to create programs around their recognized needs. The literature mentions few attempts are made to discover the motivations behind consumption patterns or to engage with the “energy poor” group’s interpretation of energy-related issues, and what kind of improvements and strategies they would envision (ibid).

Procedural Justice is defined as achieving just outcomes through local knowledge mobilization, greater information disclosure, and better

institutional representation. Researchers tout that local knowledge has been a critical motivating factor raised in the literature for seeking the inclusion and engagement of affected publics. The notion is most closely linked to indigenous peoples. This pattern of overlooking indigenous knowledge on the environment emerges within several energy contexts to the detriment of communities and the sustainability of decision-making (ibid). This idea of looking at indigenous knowledge can be translated to local knowledge within communities. Understanding and framing energy justice better contextualizes energy insecurity.

2.5 Availability & Affordability

Availability and affordability in respect to energy insecurity refers to the dependency on and diversification of energy, access and equity, decentralization, and lower prices (Sovacool et al. 2011). Research points to systems that are modern and should be readily available but bypass people in need. In the Democratic Republic of the Congo, the world's largest transmission lines carry electricity past millions of households in order to power copper mines (Sovacool and Dworkin 2014). Sovacool and Dworkin argue the affordability affects at a national level where in Nigeria, only 19 out of 79 power plants work and blackouts cost the economy upwards to \$1 billion per year. Some researchers have regarded Kenya as a success story in terms of rural electrification availability with the help of small PV systems. This success in Kenya is attributed to the ability to make battery charging

stations across the rural regions as well as selling SHSs and the necessary replacement parts (Breyer et al. 2009).

These issues are not confined to specific geographical locations. Energy insecurity is not a problem only found in the rural regions of developing countries; the same can be said for urban communities. Residents in cities also are unable to afford the benefits of reliable affordable electricity (Singh et al. 2015). Similarly, this issue of energy insecurity is not exclusive to developing countries. While the United States has better access to electricity, citizens in the rural regions of eastern North Carolina have to deal with being overcharged due to poor infrastructure and energy provider monopolies (Harrison 2013). In Vermont, the issue is one specifically related to fuel insecurity, or lack of access to affordable natural gas, where winter deaths kill more of the state's residents than car crashes (Teller-Elsberg et al. 2016). One of the major issues that has been an impediment to energy availability has been the independence of energy. Researchers and activists alike have argued that municipal owned utilities would be the breakthrough for a real solar economy. (Berman and O'Connor 1996).

Regardless of a developing or developed country the issue of energy insecurity is a class issue. One author simplifies this notion of energy insecurity; low-income households depend on energy to survive, middle-income households depend on it to thrive, and upper-income household use it to demonstrate their wealth (Sovacool 2011). When looking at the most vulnerable of classes, low-income, in many cases affordable energy and even

the availability of it is a matter of survival. According to one survey of households in Haïti, homeowners ranked lighting their homes and charging cell phones as the top priority for electricity use (Podmore et al. 2011). Whether it is the issue of infrastructure, energy companies monopolizing, or complete lack of access, there is a case to be argued for the use of solar in energy justice communities.

2.6 Technology Development

Advances in technology and development which is made up of: innovative technology, research and development, safety and reliability, resilience, energy efficiency, and investment for said technologies, are vital factors to account for. Some research has shown that even in the absence of climate change, population growth and energy demand will shift renewable energy sources, RES, requirements from 2% to 82% by 2100 (Warner and Jones 2017). Over the past 20 to 30 years there have been great advancements in RES such as wind, solar, hydro, and geothermal power. On the other hand, some researchers make the case that too much emphasis is weighted towards electrification as a solution. Concerning resilience, they argue electrification can neither resolve energy insecurity nor address the sustainable development issue as a whole (Bhattacharyya 2016).

In the United States the solar industry has been around since the 1970s following the first boom for solar. During that time, over three thousand solar companies incorporated (Berman and O'Connor 1996).

Research shows globally, an estimated 19.1% of final energy consumption was sourced from renewables in 2013. Recent growth in electricity generation is led by wind, solar PV, and hydropower. Table 2 below shows the global leaders in specific renewable energy sources.

	Hydropower*	Solar PV*	Wind power*	Geothermal*
1	China	Germany	Denmark	Iceland
2	Brazil	Italy	Sweden	New Zealand
3	Canada	Belgium	Germany	Hungary
4	USA	Greece	Spain	Turkey
5	Russia	Czech Republic	Ireland	Japan

Table 2: Global leaders in Specific Renewable Generation

**Capacity Per Capita*

Created By Elijah Romulus April 26, 2017

Source: Bhattacharya et al 2016

	Investment in Renewables	Renewable Power*
1	China	Denmark
2	USA	Germany
3	Japan	Sweden
4	UK	Spain
5	Germany	Portugal

Table 3: Global leaders in Renewable Investments and Generation

**Capacity Per Capita*

Created By Elijah Romulus April 26, 2017

Source: Bhattacharya et al 2016

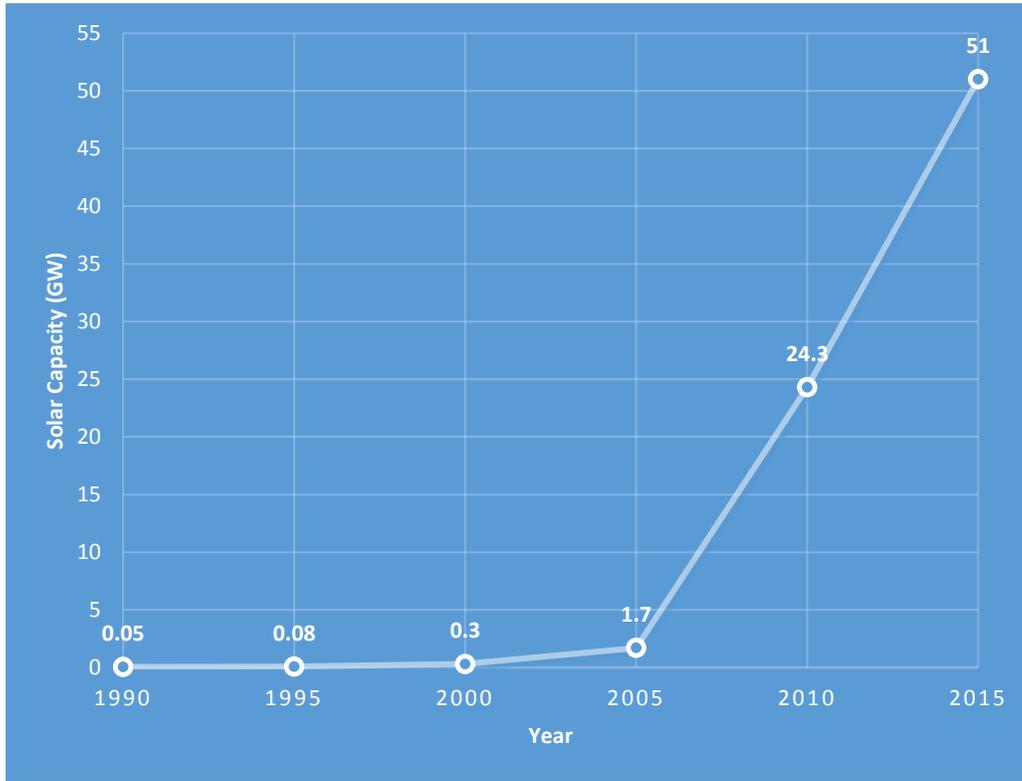
The growth in the renewable energy industry has primarily been led by developed countries, as evidenced in Table 3. Growth in the US labor sector is one area credited to the development of renewable energy. In the US, employment in the solar industry grew by 123% from 2010-2015. This growth resulted in over 115,000 new domestic living-wage jobs (The Solar Foundation 2016). In Germany, the renewable energy industry employed more than 150,000 people in 2005, with nearly 80,000 working in the wind sector. Such growth in Germany represented a tripling of jobs in the sector since 1998 (Lipp 2007).

This renewable energy boom is not confined to developed countries. Investment in developing countries in 2014 reached \$138.9 billion USD additional to China, Brazil (\$7.6 billion), India (\$7.4 billion) and South Africa (\$5.5 billion), while more than \$1 billion was invested in Indonesia, Chile, Mexico, Kenya and Turkey (ibid). The IEA optimistically predicts the renewable share of electricity generation will increase to 39% by 2050 from 18.3% in 2002 (ibid). Figure 1 and Figure 2 show the global wind and solar capacity growth over the last 16 and 25 years respectively (Binz et al. 2017, GWEC 2016, GWEC 2015, IEA 2016).



Figure 1: Global Cumulative Installed Wind Capacity 2000-2016 Created by Elijah Romulus
February 12, 2017

Source: Global Wind Energy Council, GWEC



*Figure 2: Global Cumulative Installed Solar Capacity 1990-2015 Created by Elijah Romulus
February 12, 2017.
Source: IEA 2016*

2.7 Environmental and Social Sustainability

Likewise, when addressing energy security, sustainability is an important factor. When addressing sustainability, it is important to understand both the environmental and social aspects. Key components of sustainability include land use, water, climate change, and air pollution (Sovacool and Mukherjee 2011). Climate change mitigation is important for many regions of the world. This is especially true for the 24 island nations throughout the Caribbean home to 40 million people. Higher temperatures, rises in sea level, and increased hurricane intensity threaten lives, property and livelihoods throughout the region. In recognition of the increased state of vulnerability to climate change, an organization called The Caribbean Community Climate Change Centre, CCCCC, was founded in 2005 (Caribbean Community Climate Change Centre 2017). According to the organization's website, The CCCCC coordinates the Caribbean region's response to climate change, working on effective solutions and projects to combat the environmental impacts of climate change and global warming. The CCCCC provides climate change-related policy advice and guidelines to the Caribbean Community (CARICOM) Member States and to the UK Caribbean Overseas Territories. The CCCCC also offers its archive and clearing house for regional climate change data and documentation (ibid).

Researchers argue that energy security is a public good and in the case of the United States, governance has failed to regulate effectively or incentivize ways to prevent citizens from becoming energy poor (Van Doren

2006). Part of the ability to create a sustainable rural and or urban region lies in a social response by the community as a whole. A community would need to invest in long-term solutions rather than faster less valuable results. For example, investing in solar with a higher upfront cost over paying small costs on diesel or kerosene that add up over time (Breyer et al. 2009). The idea of sustainability at its very heart is a political rather than a scientific construct (Agyeman et al. 2003). Energy justice is a matter of what Agyeman calls: just sustainabilities, the definition focuses on improving quality of life and wellbeing; intragenerational and intergenerational equity; justice and equity in terms of recognition, process, procedure, and outcome; and living within ecosystem limits (Agyeman 2013). By that understanding, for sustainable measures to be effective it relies on a societal shift to solidify it. The case study focuses on micro-generation SHSs however; research suggests micro-generation policies/initiatives that focus on the technical increasing access and capacity rather than addressing the sociopolitical components are short sighted (Bickerstaff et al. 2013).

This does not mean that sustainability is strictly an ideological construct. Being able to take care of SHSs in developing countries is vital. Acquiring the resources needed to fix SHSs and to have the personnel able to make the repairs is part of the sustainability equation. Research agrees it is a major issue in developing countries; the ability to develop and maintain renewable technology components (Podmore et al. 2011).

Two issues that one researcher defines as key problems are energy sacrifice zones and energy insecurity. An energy sacrifice zone refers to the byproduct of high demand for energy coupled with the lack of comprehensive policies focused on protecting areas that generate energy sources modern society takes for granted (Hernández 2015). Examples found in energy justice communities in the US include the concentration of waste treatment centers in working class and minority communities. Another example is hydraulic fracturing colloquially known as “fracking” which has been pursued heavily in the state of Oklahoma in mostly poor rural communities (Conca 2016). The negative effects of fracking include air pollution and water contamination. The effects of fracking were broadcasted in movie theaters with the release of *Gasland* by Josh Fox best known for the images of lighting tap water on fire. Aside from alarmingly making drinking water flammable, the harmful effects include high morbidity and mortality rates from cancer, cardiovascular, neurological, respiratory, and developmental disorders; reduced productivity; and a poorer quality of life (Hernández 2015).

Another example is coal dependence. It has led to continuing mountain top removal in the Appalachian region. The result is air pollution from coal-fired power plants in minority and/or low-income communities.

The second problem presented by Hernández is energy insecurity. Hernández split the issue into three parts: economic, structural and behavioral. The economic energy insecurity refers to the disproportionate

share of household income allocated to energy expenses with those that exceed a 10 percent threshold. Structural energy insecurity refers to physical deficiencies in the home environment such as drafty windows, poor insulation, inefficient appliances, and faulty heating and cooling systems, maintaining thermal comfort and controlling conditions of humidity and dampness. Finally, there is behavioral energy insecurity defined as behavioral responses to cope with these adverse conditions using approaches such as extreme energy conservation, seeking fuel assistance, and using improvisational heating alternatives such as space heaters and ovens to supply heat. Energy sacrifice zones and energy insecurity are central problems that energy justice aims to correct.

2.8 Regulation & Intervention

In order to aid energy justice communities on a large-scale actions to address energy insecurity require a certain amount of regulation and intervention via governance, trade, market competition, and knowledge of sound regulation. Renewable energy programs, specifically in photovoltaic (PV) solar markets, greatly benefit from governmental support to achieve a prevailing electricity supply (Breyer et al. 2009). Economic instruments can be an effective and efficient avenue to achieving sustainable energy policy goals in many circumstances. These include taxes, emission trading, subsidy reform, and preferential tariffs (Kaygusuz 2012).

Research reveals tariff reductions for renewable energy would reduce the tax that consumers pay. Energy justice communities living in rural areas

of developing countries would benefit from reduced prices on clean energy products currently too expensive partly due to import taxes (Kaygusuz 2012). In addition, preferential tariff margins would make clean technology a more affordable option in the portfolio of energy options available to electric utilities. Additionally, manufacturers located in developing countries alike would benefit from increased trade in renewable energy technologies and components (ibid).

Subsidies are the primary instrument to support solar energy development in almost every country around the world. A subsidy could be investment grants or capacity payments, output or production based payments or soft loans (Iwaro and Mwashu 2010).

Many different countries in Africa and Asia have developed energy initiatives through government programs, private ventures or PPPs. In Bamako, Mali, Solektra International launched the Akon Lighting Africa Initiative to bring solar power to twenty-five countries in Africa from Mali to the island nation of Cabo Verde (Solektra International 2016, Jamaica Observer 2017). Part of the Solektra's initiative included opening Solektra Solar Academy. This academy was in collaboration with the Centre for Renewable Energy and Energy Efficiency, ECOWAS. Nineteen young adults from eight African countries (Benin, Burkina Faso, Ivory Coast, Republic of Guinea, Mali, Niger, Senegal, and Togo) were taught both theoretical and practical training about solar technologies in its first training session that began in January of 2016 (Solektra International 2016).

Another developing nation, Bangladesh adopted a national microfinancing program for SHS. Called The Rural Electrification and Renewable Energy Development Project, it established microcredit financed facilities that resulted in the installation of over 970,000 SHS between 2003 and 2011. The model was built on the microcredit banking system pioneered by a banking institution, Grameen Bank and now adopted by numerous organizations (ibid).

Many different countries are looking at solar power as a means to aid the energy impoverished. Literature revealed China has been a leader in the field. Before the World Bank implemented a SHS program in its rural areas, the government had already spent twenty years developing energy programs that reflected their programs addressing insecurity in general (D'Agostino et al. 2011). This made additional initiatives easier to implement given the political and social climate. In addition to pulling 680 million people out of extreme insecurity dropping rates from 84%-10% over 30 years, efforts in the country have resulted in robust solar energy programs (ibid).

From 2002 to 2007, in rural areas of northwestern China an initiative led by the World Bank investing \$316 million USD was called the Renewable Energy Development Project, REDP. This collaboration bolstered PV companies' marketing capacity resulting in 400,000 SHS sold. Ensuring maintenance post sale of the SHS was one area of concern the literature pointed out (ibid). This measure was widely regarded as a success in the country as it aided 2 million residents in rural areas that would otherwise

remain energy insecure until the proper infrastructure and grid access was built (ibid).

Some research has suggested that governments' inability engage completely in commercial and legal negotiations with investors has been a significant barrier to attracting investment in the power sector in small island developing states (Niles 2013). Regulatory economic measures such as tariffs, subsidies, and taxes are a key part of the equation. However, it is for that same reason that energy security is prone to market failures and under-distribution (Sovacool and Mukherjee 2011).

The overview of literature regarding energy, energy insecurity, and energy justice on a global scale give a strong background for the case study in the following chapter. Chapter 3 provides on the ground research the literature review explored.

Chapter 3: A Case Study of Solar Power in Rural Haïti

3.1 Introduction

In early August of 2016, I joined a team of researchers and business associates on a trip sponsored by the company 10Power and their grant partner, Invoking the Pause. This was a one-week feasibility study in the rural southern department of Haïti called Sud, Figure 3 and 4 show the location of the case study sites. The purpose of the trip was to see whether 10Power in partnership with a Haitian company called, DigitalKap could launch a successful PAYG model in the region.

Haïti has a less than reliable grid that is responsible for providing electricity to its people. In this case, there is no access to the grid in the towns that were studied. Seventy-five percent of people in Haïti do not have access to electricity via a grid; this is one of the lowest electrification rates in the world (Electricity Sector Data 2015). Moreover, in many cases the available electricity is extremely expensive. It is for these reasons that the region was chosen as a research study for energy justice. One solution, given the abundance of sun and proximity to the equator, is solar power for the energy insecure. Solar power can serve communities on and off the grid, in both cases providing a cheaper alternative. The introduction of a clean technology like solar home systems and solar powered microgrids can ease the issues of dirty technologies used currently, whether they are charcoal or diesel.

This case study looks at the energy justice issues in Haïti and the different stakeholders that are addressing the situation. This case study will

focus on the energy justice communities themselves, as well as for-profit and nonprofit institutions' collaboration with said communities.

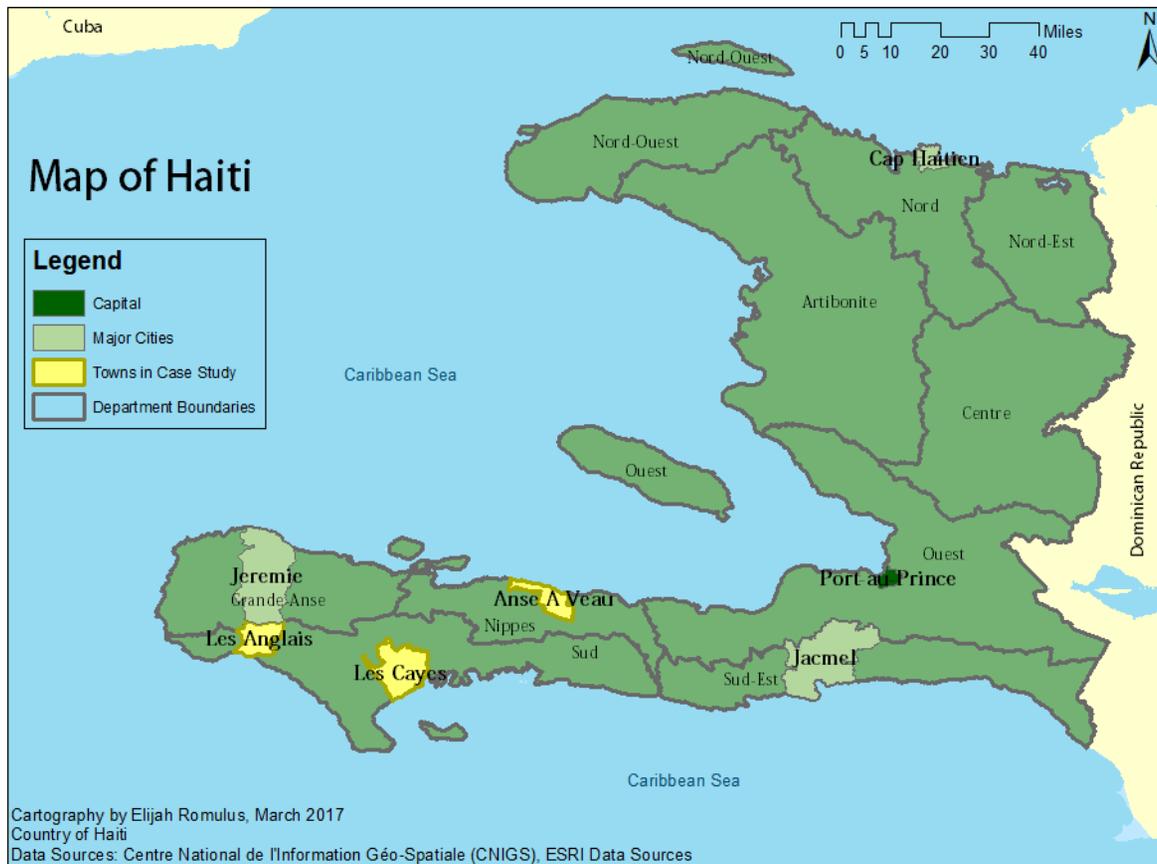


Figure 3: Map of Haiti

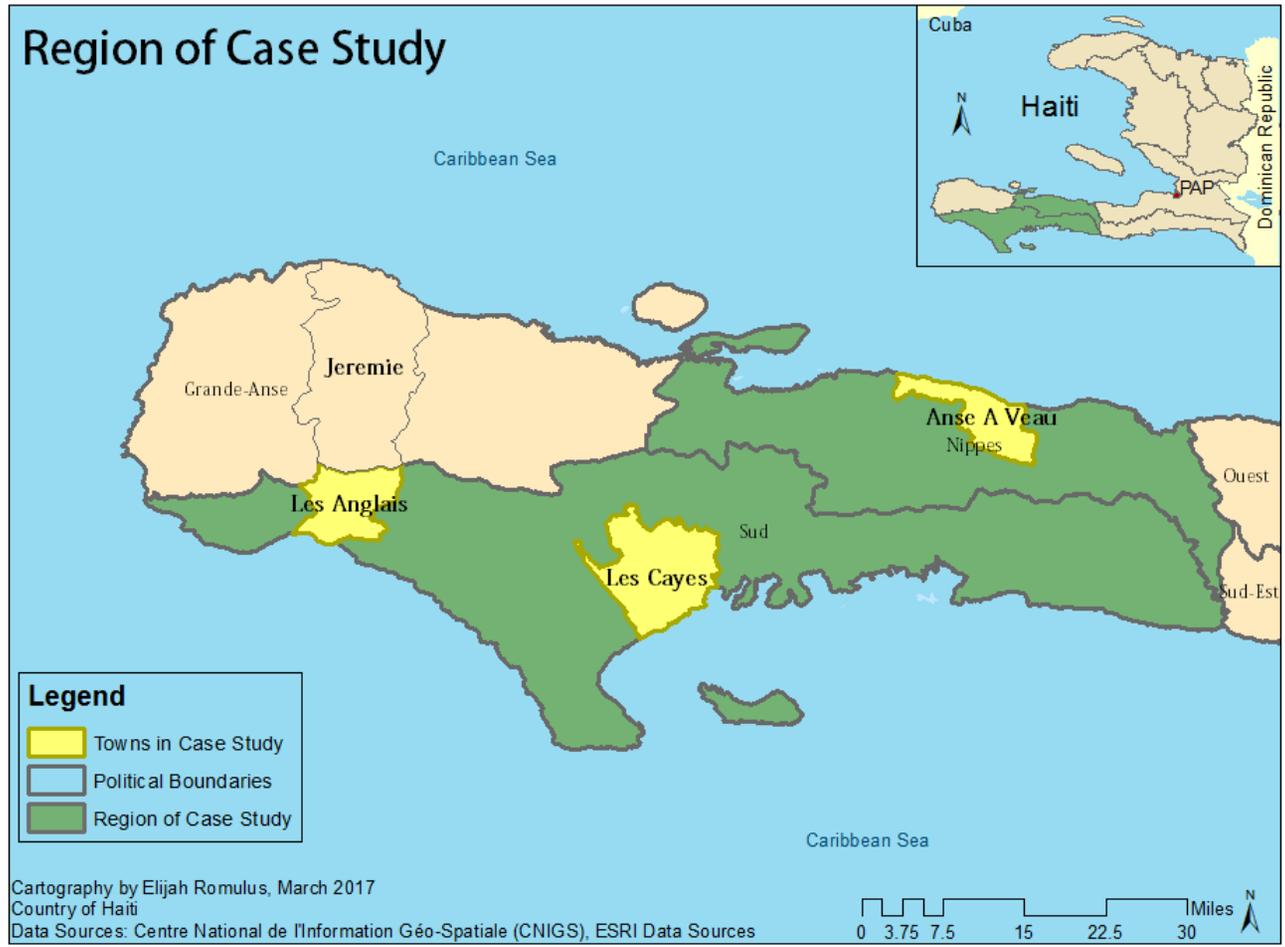


Figure 4: Region of Case Study Map

3.2 How Does Solar a Solar Home System Work?

The solar home system, SHS, as mentioned in previous places throughout the thesis is one solution stakeholders have identified for energy justice communities. Figure 5 illustrates the components of a SHS. A solar PV panel of choice wattage is connected to a charge controller. The charge controller feeds power to the battery of choice capacity to be stored, as well as any loads plugged in for electricity to power.

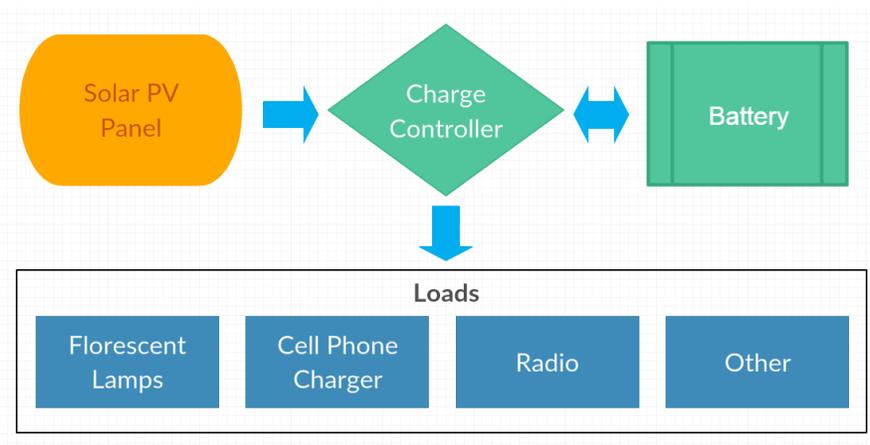


Figure 5: Components of a Solar Home System. Adapted by Elijah Romulus. Source: (Chowdury et al 2016).

The following diagram in Figure 6 compares a SHS to the traditional solar system used in a centralized grid scenario. The distribution of electricity evidenced by the blue arrows is split between the end user (breaker panel and plug loads) and the utility service (electric meter).

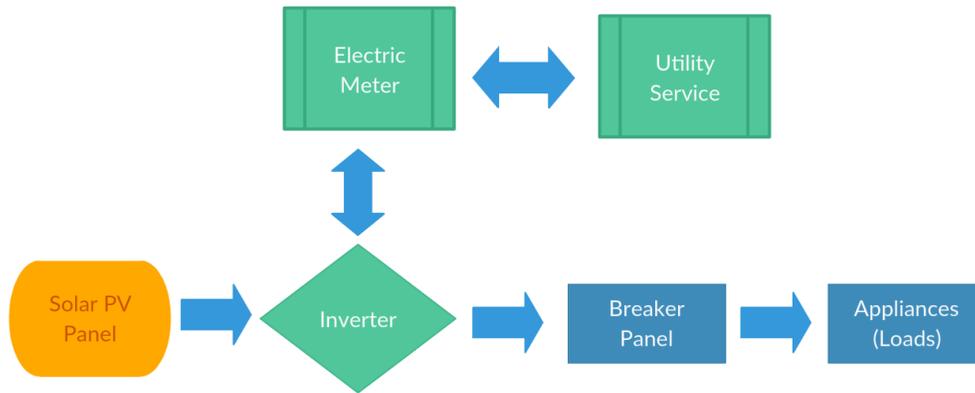


Figure 6: Components of a Grid Connected Solar System. Created by Elijah Romulus March 2017.

3.3 The Feasibility Study

The feasibility study was conducted in partnership with DigitalKap, a Haitian owned all-in-one solar provider. DigitalKap launched the Energy24 project, in the Haitian communes of Anse-a-Veau and Morency (outside of Les Cayes, capital of Sud). According to 10Power, approximately 30,000 people could benefit from the initiative. Energy24’s PAYG method would allow consumers to lease an Energy24 system (10W, 100W, and/or 150W) and make mobile payments in order to activate the supply of power from the system. When the value added has been depleted, additional payments can be made to the system as desired to reactivate the power supply.

In addition, the “Rent to Own” (R2O) method allows consumers to make small, manageable payments over a two-year period to eventually own the system outright. The flow of energy is continuous throughout the rental period (limited only by the capacity of the system, i.e. 100W). When the

consumer has fully paid for the product, they become the owner of the system. Fixed payments are made on a monthly basis during the rental period. The payment period is not to exceed two years but can be shorter. If a consumer chooses to make extra payments, they can own the system outright sooner. Extra payments will result in a lower overall cost to the consumer. The results of the feasibility study are summarized in the “From the People’s Perspective” section.

3.4 From the People’s Perspective

As the introduction mentioned, Haiti is an impoverished country with various regions in dire need of electrification. In the Sud department, that was apparent after conducting the feasibility study. The response from the people was a clear need for basic healthcare, a reliable local economy, infrastructure, education, and energy. In Morency, it was clear from the beginning that the prospect of solar power in the community was something the people wanted. The first community meeting for the study was coordinated with an NGO, Hope for Haïti, that had been setting up schools in the area, and had connections to DigitalKap.

On a Tuesday afternoon, it seemed the entire village of Morency packed into the local church, men, woman and children totaling approximately 150 people. In Anse-A-Veau the community turnout was smaller with about 50 people showing up again at the community’s church. It is worth pointing out that many times the church is the place important events and meetings were held aside from religious processions. Between

the two villages approximately 200 people attended the meetings; 25% were under the age of 25; 49.9% were between the ages of 26 and 50; 25.1% were over the age of 50.

The financial situation of the two villages was the biggest concern. In Morency the village relied primarily on fishing. The angler mentioned the need for a more reliable profession, one that was year round, to afford certain necessities. He recounted, “No fish, no economy.” Many of the people in the villages were worried about the durability and longevity of a solar product. System payments could very well mean using the majority of their earnings. According to the World Bank 59% of Haitians live on \$2.42 USD per day, another 24% live on \$1.23 USD per day (World Bank 2017).

One participant in the study wanted to know where the products came from and was disappointed that it was not manufactured in the country. When confronted with the price of a prepaid system, people in the villages who could not afford it outright were aware of using lending circles or a “sol” as they call it. In a lending circle, a group of people invests in one person to get a product, they would keep saving collectively until they invested in the second person. This process would go on until everyone acquired the goal. While participants agreed, a “sol” is a means to gain a SHS it remains to be seen if it is economically plausible.

Another issue plaguing the communities was the lack of infrastructure. Just to get to the villages in the study, the team travelled via a heavy-duty pickup truck or in one-instance motorbikes that could maneuver

the rough terrain. In the mountainous region, there were no finished roads for a sedan or a van. The participants in the study reiterated maintaining a local economy is hard when the travel is difficult.

Simply by their sheer interest and need, people showed that they wanted better sources of energy. Some people lamented the fact that they had to walk miles to pay to have their cellphones charged: instead of raising their children or making a living, time was spent travelling back and forth. In the fishing village, anglers mentioned that they could benefit from DigitalKap's products while at sea. The benefit would come by having light and radio on their boats during night fishing. Others mentioned that the money saved by switching to the solar product would allow them to spend more money on their children.

3.5 From a Business Perspective

The business sector in Haiti has been involved in energy issues both within the country and abroad. CEOs Sandra Kwak and Patrick Eugene of 10Power and DigitalKap, respectively, were interviewed for this case study. 10Power, is an LLC incorporated in California with the intention of becoming a business corporation. 10Power has been operating in Haïti for about two years. DigitalKap is a for profit business based in Haïti that has been operating for about four years. 10Power's primary means of operation is investing in renewable energy projects that can be paid back over time (10Power 2017). This has led them to partner with various solar companies in Haïti as mentioned earlier in the case study. They have partnered with

three Haitian businesses that all employ between 20-50 Haitian nationals.

DigitalKap is owned and operated by, and employs Haitian people.

The two companies ventured together on the Energy24 initiative.

Energy24 was a response to the apparent need for affordable clean technology in some of Haïti's most remote regions. The two CEOs of the respective companies shared insights on energy issues from their perspective in the country. Their insights covered: operating as a business in Haïti; their relationship with the citizens of Haïti; their awareness of the energy issues and how the companies are involved; how they see Haitian people organizing around energy justice issues; obstacles in solarizing Haïti; finally, they looked to the solar industry's future in Haïti.

Functionality and operating as a solar company in it of itself has been an issue mentioned by both companies. On the part of 10Power it is difficult as a foreign business incorporated as a Société Anonyme, SA. The World Bank ranked Haïti 181 out of 190 countries for ease of doing business in 2016 (World Bank 2017). In terms of drawing investments, the perceived risk of doing business in Haïti is another issue following the earthquake in 2010 and Hurricane Matthew in 2016. Research suggests private investment will play an important role in energy justice communities. However, investors face barriers in off-grid electrification. These barriers include but are not limited to low return, low business volume, high transaction costs, and regulatory and policy weaknesses (Bhattacharyya and Palit 2016).

Similarly, the risk of investing in a country with an unstable currency is another issue in growing a business or attracting capital.

Even with that being said, Kwak says “Genyen anpil Solèy” (There’s a lot of sun). Despite some operational hurdles, Eugene says his company has been quite successful. In addition, only a small amount of the solar market has been tapped with a large amount of room to grow. A research thesis for the Caribbean Community, CARICOM in 2010 examined three islands in the Lesser Antilles and emphasized the high potential for solar energy in the Caribbean (Scherwin 2010).

Both companies, while for profit institutions, are aware of the social/economic needs of energy justice communities in Haïti. When children are on summer vacation, DigitalKap visits various communities to teach the youth about solar power. 10Power invests in projects for large businesses and nonprofits but, like the water filtration centers and the Energy24 initiative, it finds ways to be a social enterprise. “People need energy. Few people can pay for solar upfront but people want it,” says Kwak. 10Power targets various stakeholders in the solar industry such as lending institutions, donors, solar installers, NGOs, etc.

As a company, 10Power recognizes upfront cost is an issue so finding stakeholders that can front project development and financing costs is important. Upfront costs to rural area residents is not possible but long-term financing is possible. Long-term financing can help stimulate the local economy. The ability to establish a credit system in localities can allow more

businesses to confidently operate in areas where leasing products is more feasible than outright purchase.

While a PAYG model has worked in some sub-Saharan African countries, residential communities in Haïti need further subsidies to do PAYG. The reason subsidizing is crucial is that the consumer's ability to pay for a PAYG system is lower than the cost of delivering the goods and services by the respective company. Companies such as DigitalKap and Ekotek have been looking to government aid, grants, bank loans, and other outside donations as a way to subsidize projects.

Following Hurricane Matthew, which devastated the very region where the feasibility study was conducted, 10Power and DigitalKap followed the nonprofit approach to aid people in southern Haïti. #PowerHaitiCoalition was founded and as described on their website, "it is an alliance of local and international strategic partners working together to provide sustainable infrastructure and clean energy in the wake of the hurricane and beyond." (#PowerHaitiCoalition 2017). The long-term vision is to facilitate investment opportunities that empower communities to build resilience and thrive.

10Power and DigitalKap provide a cleaner cheaper alternative in solar power are helping businesses to save money and recirculate the money into the local economy. DigitalKap is able to do this by being an operational Haitian SA while 10Power accomplishes this by collaborating with such companies. This can also be referred to as creating energy independence.

Despite many of the setbacks that face the general population and the solar industry, players in the solar industry recognize the socio-economic and political organizing that occurs in energy justice communities. Kwak of 10Power mentions the fact that Haitian government passed laws that allow leaders of communities and mayors to independently supply energy in their communities. Even so, educating leaders of communities on the possibilities the law allows for is another issue. Patrick mentions, while people are not privy to all the intricacies of solar, there is a percentage that understand it is a way to generate electricity. Eugene sees his company as one that expands that understanding and grows people's excitement for solar. One example is partnering with a popular production company in the country, HaitiXchange to market their products that got upwards to 100,000 views on Facebook.

Kwak stresses that in regards to energy justice, "10Power considers climate change and energy justice essential." In addition, the communities suffering the most from the harmful effects of climate change have not experienced the benefits of industrialization. Quantum development and 4th world development is at the crux of the organization's movement. Quantum development in relation to the 4th world refers to not only bringing said countries to present technology but moving to the present and innovating past conventional technology. While their customers have various drivers, they are all trying to obtain a better quality of life. 10Power chooses the theory of quantum development instead of leapfrog development. They believe it is possible to jet pack to a new future instead of going with

conventional wisdom or the modern technology. Why not use the opportunity to innovate past that? 10Power avoids the sunk costs in destructive technology such as fossil fuels, and looks to be a part of developing the sustainable and reliable technology of the future.

Another stance of 10Power is the fact that right now society has cost effective technology that can enable 100% clean energy that does not have to require a “brain drain” in fixing the environment. This “brain drain” refers to the current resources used to combat the harmful effects of climate change due to fossil fuel dependency as opposed to potential resources to develop renewable technologies. 10Power see themselves as being a part of the solution to a renewable energy future. Even changing to looking at the measures on which we base societal success to something like Bhutan’s Gross National Happiness, GNH Index (Kelly 2012).

GNH as opposed to the current Gross Domestic Product, can shift to more wellness and health based models. While GNH is still against conventional indicators, it measures based on good governance, sustainable socioeconomic development, preservation and promotion of culture, and environmental conservation when leaders are considering legislation (Schultz 2017). DigitalKap founder Eugene concludes that for the most part people know about solar and the possibilities that come from it – it is a matter of how that can happen.

Reflecting on the obstacles in solarizing and electrifying Haïti, the two biggest obstacles identified are financial and educational challenges.

DigitalKap responded, aside from the financial ability, people need to be educated about solar and what it is. The more the general population understands solar energy, the better it can grow. DigitalKap find it is the biggest obstacle because if one does not understand something and what it can do for said person then they will not have any interest in it.

Both companies look towards the future of solar power in Haïti. 10Power was really excited for scaling their operation in Haïti. They look forward to building up their larger commercial and industrial base. Afterwards, they look forward to bridging agriculture systems and solar power in the country. Kwak mentioned 10Power moving to philanthropic ventures once they can grow the company. Additionally, she stressed as a company they are looking to partner with university professors to train women and men to become technicians, installers, electricians and engineers. With that training the solar industry in Haïti can truly be for Haïti by Haïti.

DigitalKap's view of a Haïti with solar power insists that the government rebuild the existing system. Eugene says, "EDH has to improve the infrastructure so solar companies can connect to the grid for people. If Haïti had a grid like the US, people would not need battery backup for solar which is very expensive." Moreover, with a grid, people would be able to feed back into the system. "If the Dominican Republic can do it, we can too," says Eugene. He pointed out that the price of solar panels is going down but the price for batteries is going up and that is why the systems are expensive. If

that price surge can be fixed, then it will be possible to solarize Haïti. “We need to make it affordable.”

A solar powered future in Haïti is one where the government is involved to support companies like DigitalKap to bring power to people like those in the southern rural areas. Furthermore, the government would have to alter import taxes on solar products to bring the tax price down in order to bring more solar products into the country. Eugene concluded, “There is a lot of discussion already underway for solarizing Haïti and I hope the conversation continues.”

3.6 From a Nonprofit Perspective

The last actor that was assessed in the case study, in regards to energy justice in Haïti, was the nonprofit sector. The EarthSpark was founded as a reaction to the energy issues people in Haïti are still dealing with.

EarthSpark’s founder prototyped a wind turbine and was contacted by a diaspora group for street lighting in Haïti. During a research trip the founder recognized the people’s deep desire for lamps. Small scale solar lanterns are life changing and that is how the NGO started functioning. However, citizens very much want modern technology. Microgrids made that possible because the closest grid access in the area was an hour away.

Rachel McManus, executive director of EarthSpark International was interviewed. EarthSpark International, a US based nonprofit, has been working in Haïti since 2009, they have sold over 18,000 small-scale clean

energy products ranging from solar lanterns to efficient cook stoves. In 2012, the NGO started a privately operated pre-pay microgrid in Les Anglais, Haiti, a small town without prior grid access. This microgrid was independent from the national grid. In 2015, the NGO expanded to 450 connections, directly serving over 2,000 people with 24-hour electricity powered primarily by solar energy and battery storage, cutting customers' energy costs by up to 80% over previous energy sources (EarthSpark 2017).

The microgrid is large enough to power small industry while progressive enough to offer accessible service to every single resident living within the infrastructure's footprint. EarthSpark's mission is to eradicate energy poverty. They have created a SparkMeter, a social enterprise that has been implemented in 12 countries worldwide. The SparkMeter is a low-cost, pre-pay enabled, smart metering system used as a solution for electric utilities in developing countries to serve low-income customers (SparkMeter 2017). The social enterprise they have founded in Haiti is called Enèji Pwòp, which is an incorporated Haitian business of S.A. They are currently working on an investable plan for up to 80 microgrids by 2020.

The executive director, McManus, reflected on the NGO's social enterprise and its relationship with the Haitian people. Enèji Pwòp has six staff members that are Haitian as well as two shareholders in the S.A. The microgrid operates in Les Anglais with 450 customers who pay for electricity by purchasing credit like a prepaid phone. 65% of customers pay \$1-2 a month for electricity. This is not exactly how much it costs to maintain the

grid but it is what the population is able to pay. Energy vendors for the microgrid are sometimes employees and sometimes-local entrepreneurs. By allowing local entrepreneurs to buy credits in bulk and sell them independently, they foster growth of the local economy.

EarthSpark has seen itself as a catalyst in engaging citizens in their energy justice issues. The NGO has also forged relationships with the US Embassy and former energy security minister Rene Jean-Jumeau to advocate for rural energy access. In Les Anglais there is an energy committee that was first appointed by the NGO and then transitioned to a committee elected by the microgrid customers. The elected committee represents the people. It acts as a vehicle to educate the public on the workings of the microgrid and bring back customer's responses to the operators of the system. Speaking to what people are doing in individual communities, EarthSpark did a market study across 89 towns for microgrids, and invited mayors to view the technology. "Everyone sees the benefits from solar power," said McManus, "There's an interest and desire." However, regulatory methods need to be updated and the upfront cost of solar, in the form of tariffs, needs changing. This is not just for the micro level but on the macro level as well, stressed EarthSpark. Globally, world leaders need to move past micro solar lantern fixes and move to how they can get involved in expanding grid access to rural communities in developing countries.

EarthSpark pointed out several obstacles to solarizing and electrifying Haïti. “At the national level, there’s a desire to see fossil fuel based generation which should be diverted to clean technology. Nevertheless, solar power in Haïti is growing,” said McManus. There are abundant solar powered street lights around the country. The problem, however, is that NGOs come in and set up the lights but there is no maintenance or upkeep for them once the technology fails. “No oversight or maintenance,” McManus explained. Lastly, there needs to be a good amount of time and effort put into economic development for long-term sustainability.

EarthSpark concluded with contemplating on its success and the future for solar in Haïti. “Yes, we’ve been successful in the fact that we have 450 households that are running on 90% solar based running 24/7,” said McManus, and through Enèji Pwòp “we have sold 1,800 solar products.” On the other hand, the NGO is far from having an investable model. Moreover, they are looking to organize costs and operations.

In the future, EarthSpark thinks there need to be improvements in SHSs as well as advancing the PAYG scheme. There are about 80 towns made up of 200,000 people the NGO could potentially solarize, but there are 7 million people without energy in Haïti. Finally, EDH needs to expand, restructuring EDH and negotiating for help will be key, as well as expanding microgrids and SHSs all in tandem.

3.7 Conclusion

Many issues arise from energy insecurity. The residents of Les Anglais, Morency, and Anse-à-Veau, businesses such as 10Power and DigitalKap, and NGOs such as EarthSpark are all figuring out way to address the issue. The largest issues that all perspectives mention are the socio-economic factors hindering energy security and the lack of governmental interventions. Solar power is not the only way to aid energy justice communities but it is a clean energy solution. The following chapter analyzes the research conducted in the case study to answer the questions posed in the first chapter.

Chapter 4: Case Study Analysis

Name	Type of Stakeholder	Ways of Addressing Energy Insecurity	Energy Justice Obstacles
Citizens of Morency & Anse-à-Veau	General Population	Use of kerosene, oil, walking long distances to power cell phones, create “un sol” lending circles to invest in energy products	Limited grid access, education, financial means, susceptibility to natural disasters.
10Power	For-profit Institution	Investing in different renewable energy projects, investing in Haitian owned solar companies for commercial and residential installations, coalition building, partnering with Haitian solar companies.	Government cooperation, perceived risk of investment.
DigitalKap	For-profit Institution	Installing solar for the commercial and residential sector, economic development by being 100% Haitian owned and staffed, selling PAYG SHSs.	EDH limited grid access, government cooperation, taxes on solar products, and solar awareness of potential customers.
EarthSpark International/ Enèji Pwòp	Nonprofit Institution/ For-profit Institution	Creating microgrids in villages, selling solar lanterns, fostering economic growth in local economies.	EDH limited grid access, government cooperation, creating and investable model, reframing energy insecurity on an international level.

Table 4: Case Study Summarization created by Elijah Romulus March 11, 2017.

4.1 Introduction

It is clear from that case study that there are multiple stakeholders involved in the energy justice issues in the country. Table 4 shows a brief summary outlining the type of stakeholder involved in the case study, ways said stakeholder(s) is (are) addressing energy insecurity, and finally the obstacles that prevent energy justice from being obtainable.

Across the board, community members, businessmen and women, and NGOs lamented on the lack of energy education, lack of job opportunity, lack of infrastructure, and lack of the national government's participation. On the other hand, these deficits have pushed for some very interesting and innovative ways to solve the energy justice issues.

It is important to take a look at the country profile, some of the data and demographics of the region that can better put these questions in context. This information looks at the socio-economic and energy indicators that help explain the status of the country. Stakeholders in the case study identified basic health, economic opportunities, and infrastructure in the form of roads and grid access as necessary to support energy justice communities. It is evidenced by Haiti's unemployment rate and poverty levels that economic development in the regions of the case study is crucial.

Data in Table 5 shows over forty percent of the population indeed lives in rural regions throughout the country. The availability of cellphones in the country speaks to the unique opportunity to expand SHSs. While the

country does not have widespread landline phone service, it boasts a moderate cellphone service that has grown considerably in a short amount of time. This is an example of the leapfrog technology that solar can provide in the country. The chance to skip the gradual development of old technologies that were previously out of reach and jump right to the technology of today on a mass scale.

Indicator	Year	Value
Region	2015	Caribbean
Surface area (sq. km)	2014	27,750
Population (proj.)	2016	10,848,000
Pop. density (per sq. km)	2016	3,93.6
Urban population (%)	2015	58.6
Life expectancy at birth (females/males, years)	2010-2015	64.4/60.2
Unemployment rate (% of labor force)	2010	40.6
Population below poverty line (%)	2012	58.5
Mobile-cellular suscriptions (per 100 inhabitants)	2014	64.7
Individuals using the Internet (%)	2014	11.4
Energy production, primary (Petajoules)	2013	140
Energy supply per capita (Gigajoules)	2013	16

Table 5: Haiti's Socio-Economic & Environmental Indicators created by Elijah Romulus March 11, 2017.

Sources: CIA 2017, UN 2017, World Bank 2017.

It is important to note Haiti's relatively small carbon footprint in comparison to the rest of the region. The Figure 7 compares CO2 emissions from Haiti compared to Latin America and the Caribbean. It is clear that Haiti is not making a great contribution to greenhouse gasses connected to climate change.

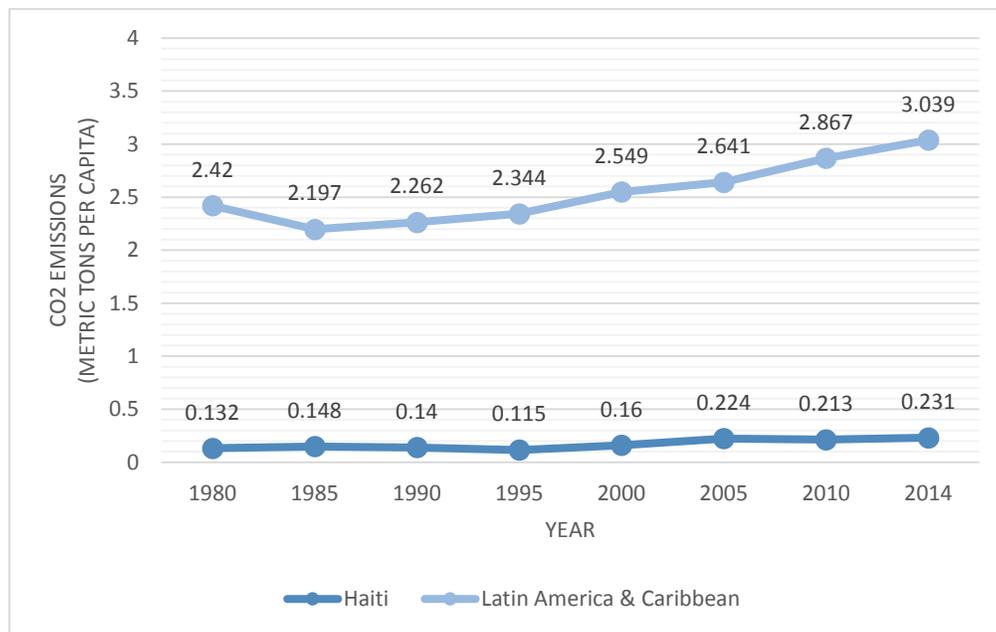


Figure 7: CO2 Emissions of Haiti vs. Latin America & Caribbean Created by Elijah Romulus on March 16, 2017.

Source: World Bank 2017.

4.2 Analysis

4.2.1 Main Research Question

The main research question asked: In what ways might a social enterprise and business partnership between DigitalKap and 10Power address the problem of energy insecure areas throughout rural parts of southern Haïti?

According to interviewees, invoking the change needed in the rural areas, requires a multifaceted approach headed by the government. Unfortunately, the instability at the federal level in Haïti may not result in a climate that can foster the change. Both CEOs of the interviewed companies as well as the executive director of the nonprofit stressed that without the government support of solar, the solar industry will not reach its full potential. EDH has been marred by underfunding and the inability to further develop its grid system. This has led to a large deficiency in its rural electrification capacity. EDH and the electrification or lack thereof is what is driving the need for solar to power basic energy necessities such as cell phones and radio for communication and lights to see at night.

The business and nonprofit sectors have stepped in to fill the void the utilities are leaving. This is not any different from other public sector work that occurs across the country. Following the case study there are multiple ways 10Power and DigitalKap can help address the problem of energy insecure areas throughout rural parts of southern Haïti. It is of most importance that the southern region of the country has adequate access to electricity. This urgency is due to the agricultural impact it has on the

country. For the proper production and cultivation of crops in Haïti, a reliable energy source is important to operations within the agricultural sector. The southern region of Haïti is considered the breadbasket of the country and staple crops such as rice and sugar are grown in those regions. One way is to attract further domestic and foreign aid to the regions to provide help on a micro and macro scale. Being able to develop microgrid systems as well as provide solar home systems will give the region the boost it needs and can be an avenue to stimulate the economy. This is evidenced by the work happening in Les Anglais.

Further educating the public on the importance of solar power and its benefits will be crucial to getting the community support needed. Continued research such as the feasibility study can help gauge what the communities need as opposed to bringing in technology and aid that they had not asked for or were aware of in the first place. Community support is important to any company that is trying to establish a consumer base.

The region studied in the case is extremely mountainous and much of the countryside's infrastructure, roads in particular, is not developed. If the company aims to create a consumer base in the region it would be important to establish a storefront in the area by either partnering with cellphone providers, or employing residents that have motorbikes that can navigate the rough terrain. Again lobbying the federal government to aid in the economic and infrastructure development is suggested.

The largest area of impact would be training individuals in the area to be electricians, engineers, and or technicians. The ability to maintain a solar system is crucial. DigitalKap is a Haitian owned and staffed company and 10Power actively seeks to partner with companies such as DigitalKap. Being able to train local residents to maintain solar systems would greatly increase the sustainability and resilience in the region, and perhaps lead to a more investable model. A solar company that is looking to sell a product in these regions would literally have to become the economic stimulus for the region; this would mean a long-term investment plan.

4.2.2 First Sub Question

The first sub question asked: What are the aspirations of energy justice communities? The community members of Anse-à-Veau, Morency, and to a larger extent Les Anglais, all made it clear that they were in need of basic necessities. There is a need for basic roads, basic healthcare, a local economy, and cheap reliable energy. On the other hand, these communities do not want the bare minimum, they know what the developed world has and they want the same technology. These communities want an energy source and the infrastructure to support internet access, power a home with all the appliances from a fridge to air conditioning to a computer.

The greatest motivation in the communities that were studied was to make a better living for their respective children. Many times the lack of a strong local economy resulted in people traveling far in search of work. As mentioned in an earlier chapter people have to walk far distances to charge

their phones the whole process can take up to a day and that time back could be spent raising and providing for their children.

Gender equality is an issue that is addressed in the feasibility study as well. In the two villages that were studied, the beginning of the community meetings was male dominated. It was the men in the audiences that were voicing their opinions. Not until the floor opened up specifically for the opinion of the women in the crowd did the women feel comfortable enough to speak out and voice their comments and concerns. Ultimately, multiple women were the heads of their household.

4.2.3 Second Sub Question

The second sub questions asked: What are the problems energy justice communities are facing? There are many problems that are imposed on energy justice communities in the case study. The energy insecurity is the reason for the regions selected. The lack of grid access from EDH made electrification impossible. People had to use energy sources that were harmful to themselves and their environment such as diesel, crude oils, and charcoal.

Once people were surveyed for the problems that face their communities, energy insecurity was not the only issue that presented itself. Issues people talked about included dealing with disease and basic medical aid; the lack of roads that could make transportation easier; lack of a stable economy; and a lack of basic education.

Natural disasters and the lack of proper infrastructure has led to some of the most devastating effects on energy justice communities. This susceptibility to natural disasters is an issue of concern some of the people involved in the feasibility study expressed. The feasibility study by 10Power and DigitalKap looked at research in the southern region of Haïti conducted in August of 2016. On October 4, 2016 Hurricane Matthew, a category 4 storm ripped through the southern part of Haïti. The Grand Anse and Sud Departments took the greatest brunt of the storm and those departments made up a majority of the region studied in the case.

In the Sud department 15 out of the 18 communes, or city/regions, were severely impacted, 264 people lost their lives, 158 in Les Anglais alone, 90% of the crops in the department were damaged (AlterPress 2016, Assessment Capacities Project 2016). In Les Cayes, 3000 people were injured (Handicap International 2016). These natural disasters play into the many health issues that have plagued the country as well. Following the 2010 earthquake in Haïti multiple aid groups were deployed to Haïti to help in the wake. The United Nations, UN, in the midst of helping the damaged country, poisoned a main river source by disposing waste and fecal matter. This mishandling of waste sparked a cholera pandemic in Haïti, a country that hadn't seen the disease for over a century (Domonoske 2016). After Hurricane Matthew the damaged region was exposed to the disease and more cases of cholera were a result (Chery 2016).

Natural disasters expose the need for infrastructure: buildings and homes, plumbing, roads, bridges, and grid connections. In the same manner, there is a need for medical aid and improved public health. Finally, the rise in global greenhouse gasses leads to a rise in the possibility of harmful natural disasters such as Hurricane Matthew.

Economic instability is another issue that affects the energy justice communities and the population of Haïti as a whole. Lack of infrastructure, political instability and US backed dictatorships, and a history of foreign actors encroaching on the Haïti's economy has left the country the poorest nation in the western hemisphere and one of the poorest in the world (Quigley 2010). The region in the case study is referred to as Haïti's Bread Basket for its fertile land that supports the agriculture sector (BBC News 2016). Rice is Haïti's staple product. Much of the cuisine in the country uses rice as the primary grain. The country has the ability to grow and support its own rice industry; however, policies enacted under the Clinton administration forced the country to buy rice from the United States. "It may have been good for some of my farmers in Arkansas, but it has not worked," said Mr. Clinton (Doyle 2010). The US rice was sold to Haïti at a lower price destroying the rice economy and making the country dependent on international imports.

Former US President Clinton has since apologized for the policies that devastated the agricultural sector (Associated Press 2010). People in Anse-á-

Veau, Morency, and Les Anglais, all need a steady and reliable economy in order to support a business that looks to sell any solar products. In the same breath, as mentioned earlier, a business that could at the same time be a job creator and stimulate the economy is one that would benefit both parties.

Lastly, quality education is an issue that affects the energy justice communities in the study. In Morency, it was through a nonprofit called Hope for Haïti, which made it possible to survey the community in the feasibility study. The nonprofit for years has worked in the area to provide basic education and develop schools for the village (Prince 2011). This plays to the fact that on top of a basic education there is a need to educate people on solar power. In the demos for the Energy24 launch, it was a combination of community outreach, sales pitch, research, and education on solar power.

4.2.4 Third Sub Question

The third and final sub question posed: What agencies, organizations, and/or businesses are aiding energy justice communities? Haïti has the second most non-governmental organizations, NGOs, per capita in the world (Polman 2015). This amount of NGOs in the country has played to the benefit and detriment to the Haitian population. In cases such as the ones studied in this thesis, NGOs provide necessities to communities the Haitian government has not reached.

The trip to Haïti from the feasibility study's perspective was an exemplary story of how NGOs, social enterprises, and businesses can work

together to aid those in need. Haiti Communitere is an organization that was founded after the earthquake. Haiti Communitere acts as a base for volunteers, NGOs, and social enterprises to stay at an extremely low price and network with other like-minded individuals. It provides community programs to locals like computer literacy programs and is partially funded by its operation as a hostel. Staffed by local people it provides steady jobs for those in the area. It was there that 10Power was able to touch base and prepare for the multiple trips across the countryside.

There are various NGOs and businesses connected to water issues which often affiliate with energy justice issues and communities (a business example being Ovive and 10power). Kouzin Dlo is a social enterprise that offers water treatment at a low price and helps boost the local economy (Kouzin Dlo 2017). Project 509 is an organization that works in remote mountain communities in Haiti. They improve access to clean drinking water, increase education about water borne disease, and distribute essential resources that promote basic sanitation and hygiene (Project 509 2017).

From a business standpoint, as part their outreach, 10Power and DigitalKap recruited women to be energy agents in a way to empower women economically in the energy justice communities. Enèji Pwòp in Les Anglais looked to teach, employ, and provide a cheaper cleaner energy alternative to the community they work in, similar in work with a different approach.

Finally, as mentioned in the case study, following Hurricane Matthew 10Power and DigitalKap joined a team of various businesses and nonprofits to aid the area. There is a list of twelve partners all on board to provide aid, and address energy justice issues. The partners range from educational institutions, a Solar City foundation, social movements and businesses from within Haïti and more (#PowerHaitiCoalition 2017).

4.3 Conclusion

Various NGOs, social enterprises, and businesses are working with energy justice communities throughout Haïti in one way or another. The biggest takeaway from this case study is the need for a cheaper and reliable energy source in energy justice communities, the need for government support, and capacity building in regards to solar. It is unclear if these needs will be met but the recommendations in Chapter 6 will address them. 10Power and DigitalKap can be most effective in fostering the growth in the local economy; by employing Haitian employees they have started this contribution.

Financial support to front initial costs, such as subsidies, is vital for initial growth of the industry. International agencies can play a pivotal role in the industry considering the fact that climate change is an issue being addressed globally.

Locally, if EDH were able to support the solar initiatives that the businesses are engaging in it could accelerate socio-economic progress. As mentioned earlier in the thesis EDH is divided into different power plants

across the country it is not one centrally connected grid. Support could take the form of EDH partnering with companies and nonprofits that are electrifying areas throughout the country in the form of financial and sociopolitical support. This would benefit all stakeholders and reduce the chances of creating competition.

The education piece is another major key to solar success. People should be educated about the benefits of solar and a portion trained to maintain and monitor the technology in the energy justice communities. An emphasis on training individuals in the rural areas as electricians and technicians would not only create resilient energy justice communities but also ensure the maintenance and continuation of payments in a PAYG model. With these two factors addressed, just sustainability in the rural regions of Haïti and the country as a whole in regards to energy insecurity is possible.

Chapter 5: Lessons Learned & Discussion

Chapter 5 will expand on the research questions in a broader context while addressing some of the gaps in the research and build a case for recommendations made in the following chapter.

The main research question from Chapter 1 asked: In what ways might a social enterprise and business partnership between DigitalKap and 10Power solve the problem of energy insecure areas throughout rural parts of southern Haïti? The analysis in Chapter 4 showed that those ways include not only looking at profit margins but elevating the socioeconomic status of the community that said companies deal in. This is no easy task by any stretch of the imagination. However, borrowing from various examples around the world with microfinancing models, energy initiatives with governments, and the like, the companies in the study have a chance to develop the progress they are already making. The remaining sub questions were answered in the analysis but open up for a wide-ranging discussion in regards to energy justice.

5.1 Lessons Learned

Four main takeaways can be derived from the research and analysis of the case study. The first lesson was to meet people where they were and in their element. The feasibility study conducted by 10Power and DigitalKap to launch the Energy24 initiative was an important barometer for success. This does not just apply to Haïti. To enact an effective initiative nonprofit and for

profit stakeholders have to talk to the residents of energy justice communities. Understanding the needs of the people and coming to “show face” so to say is important to building trust and teasing out the needs of the people. One has to understand the culture and the environment they are engaging business in and adapt. This plays into the need for recognition justice discussed in Chapter 2. Material outcomes of a populous can determine their capabilities. Material income and wealth provide very real capabilities to meet needs for security, to avoid the stresses and insecurities of life without adequate resources (Agyeman 2013). This understanding of recognition justice is important to all stakeholders addressing energy justice.

The second lesson is; there are many different actors involved in energy justice. The case study primarily looked at three stakeholders when addressing energy justice: the energy insecure citizens, and the businesses and NGOs involved. However, there are additional actors involved these include but are not limited to governance bodies, banking and lending institutions, and academia. It is important to get as many stakeholders at the table to implement effective initiatives or business ventures.

The third lesson is that stakeholders should combine energy justice and renewable energy because it has been done successfully. As mentioned in the literature review, China presents itself as a model the developed and developing world can look towards. China is exemplary when developing renewable energy plans and aiding energy justice communities. The country

is somewhat an anomaly; it is one of the world's largest polluters but at the same time is leading the world in RE development specifically in wind and solar (Werber 2016, Ng et al. 2016). Grameen Shakti in Bangladesh is another success as mentioned earlier, 250,000 SHS installed along with 40,000 cook stoves, and 7,000 biogas plants over 15 years. Over that period, Bangladesh's microfinancing model aided over 1 million people (Sovacool and Drupady 2011, Sovacool and Dworkin 2014). Germany is the model country for the developed world when it comes to RE development. It increased the amount of electricity from RE from 7% in 2000 to 25% in 2014. This is impressive considering it is the world's fifth largest economy and third largest exporter (ibid).

The fourth lesson is that training individuals in energy justice communities is crucial. To build a just sustainable and resilient community training individuals to maintain the technology implemented will ensure stability. One of the issues that occurs in much of the developing world is when technology such as solar is introduced to communities and said communities do not have the means to maintain the product. When the product breaks down or malfunctions, it ends the benefit it was providing. A good model mentioned in Chapter 2 is the Akon Lighting Africa initiative. The Solektra Solar Academy, created from the initiative, addresses the lack of training in energy justice communities. The Academy started in 2016 and hosted several technical and electrical trainings.

5.2 Discussion

The sub questions were intentionally asked as a way to open up the discussion and not confine it to the boundaries of Haïti. Energy justice is yet another symptom of the current system used globally. Capitalism is the socio-economic model accepted by the western world, the United States the greatest example. This standard of living has been offered to the east. The model ultimately relies on an abundance of cheap labor and a seemingly endless supply of natural resources. The result of adopting this model has been an ever-increasing income and wealth inequality gap around the world. The inequality gap has reached a level where eight men own the same wealth as half of the world (Hardoon 2017). In addition, the fossil fuel dependence to keep the capitalist model moving is heating up the world and creating devastating weather patterns around world according to some scientists and researchers (Abramsky 2010).

It is the author's opinion that energy justice is ultimately a matter of economic justice and environmental conservation. Energy insecurity is not bound to developing countries. World-class cities such as Boston, Massachusetts have energy justice communities that spend an exorbitant amount of their incomes on energy from cooling down in the summer to warming up in the winter. Community shared solar is a solution that energy justice communities in Boston and across the US are turning to (Cross et al. 2016). The city of Boston is addressing the concerns of energy justice and resilience by researching the implantation of microgrids to decentralize the

energy sourcing and production (Boston Redevelopment Authority 2016). It is clear that the aspirations of energy justice communities are to live a life free from financial stress primarily, if it can benefit the environment that is a plus. While the price of solar and wind technologies keeps dropping solving both economic and environmental issues is possible.

While the technology is increasingly making a clean green and affordable energy future possible there are still barriers preventing it. Politics plays a large role in the success or failure of the energy justice movement. In developing countries, providing subsidies to clean technology is not always plausible. Subsidies for any energy source create larger budget deficits for governments and can be seen as diverting funds from programs such as healthcare and education (Sovacool and Dworkin 2014).

In 2015, the International Monetary Fund, IMF, revealed fossil fuel companies are benefitting from global subsidies of \$5.3 trillion a year (Coady et al. 2015). Shockingly, that expenditure was greater than the total health spending of all the world's governments. The report stated, ending the subsidies would reduce global carbon emissions by 20% and decrease the number of premature deaths from outdoor air pollution by 50%, an estimated 1.6 million lives a year (ibid). This evidence shows that investing in clean technologies will not only save lives immediately but for future generations. Many of the energy justice communities are exposed to the harmful effects of climate change such as more intense and longer lasting

hurricanes (Holland and Bruyère 2014). Recognizing the harmful effects of climate change makes using cleaner technologies of greater importance.

5.3 Limitations of Research

The research for this thesis provided key insights to the energy justice issues in the southern region of Haïti however; it is not without its limitations. The research conducted in the case study included a feasibility study by 10Power and DigitalKap in two villages. The study looking at the two villages in southern Haïti cannot necessarily be applied to the country as a whole. In addition, following the devastating effects of Hurricane Matthew in 2016 could have greatly affected the villages and altered their needs. Another study of the designated energy justice communities in the region may result in a change of priorities. Another way the research could have been skewed is the Haitian people's familiarity with aid groups and organizations doing work in the country. This may have altered their perception for better or worse when surveying the villages.

The biggest gaps in the research were the lack of direct contact with government agencies or financial institutions. Any information was secondary at best and without the insight from the mentioned actors, it is impossible to elaborate fully on the stakeholders involved in energy justice communities. This lack of communication with the Haitian government was partly due to the author's attempt at keeping the safety of the participants and in the case study and author intact. This concern is due to the danger

associated with making even the façade of a political action in Haïti and the life threatening consequences associated with it.

Chapter 6: Recommendations

6.1 Capacity Building

Stakeholders: This recommendation's audience is aid organizations such as the United Nations, academic institutions in Haïti such as Université d'Etat d'Haïti, NGOs in Haïti such as Oxfam, and the Haitian Government.

It is clear that the capacity to foster a solar energy infrastructure in Haïti requires the necessary sociopolitical structure and support. The literature explains capacity building as an activity implemented in a variety of ways – demonstrations, grants, consulting, and training and development. Capacity building tends to address specialized management issues such as organizational development depending on the interests of the capacity builders (Honadle 1981).

For solar in Haïti capacity building means public education for solar and technical training for workforce development and building resilient communities. Literature supports the need for public education and calls for electricity campaigns (Sovacool and Dworkin 2014). They could include but are not limited to include grade school classes on solar energy and the environment, public demonstrations/social media campaigns, and tours of clean power facilities such as the Les Anglais solar powered microgrid.

Technical training for the maintenance of SHS and other solar technology is needed to foster sustainability and resilience as well as workforce development. In addition, basic literacy and math skills should be

taught for customer support and retail services. The Akon Lighting Africa Initiative's Solar Academy is one example mentioned previously in the thesis where people are trained to be engineers, electricians, and technicians. The training of trainers is one technique to reduce outside dependency, one social service program in particular was found in China. This was in partnership with the UN where rural training centers were developed to support the needs of the specific region. 1,070 trainers were able to train 68,000 people over a three-year span (Geng and Douglass 1995).

Capacity building will not only benefit the energy justice communities but it will attract business and investors with the necessary structures to support a solar economy.

6.2 Infrastructure Development

Stakeholders: This recommendation's audience is aid organizations such as the United Nations, global finance institutions such as the International Monetary Fund, and the Haitian Government.

A reliable infrastructure is necessary to aid energy justice communities and foster the growth of a solar economy in Haïti. Transportation of materials and access by civilians to potential solar vendors is crucial. Bridges, roads, dams, levees, and buildings all need to either be constructed or repaired. The transportation and water infrastructure also needs to withstand the force of hurricanes as the region is prone to the extreme weather patterns.

There is insufficient literature on Haïti's infrastructure other than the fact that it is in poor condition and prone to natural disasters. The UN's peacekeeping mission in Haïti is drawing to a close and there is a continued concern with the responsibility of the UN for Haïti's Cholera epidemic. Regardless of taking responsibility for the epidemic or not, coordinating infrastructure development with the Haitian government and the International Monetary Fund will promote the infrastructural support energy justice communities in Haïti need as well as other stakeholders involved.

6.3 Common Ownership

Stakeholders: Energy Justice Communities and the Haitian Government.

Common ownership of renewable energy technology is the just and sustainable method to aid energy justice communities. If said communities can take ownership of SHS and microgrids for example, then they will be able to foster the growth of a local economy. The UN estimated in 1994 that the livelihood of nearly 3 billion people was made secure by cooperative enterprises. Cooperatives, Coops, are autonomous, self-helping organizations controlled by their members. If cooperatives enter into agreements with other organizations, businesses, governing bodies, or raise capital from external sources, they do so on their own terms, ensuring democratic control by their members and maintaining their cooperative autonomy (Abramsky 2010).

6.4 Public Private Partnerships

Stakeholders: For profit institutions and NGOs

Renewable energy supply must be competitive with conventional power plant technology and fossil fuels. Countries should go about building new renewable energy industries using their own labor force and wage levels. For profit companies such as 10Power DigitalKap and Enèji Pwòp can all benefit from development of the industry. Literature shows private companies have taken care of public energy supply. However, in such cases, concessions have been based on widespread public regulation and legislation to prevent private providers from abusing a monopoly supply (Abramsky 2010). The state provided direct construction grants, guarantees of loans or it was the state companies, which implemented the investment.

In absence of a stable government, seeking funding from the World Bank and partnering with NGOs like Oxfam can provide the structural support for wide scale solar expansion in Haiti. The World Bank specifically is looking to PPP projects to leverage private capital and expertise as vehicles to support the deployment of RE and energy efficiency projects in developed and developing countries (World Bank 2017).

6.5 Reparations for Energy Justice Communities

Stakeholders: The Caribbean Community, CARICOM, the government of Haiti, the government of France, and energy justice communities.

Former slave and colonized nations and peoples have had a clear disadvantage in developing with the rest of the world. In the case of Haïti, the Spanish empire carried out genocide of the Arawak Taíno people. The French then acquired half of the island and turned it into a plantation economy for sugar and coffee at the expensive of the lives of African slaves. This process impacted the development of the land on the island and the countless lives lost and impacted. Much of the western world had a hand in colonizing regions throughout the world considered developing countries. Colonization transitioned to industrialization with the abolishment of slavery and the effects of industrialization are still felt this day. “Contrary to the British media, we are not exclusively concerned with financial transactions, we are concerned more with justice for the people who continue to suffer harm at so many levels of social life,” said Sir Hilary Beckles, chairman of the reparations task force (Pilkington 2014).

In 2009 Bolivian President Evo Morales held a press conference at the United Nations” Copenhagen Climate Summit (Democracy Now! 2009). In this press conference he expressed the need for what can be considered as climate reparations, “reparations for damages that have been created by the irrationally industrialized countries.” He goes on to cite the military budget

of the United States compared to the \$10 billion USD they wanted to spend on climate change. President Morales' concerns are grounded in truth. The US military budget as of 2015 was \$596 billion USD. President Trump would like to raise the military spending by \$54 billion USD (Al Jazeera 2017; Taylor et al. 2017). According to a 2016 report by Environment America, the US Department of Defense is the country's third largest polluter (Urry 2016). The idea of climate reparations is that industrialized countries owe a climate debt to developing countries for the greenhouse gas emissions destroying the atmosphere.

In 2013 Caribbean government officials from Guyana, Haïti, St. Vincent and the Grenadines and Suriname established the CARICOM Reparations Commission (CRC) with a mandate to prepare the case for reparatory justice for the region's indigenous and African descendant communities who are the victims of Crimes against Humanity in the forms of genocide, slavery, slave trading, and racial apartheid.

The CRC developed a 10-Point Reparation plan; two of the points call for a technology transfer and debt cancellation (CARICOM 2017). The technology transfer argument addresses the ill-equipped development of Caribbean nations as European nations flourished in the age of industrialization. The demand is for a technology transfer of resources and science sharing for development. Renewable energy technology such as solar and wind fits in that narrative. Debt cancellation refers to the massive of

amounts of debt, in Haïti's case to France, former colonies owed their colonizers once granted independence. This debt has led to Haïti's fiscal entrapment in many regards. A debt cancellation would give the Haitian government the finances it would need to invest in infrastructure and a solar economy.

A demand for reparations that includes the socioeconomic and environmental ramifications of colonization and industrialization can build a strong case for the necessary funding of a robust solar economy in Haïti.

Chapter 7: Conclusion

The energy justice issues must be addressed if we are to solve the issues of environmental and climate justice. The harmful effects of climate change are getting increasingly worse. The scientific community has gauged the earth at over 4.5 billion years old (Braterman 2013). In the last three years alone we have experience the hottest recordable temperatures in the history of the earth (Shaftel 2017). This warming of the earth has in some areas such as the middle east and eastern Africa, resulted in catastrophic drought. This drought has led to famine and to some extent civil wars. The world's population is increasing, countries are developing, and with that the need for energy will increase accordingly.

Chapter 6 provided five recommendations in regards to Capacity Building, Infrastructure Development, Common Ownership, Public Private Partnerships, and Reparations for Energy Justice Communities. Chapter 5 reviewed the lessons learned from the case study as well as a discussion and the limitations of the research. Chapter 4 was an analysis of the case study addressing the research questions asked in the beginning of the thesis. Chapter 3 was a case study of solar power in Haïti's southern rural regions. This case study was a culmination of: a feasibility study the author embarked on in August 2016 to Les Cayes and Anse-à-Veau Haïti and interviews conducted of solar business CEOs of 10Power and DigitalKap doing work in Haïti as well as an executive director of a nonprofit, EarthSpark International operating a solar powered microgrid in Haïti. Chapter 2 consisted of a

literature review that looked at energy, energy justice and its framing, and energy insecurity as it pertains to: availability and affordability; technology development; environmental and social sustainability; and regulation and intervention.

Energy injustice unfortunately is just one issue that has plagued the country of Haïti. The country has had to deal with fighting colonizing forces from France to the United States, embargos by said colonizers and dictators such as Papa and Baby Doc Duvalier. This has led to an economic situation that has yet to be rectified in the country. In addition to the financial woes Haïti has had to deal with, natural disasters such as Hurricane Matthew have devastated the region. Moreover, foreign aid many times adds to the devastation. The Red Cross built just six homes in Haïti after receiving millions of dollars in donations after the 2010 earthquake (Elliot 2015). The United Nations reintroduced cholera causing a nationwide pandemic and was connected to child sex rings, 2000 allegations over 12 years in Haïti (Katz 2016; Dodds 2017). It would seem the country is in a constant humanitarian crisis.

At the heart of this thesis is a story of a resilient people. Because through all of the hardships, every day people in Haïti still find ways to survive and it is up to those with means to help the people thrive. There is a Haitian proverb that states “Men anpil, chay pa lou,” this means, many hands make light work. The energy justice movement will need all hands on deck.

Stakeholders have to work together as citizens, businesses, governments, global aid organizations, nonprofits, financial institutions, and academics. Renewable energy in the forms of solar, wind, hydro, etc., is the technology of now and it has to be made available to energy justice communities on a larger scale. Only when people work together effectively will the issue be resolved and a just sustainable outcome be achieved. If voyages into outer space can occur then there should be no feat too great for humankind to resolve and energy justice is one of them.

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