

Powering the Revolution: An Assessment of Cuba's Renewable Energy

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## Introduction

A majority of individuals in America can flip on a light switch and not have to think twice about how much energy they are using. When I turn on my stove to cook meal, the thought of gathering firewood does not even cross my mind. However, in other parts of the world, gathering firewood to cook meals is a daily ritual. I am fortunate to live in a developed country with advanced energy infrastructures that allow me to have easy access, while individuals in developing countries tell a different narrative. “Developing countries have 80% of the world’s population but consume only 30% of global commercial energy” (Martinot et. al 2002). According to the World Bank, energy use in United States in 2014 was 6,949 kilograms equivalent to oil; Spain 2,465; Ecuador 892 and Cuba 1,028 (2014). Countries such as the U.S. consume large amounts of energy, while others like Ecuador and Cuba consume just a fraction of that. The difference is striking and raises question about how energy is used and moreover how individuals have access and benefit from it.

The driving question that led me to researching renewable energy in developing countries is how equitable will distribution and access to renewable energy be? To help me answer this question, in part, is to look at Cuba and understand what approaches the Cuban government is taking to pursue its goal of renewable energy. The implementation of renewable energy projects at various scales indicates Cuba is progressing toward its renewable energy goal while ensuring there is a more even distribution of benefits to its citizens. Before I dive into what kinds of renewable energy projects are being implemented in Cuba I will provide a background of renewable energy in developing countries and a brief history of Cuba.

After setting the background I will explain the two major theoretical frameworks, Development and Post-Development theory, that guided my research and analysis. This

section will discuss what each theory is, a couple key thinkers and their contributions to the field of study. Following this section is a discussion of my where my research is situated, which is renewable energy in Cuba. This will provide the necessary information for understanding the role of renewable energy in Cuba and how Cuba is integrating renewable energy. Furthermore, it examines Cuba's motivations for integrating more renewables into their energy portfolio and how that has led to La Revolución Energética, or The Energy Revolution. For the purposes of simplicity I will from now on refer the revolution by its translated name.

Once setting up my situated context I the methods I used for analysis. This section is to tell the reader how and why I analyzed my data the way I did. It also explains and justifies the rubric I created to assess the renewable energy projects in Cuba. Following my methods are my results. This section shows the table I created that pools together all the projects that I was able to find information on. I also provide my assessment of Cuba's renewable energy projects based in my rubric and characteristics of development and post-development theory.

The last section is a discussion of my results and the implications of the Cuban context in a larger scale. This section is to debrief the implications of Cuba's renewable energy projects, what potential outcomes, the trends they could follow and what it means for Cuban individuals. I, then, finish with a discussion of how the Cuban context can be applied to other contexts, be it in Latin America or other parts of the world. The majority of Cuba's renewable energy projects are funded by foreign entities, which fall more in line with traditional development theory, however, the contracts and plans for implementation align more closely with post-development theory. This in addition to Cuba's priority of

social programs indicate a more even distribution of benefits upon completion and operation of its various renewable energy projects.

### Renewable Energy in Developing Countries

Lifestyles, energy use and consumption in developed countries are vastly different than those living in developing countries. The *World Economic Situation and Prospects Report* published by the UN Department of Economic and Social Affairs (UN/DESA) and UN Conference on Trade and Development (UNCTAD) outlines the classifications for what makes a developing country developing. Countries are classified based on their Gross National Income (GNI) per capita as well as decisions made by the United Nations Economic and Social Council and the General Assembly with recommendations from the Committee for Development Policy (2012). This type of classification will become important as I dive further into Cuba's renewable energy situation.

Energy use and consumption is a concern when individuals are trying to cook meals for their family or power technologies such as light fixtures, radios and telephones. "Roughly 350-400 million households, or 40% of the population of developing countries, do not have access to electricity" (Martinot et al. 2002). In many developing countries, many individuals still rely on traditional forms of energy. Traditional energy refers to petroleum, natural gas and oil.

Renewable energy technologies (RETs) can be referred to in two ways; the first is traditional biomass such as fuel wood, animal waste and crop waste. It also takes form in more modern technologies that are based on solar, wind, hydro and geothermal (Martinot et al. 2002). Before I further discuss my research topic, I want to draw a distinction between energy and electricity. For the purposes of this paper, when I refer to energy I am referring

to how it can be converted into electricity, whereas electricity is the converted form of energy that comes from renewables.

Primary concerns of energy within developing countries are often focused on access and the need for energy supplies that can help developing country populations, otherwise known as energy poverty. Sovacool cites the UN Development Programme and the Asian Development Bank for defining energy poverty, as the inability to carry out household tasks, such as cooking and reading; as well as the lack of access to affordable, reliable and high-quality energy that can support economic and human development (Sovacool 2014, 24). This often produces unintended consequences. Most commonly women and children spend most of their time just transporting fuel and water to power some of the most basic needs such as showering and cooking. This raises concerns surrounding gender, access to opportunities, such as education, and health since hours are spent transporting these materials rather than education or other types of productive work (Sovacool 2014).

For developing countries it is not a matter of not wanting to develop RETS, but more of a series of obstacles and challenges. “Yet many, if not most, developing countries still lack the capacity and technology shift to more sustainable and affordable supplies of energy without external assistance (as cited by UNESCAP in Sovacool 2014). Some of the most common problems RETs face are institutional finance, competitive prices, lack of incentives to switch to RETs, underdeveloped infrastructure to support RETs and inadequate or lack of government support (Gabriel 2016). This brings into question, how will the transitions to renewable energy technologies impact developing countries? Given Cuba’s government structure, the governing party has continued to prioritize standard of living and social programs. As a result of this, its pursuit of renewable energy has expanded

to both urban and rural populations that have allowed its citizens to enjoy a better standard of life.

### Cuba

Cuba is a small country located off the coast, Southeast of the United States. It is divided into 14 provinces and experiences some of the highest and continued improvements to social standards among developing countries. As a one-party socialist state governed by the *Asamblea Nacional de Poder Popular* (National Assembly of People's Power), Cuban people are supported by a social safety net (Cherni and Hill 2007). A social safety net is a collection of services that is provided by the state or government; Cuban residents are provided with universal education and health care as well as essential goods that are allocated by a rationing system (Cherni and Hill 2007). Cuba has had long-standing geopolitical tensions with the United States. While tensions between Cuba and the United States have improved within the last few years, their historical relationship is full of political turmoil that dates back to post-Spanish colonial rule. These tensions were further strained during the Cold War Era (Rumbaut and Rumbaut 2009).

Cuba's geopolitical history began with the arrival of Christopher Columbus in 1492 and was immediately followed by the Spaniard invasion. The indigenous groups Guanahatabey, Ciboney and Taíno, prior to Spanish rule, inhabited Cuba, but all were killed off by peripheries of colonialism (e.g. disease). Under Spanish rule, Cuba served as a stopping point for the Spanish fleet and worked on an economy of pastoralism and agriculture (Kästle 2017). As a result of these agricultural practices, Cuba became a monocultural economy that functioned on the production of sugar from sugarcane (Wiesel 1968).

On January 1, 1899 the Spanish flag was lowered in Havana, but replaced by the United States flag. This signaled what historians termed “birth of American imperialism” at the turn of the century 1900 (Martínez and Capote 1993). It was during this period that Cuba’s independence became limited as the U.S. had specific authority to intervene in Cuba. U.S. supported dictators Gerardo Machado (presidential term: 1925-1933) and Fulgencio Batista (presidential term: 1933-1959) created a stratified society in which a majority of the population had an education level no higher than third grade (Rambaut and Rambaut 2009, 85). The political atmosphere under these two U.S. supported dictators was filled with uneven distribution of wealth, brutality and corruption, particularly under the Batista regime, which took complete control of the nation via military coup d’état in 1952 (Kästle 2017). It was also during this time period that Cuba tried to jumpstart other ways to boost their economy, in particular, tourism. Unfortunately, with the large presence of the U.S. the tourism industry only aimed to serve and thrive under the U.S. as American capital cycled between American tourists and American owned entities thereby neglecting the development of the Cuba economy (Wiesel 1968).

Decades of Spanish rule, U.S. supported dictators and intervention led to the Cuban revolution of 1959. Fidel Castro seized power of Cuba on January 1, 1959 and led to the revolution to a one party Communist state (Kästle 2017). This event took place during the Cold War era, a time period marked by fear of the spread of Communism. Castro’s overtake and key events that unfolded during the Cold War Era led to rapid deteriorations and heightened relation tensions. “The struggle against communism would serve to justify U.S. policy toward the underdeveloped countries until the implosion of the USSR, some 30 years after the coming to power in Cuba to the revolutionary government” (Rumbaut and

Rumbaut 2009, 86). The fear of communism within the U.S. led to the ending of diplomatic relations in 1960 and imposing of trade embargoes throughout the Cold War Era.

The key events that heightened tensions between the U.S. and Cuba were the Bay of Pigs Invasion that preceded Cuban Missile crisis (Kästle Online 2017). The Bay of Pigs Invasion took place in April of 1961, a botched U.S. CIA investigation, pushed Cuba to secure its alliance with the Soviet Union. In the following year, the Cuban Missile Crisis revealed Cuba had obtained nuclear missiles from the Soviet Union. This provoked the U.S. to deploy a preemptive military strategy by ordering a naval blockade of Cuban military shipments. As quoted by President John F. Kennedy, “any nuclear missile launched from Cuba against any nation in the Western Hemisphere” was to be deemed an attack on the U.S. Eventually missiles were withdrawn in both the U.S. and Cuba that marked the end of the most dramatic part of Cuba’s Socialist revolution (Rambaut and Rambaut 2009, 86). The legacy of the tense relationship between Cuba and the U.S. exists today. However, with Cuba’s intention to develop renewable energy, it could provide an opportunity to improve relations.

Given Cuba’s history and current political atmosphere, this makes Cuba an interesting and complex place to research. Wrought by decades of colonial rule, corruption, and economic strains Cuba’s has become a sort of an enigma in whether it is a developed or developing country. According the WESP report from above, Cuba is classified as a “developing economy,” even though they fall under the “upper middle income GNI per capita” group. I would argue that this could result from their government structure and that Cuba is still largely a monocultural economy. These two factors could have heavily contributed to the WESP’s decision to classify Cuba as a developing country even though residents high levels of standard or living (Suarez et al 2012; Vazquez et al 2015). This



brings me to my discussion of development and post-development and how Cuba relates to these classifications.

### **Theoretical Frameworks**

The two theoretical frameworks that guided my research are Development and Post-Development theory. I believe that these two frameworks provide the necessary discussions and ideas that relate to the kinds of question that concern me and Cuba's development of renewable energy. They are also critical to my assessment of how benefits will be distributed and impact Cuban residents.

#### Development Theory

Development theory lacks a coherent definition as thinkers and scholars widely vary in their approaches to best achieve development. Binder provides a general idea of development, "many critics of the liberal theory of development have argued that it can best be understood as an ideological reflection of American capitalist and imperialist interests in the third world" (Binder 1986). Therefore development became a tool for developed countries intervene in developing countries for economic gains and interests. More recently, however, development has come to be understood as "post World War II impetus to 'develop' the newly independent states" (Simon 2006, viii). This sentiment was echoed in President Harry Truman's 1949 inaugural address that created a global movement towards development.

The United States is pre-eminent among nations in the development of industrial and scientific techniques. The material resources which we can afford to use for assistance of other peoples are limited. But our imponderable resources in technical knowledge are constantly growing and are inexhaustible.

I believe that we should make available to peace-loving peoples the benefits of our store of technical knowledge in order to help them realize their aspirations for a

better life. And, in cooperation with other nations, we should foster capital investment in areas needing development (Harry Truman 1949).

This created the desire to developing countries rather than pursue economic gains. This resulted in a power dynamic between developed and developing countries perpetuating an “us versus them” rhetori, much of which is still present within current global discourses.

Other notable development theorists are Karl Marx and Walt Whitman Rostow.

Marx held optimism and trust “in the transformative potential of science and the material plentitude made possible by technological advance” (Peet, as cited in Simon 2006, 166).

Ironically Rostow’s work harshly critiqued Marx’s but heavily paralleled it. Rostow’s major contribution to Development theory is his ‘Stages’ theory, it distinguishes five stages all countries must pass to become a modern society. These five stages are “(1) the traditional society; (2) the preconditions for take-off; (3) the take-off; (4) the drive to maturity (self-sustained growth); and (5) the age of high mass consumption” (Menzel as cited in Simon 2006, 213). The building block of Rostow’s theory comes from modernization-promoting use of science and technology, increases in savings and investment rates to achieve continual growth and innovative entrepreneurship (214). From these two key thinkers in development theory, it can generally be interpreted that development relies on the idea of progress and end goals, but the means at which it can be achieved (i.e. technological advances) varies.

#### Post-Development Theory

Post-Development Theory, on the other hand, is a relatively new discipline that serves mainly as a critique to Development Theory. Post-development theory much like development theory does not have a definition, but rather a stream of thought that is more or less agreed upon within this field of study. Lie’s article states that,

“In its somewhat vulgar appearance, post-development asserts that development is embedded in a Western, neo-colonial discourse that perpetuates unequal power relations between the North and South of the world, in which the post-Cold War United States stands as the beacon on the hill, guiding nations to follow in its footsteps” (2008).

Furthermore, post-development theory has found development theory, especially, post-World War II to be rooted in capitalist and Marxist traditions. Matthews states, “This group of theorists feels that the concept of development is obsolete or bankrupt and that the practice of development has done more harm than good” (2004, 373). Prominent post-development thinkers consist of Wolfgang Sachs, Arturo Escobar, James Ferguson and Majid Rahnema. All of these authors argue that the need for change is not opposed, but rather it is the need for effective change that does not further exacerbate the unequal and harmful outcomes that occur from traditional forms of development (Matthew 2004; Lie 2008). Therefore, the most basic ideas of post-development involve a focus more on the individual, find Global North gifts and aid as exploitative and try to subvert the system. However, post-development does not present any clear solutions or steps forward. Thus, I would argue it presents an argument for a case-by-case assessment similar to some of the renewable energy projects being implemented in Cuba.

### **Situated Context**

#### Cuban Energy Portfolio and History

Cuba’s energy portfolio and history is characterized by periods of instability and stability. Prior to the revolution, about half of Cuban households were not connected to the electricity grid, but after 1989 that number skyrocketed to 97 per cent (Vazquez et al. 2015). This was a result of the introduction of the Cuban Electricity Conservation Program (PAEC) and the Energy Conservation Program of the Ministry of Education (PAEME). These

two entities managed energy efficiency, promoted energy education and started programs under the Energy Revolution that allowed Cuba to achieve this high level of energy distribution (Suarez et. al 2012, 2726). During the years in which Cuba was working towards larger distribution of energy they heavily relied on traditional forms of energy.

From 1959 to the early 1990s, Cuba was largely dependent upon imported oil from the Soviet Union. The collapse of the ally during the early 90s shocked Cuba and caused their GDP to fall to 35 percent, leading to what then-President Fidel Castro to called “the Special Period in Peacetime.” In response, Castro initiated the “Programa de Fuentes Nacionales” (Program of National Sources) in 1993 that aimed to prioritize energy efficiency, national crude oil and the sugar industry (Vazquez et al. 2015). This prompted Venezuela to step in and form a trade partnership with Cuba. Rather than trading oil for sugar, the trade involved sending approximately 20,000 Cuban medical professionals to work in Venezuela (Vazquez et al. 2015). While this exchange helped ease the ripple effects felt by the Cuban economic crisis it once again made Cuba dependent upon oil. Consequently, Cuba is now examining new means of producing energy, particularly through renewables.

### Renewable Energy

There are many forms of renewables that Cuba can undertake such as solar, geothermal and hydro. As it stands, renewable energy sources come primarily from biomass, hydroelectricity, solar and wind. Solar is a smaller percentage of these renewables. Therefore, Cuba is looking to expand their solar energy production through photovoltaic (PV) systems. The aim is create small-scale PV systems that can be installed in more rural areas and allow access to an energy grid for these populations. According to Suarez et al, “... around 6068 modules have been electrified with a total installed capacity of

around 1.8 MW, the beneficiaries have been households, schools, medical clinics and cultural houses” (2012, 2729). In addition to expanding their solar sector, Cuba is researching the potential of sugarcane bagasse, a byproduct of sugar production, and other biomass as a means of energy production.

### Sugarcane and Other Biomass

Cuba has long relied on and been a monoculture economy of sugarcane. All vertical stages of production of sugarcane and sugar all carried out within Cuba, separating it from other countries with an open monoculture. As a result, Cuba played a major role in the sugar industry prior to the Cuban Revolution. Even though Cuba was a large player in the sugar industry the country itself lacked any industrialization to make it competitive. “61 per cent of the arable land area is covered by sugar cane which yields, together with sugar nearly one third of national income. The share of sugar in exports amounts to some 85 per cent” (Wiesel 1968). The numerous restrictions and cut off that the United States imposed upon Cuba led to a hiccup in Cuba’s energy production.

“The main renewable energy source used in Cuba is sugarcane bagasse. Its use has, however, decreased considerably after 1990 due to the reduction of sugar production. Yet there remains to be a considerable potential for biomass based electricity production using distributed generation, especially for the off-grid areas” (Vazquez et al 2015).

In addition to the potential of sugarcane bagasse, Marabú, an invasive plant species, serves as another means to produce energy.

Marabú has taken over large portions of agricultural land, an estimated 2 million hectares and is competing with grazing land for cattle. It has been previously used for charcoal production in the form of activated carbon that has been exported to other parts of the world (Käkönen et al. 2014, 23). Cubaenergía, a Cuban research organization on

renewable energy, “calculated that around 900,000 or million tonnes of marabú could be harvested yearly. According to Cubaenergía one fifth of the area now covered by marabú could be maintained for biomass production with marabou or some other suitable species. And the rest should be transformed in to agricultural area for food production” (Käkönen et al. 2014, 23). Other biomass materials that could supplement these two are rice husks, fuel wood and biogas (Suarez et al. 2012, 2729).

### Cuba’s Energy Revolution

Many conditions gave rise to Cuba’s decision to start using more renewables in their energy portfolio. The collapse of the Soviet Union, the desire to become less dependent upon oil and two hurricanes that partially destroyed Cuba’s major power plants led to the La Revolución Energética or energy revolution (Käkönen et al. 2014). The Energy Revolution is based on six building blocks that has been defined by the government. The six are; (1) improvement of energy efficient appliances in households and business, (2) completion of large power plants and generated distribution while improving transmission and distribution networks; (3) development of renewables, (4) increasing exploration and production of Cuba’s own fossil deposits, (5) working towards more international cooperation and (6) increasing public awareness [education of renewable energy] (Seifried, 2013).

The program began in 2006 that started with the replacement of 2.5 million refrigerators and switch over from incandescent light bulbs to compact fluorescent lamps. In addition to the energy revolution, the Cuban government has put forth a goal of dedicating 24% of their energy production to RETs by the year 2030. The primary means of achieving this are through solar, wind and biomass the sole crop bagasse a byproduct of sugarcane production. In order to understand the outcomes of Cuba’s Energy Revolution I

did an analysis of the renewable energy projects that have been implemented and negotiated.

## **Methods**

### Assessment

My methods aim to answer the question how is the development of renewable energy creating or helping greater access for Cuban individuals? My rubric works with generalizations and leaves a room for interpretation about development and post-development theory. My intention is to not simplify complex situations, but rather try and create an assessment that can be applied within the context of Cuba as well as other developing countries.

Before I began analyzing Cuba's energy revolution, I created a general rubric that draws from development and post-development theory. The intent was to create a general rubric that could be used for renewable energy projects within different developing and even developed countries.

### Funding Category

In my rubric, I first assess the different ways in which development projects are funded. The lines between what is development-centric and post-development-centric become blurred as both theories still cite large donors or organizations as major source of funding. Bilateral donors are state-to-state usually in the form of aid packages and are typically driven by political means such as reducing threats or increasing state-to-state relations. Multilateral donors are institutions that are made up of many states, such as UNICEF, the World Bank, the International Monetary Fund (IMF) and the United Nations Development Program. Non-Governmental Organizations tend to be smaller groups that are focused on more specific, local projects; some NGOs include the American Red Cross

and Oxfam. The donors I put under post-development could also fall within Development Theory. In order to create a distinction I categorized donors that demonstrated a clear power dynamic to fall under development theory and funding that would be more human-focused to fall under post-development theory. Microfinance organizations, welfare programs and philanthrocapitalism/foundations are much more focused on individuals. For example, a microfinance organization such as the Grameen Bank give out smaller loans to individuals with a much lower interest rate over a longer period of time.

#### Agency Category

The next category I created is titled “Agency”. I am defining agency as where and how much capacity or power is made about these development projects. In other words, who is setting the agenda and making decisions? Do foreign/international actors work with locals and communities or are they left in the decision-making process and progress? The purpose of creating this category is to draw from the critiques put forth by post-development theory. Typically within development theory, the decisions are driven by foreign intervention and are usually don’t meet what the communities need and/or want. On the other hand when I define agency under post-development I am discussing it in terms of cooperation between foreign and local actors. Under post-development that could entail consultations and working closely with local communities and individuals to develop projects that they want and need.

#### Scale Category

The third category refers to “scale.” I am defining scale as the amount and ways in which development is achieved. Scale in regards to development theory is the tendency towards larger development projects. This does not mean that development spans the entire surface of a country, but rather has a tendency to expand into and push out smaller



communities. In addition to more massive-scale of development, funding is directed to the organizations that head these development projects rather than the individuals. For post-development it is much more targeted or specific as to help communities build towards sustainability (which I will talk about more in the next paragraph) and a higher standard of living, not necessarily through a means of technological advances, but perhaps farming practices, education systems, etc. In addition, scale relates to funding since funding in development theory tends towards organizations and a middleman, whereas funding under post-development goes towards communities and locals.

#### Social Outcome Category

The last category is titled “Social Outcome.” This category is primarily focused on the benefits and results that have come out of the renewable energy projects. Typically under development theory when projects are implemented and new technologies are built maintenance and servicing is taken care of by overseas professionals. As a consequence of this it takes away from the opportunities for locals and communities to be trained and create careers or jobs from this. In post-development there is greater cooperation between international actors and locals. This cooperation allows locals opportunities for learning and making their own decisions concerning projects. This category also is intended to assess the ways in which benefits are distributed within communities. Under development theory, benefits tend towards individuals and communities that have more disposable income. Under post-development, there is a trend for benefits to be more evenly distributed, though not always equal.

Table 1. Development versus Post-Development Theory Rubric

<b>Development Theory</b>	<b>Post-Development Theory</b>
<b>Funding/Finance/Donors/Actors</b>	<b>Funding/Finance/Donors/Actors</b>
Bilateral (State-to-State) Multilateral (International Institutions) Non-Governmental Organizations (NGOs) Private (Individuals, Foundations, Large Corporations/Organizations)	Microfinance organizations Welfare Programs Philanthrocapitalism/Foundations
<b>Agency</b>	<b>Agency</b>
Foreign/International intervention and agenda setting Projects administered by foreign entities	Individual/Human focused Foreign and Local Cooperation
<b>Scale</b>	<b>Scale</b>
Tendency towards mass-development Funding directed to organizations	Targeted/Specific (e.g. Province) Funding directed to locals
<b>Social Outcome</b>	<b>Social Outcome</b>
Primarily international actors Uneven Benefits	Primarily local working with international actors More even benefits to all

### Documented/Reported renewable energy Projects in Cuba

Once, I created my rubric I, then, turned my attention to looking for reports about renewable energy projects that have been, in the process or will be implemented throughout Cuba. This proved to be a bit difficult as there are not many detailed reports on Cuba's renewable energy projects. There are a few published articles that document biomass projects and very few solar and wind projects. Therefore in addition to these reports I looked for various news reports/articles and press releases spread across various news and media outlets. I accumulated 25 articles that talk about the different renewable energy projects that Cuba is undertaking. After reading through the articles I created a table that categorizes the different kinds of renewable energy projects. The primary types of projects are biomass, solar, wind or a combination of all three. After categorizing which kind of renewable energy they are, I then locate where in Cuba they will be implemented and the amount of money invested in these projects. In addition to indicating the type, location and investment amount, I also indicate the company, organization or actor involved in the building and financing of the renewable energy projects.

### Application of My Rubric

As I was researching what kinds of renewable energy projects are being implemented in Cuba I was looking for specific information that each news source provided. This information consisted of disclosed companies and investors; what lines of communication exist between funders and the individuals they are aiming to benefit; the scale and locality of the each of these renewable energy projects and the benefits are afforded to Cuban individuals. I loosely define benefits in terms of tax breaks or opportunities that are created as a result of renewable energy. With each of the projects I found that there were elements that clearly fell under development or post-development

theory. There were also components that had combined characteristics of both development and post-development theory. Lastly there are projects that just provided little to no information for me to make a concrete assessment of whether it was or a mixture of development or post-development theory.

An example of how I applied my rubric to the various projects I researched is from ZERUS SA in conjunction with Havana Energy. First and foremost I looked at what company Havana Energy is partnering with, which is ZERUS SA a British company. I also looked at the type of partnership it is and the amount of money invested. The project is a joint venture that would require \$250 million USD that would build five power plants. Under these pretenses I classified Cuba's investors under Development theory. As for scale, I classified it as post-development because each of the bio-power plants that would be built in relation to the island's sugarcane plantations. This would indicate that ZERUS is not just choosing a plot of land at random to build their power plants; it would also be a plant on a smaller-scale. Agency was classified as a combination of development and post-development theory because this joint venture is still largely dictated by foreign and large government entities. However, both actors remain cognizant of the needs of the area and ways to work with locals to ensure a distribution of benefits. The social outcome has also been classified as a combination because the intent is to improve commercial relations and open up avenues of opportunities for other British companies. On the other hand, by opening up these bio-power plants it would make use of biomass, bagasse and marabú, which would otherwise be wasted. As a result farmers would be able to reopen their sugar mills, employ Cuban individuals and provide more fertile for other crops to grow on Cuban soil.

By doing an analysis of this one project there are still a lot of other questions that arise from this. Given that these projects are new developments, how different will the execution and reality be from the plan and intended project? While I can only objectively assess what it presented in these articles and news releases, it is still difficult to determine what the outcomes of these various projects are.

## **Results**

### Projects Spreadsheet

Included on the next page, I created a spreadsheet that compiles the types of renewable energy projects, the investors, companies and location of these renewable energy projects. In the articles I looked for primary investors in Cuba's renewable energy projects. I then looked for the kinds of renewable energy projects that are being developed, followed by their location. Finally I looked for the amount of investment by each organization and the projected energy generation. The total amount of investments and projected energy generation were not by my calculations, but rather same amount that has been reported by all the articles. I want to note that I included two actors that have "N/A" filled out for each category. First the Stonegate Bank is the first major bank that has opened up a credit card to be used in the United States. Second, Energizing Cuba is a public-private partnership between Cuba and US institutions and stakeholders. They are responsible for incentivizing organizations, stakeholders and other actors to invest in Cuba.

Table 2. List of renewable energy projects that are or are being negotiated in Cuba

Company/Investor	Project Type	Location	Investment Amount (USD)	Projected Energy Generation
Havana Energy and ZERUS Investments SA	Biomass	Ciro Redondo	\$250 million	Five Power Plants - 150 MW
Cubaenergía in cooperation with Ankur (India)	Biomass - Marabú	Isla de Juventud	N/A	9 million tons
China Goldwind Science and Technology Co. Ltd	Wind	Gibara	\$600 million	633 MW
Integrated Department of Wind Energy Project Management of Renewable Energy Sources Investment Company (EDIFRE)	Wind	La Herradura; Herradura 1	\$174 million	51 MW
EDIFRE	Solar	Cuba	N/A♦	100 MW
Hive Energy	Solar	Special Economic Development Zone at Port of Mariel	\$100 million	50 MW (93GWh by 2018)
Spanish Solar Association (UNEF) and Cuban Society for Promotion of Renewable Energy (Cubasolar, NGO)	Solar - PV Tech	Over 14 PV plants in Cuba	N/A	50 MW
International Renewable Energy Agency (IRENA)	Solar - PV	Cuba	Part of \$57 million concession loans to developing countries	N/A
Abu Dhabi Fund for Development	Solar	4 Provinces in Cuba	\$15 mill concessionary loan, part of IRENA loan	N/A
Commercial Funded Solar	Solar	Cuba	\$7.3 million	5 MW storage
Cuban Government	Solar	Granma Province ■	N/A	100% Electrification
Cuban Government	All	Cuba	\$3.5 billion	24% of Cuba's total energy prod
United States ❖	All	Cuba	\$20 million	N/A
Stonegate Bank (FL, USA)❖	N/A	N/A	N/A	N/A
Energizing Cuba©	N/A	N/A	N/A	N/A

**Notes:**

♦Though no amount has been specified, the loan comes from Export-Import Bank of China

■"Solarization of Granma Province", A model for the rest of the island

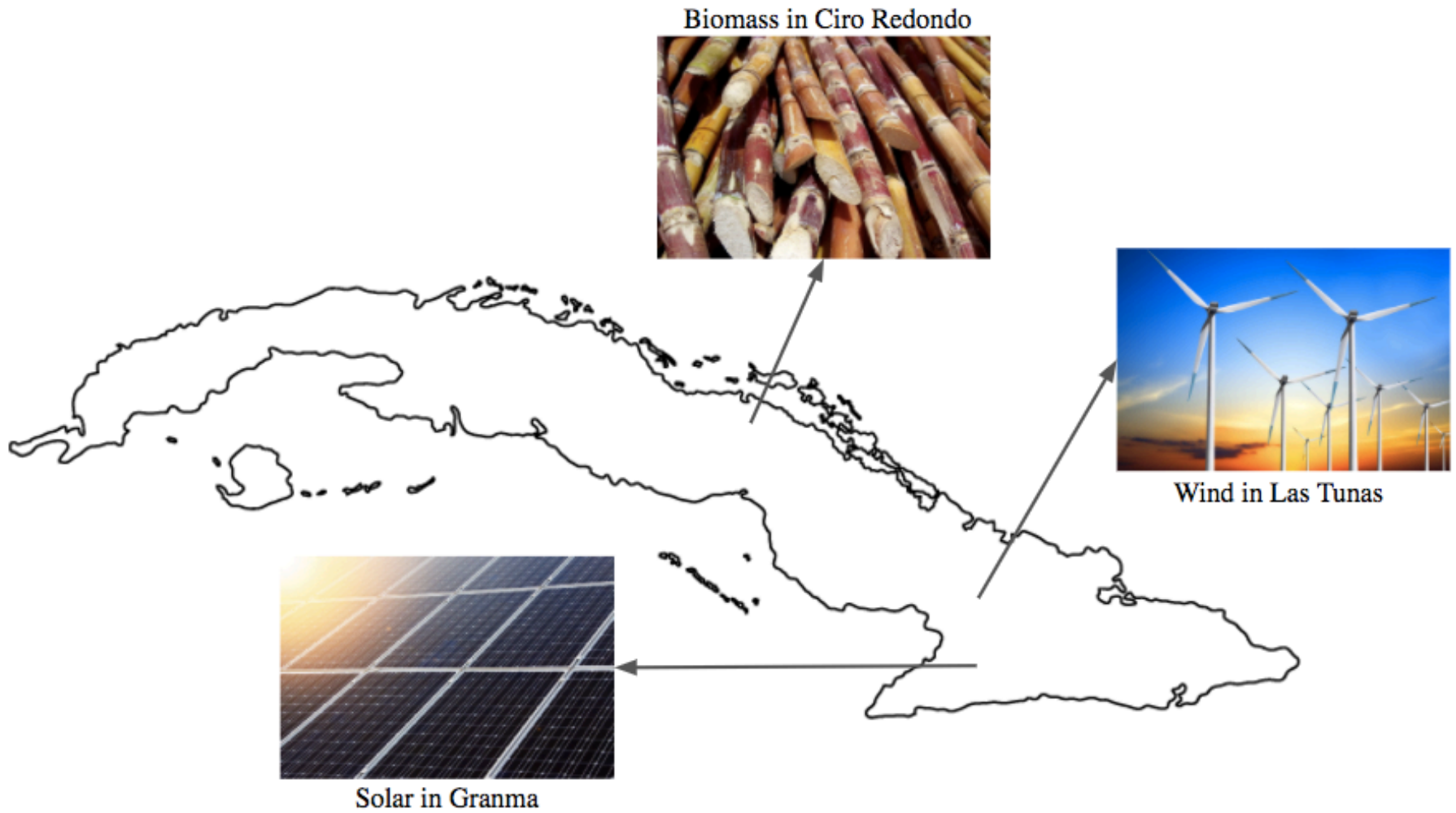
❖Several News Reports have no concrete reports/answer but US will have a role in aiding

❖First US Bank to provide US Banking services to Cuba in two years

©Public-Private partnership between Cuba and US institutions and stakeholders

©Seeking 4.2 billion in foreign investments

Figure 1. A map of Cuba of where some of the renewable energy projects are being implemented



## Discussion

### Cuba's Renewable Energy Projects

It is unsurprising to see that a majority of Cuba's renewable energy projects are funded by foreign entities. It is also impressive to note the scale and scope of these various renewable energy projects.

The biomass power plants that both ZERUS and Cubaenergía are helping implement have characteristics that are both traditional and alternative in development outcomes. Firstly, the scale for both of the power plants is classified as alternative because they are plants built with respect to the surrounding landscape. As discussed above, ZERUS is working with sugarcane plantations to build plants that are relative and economical to sugarcane production. Furthermore, these marabú that will be used for this type of energy production will help reduce the amount of land area that is covered by this invasive plant species.

The second type of energy that Cuba is working to integrate into their energy grid comes from wind potential. Typically wind farms are large in scale, while the wind farms being negotiated and built in La Herradura and Las Tunas are no exception, it has been classified as post-development because it is working in conjunction with its given landscape. The projects are also aiming to be built closer to the coast of this province. The detail in which made my final decision was due to the fact the wind farm was adjusted for its region. However, I am still skeptical of how this mass-scale wind project will affect its surrounding communities.

Lastly, what is notable about the projects spreadsheet is the amount of solar systems that are being created and the various foreign entities that are involved. As mentioned previously, Cuba is aiming to expand their PV renewable energy systems. "Cuba



developed an ambitious photovoltaic electrification program to bring electricity to the rural population..." (Suarez et. al 2012, 2729). An initiative that jumpstarted and motivates the "Solarization of Granma Province", which I will further discuss next, as the solar model that Cuba wants the rest of the island to follow. This makes sense given Cuba's geographical location and solar potential. By building and implementing small-scale solar system, this allows communities to have greater access to the energy grid.

#### "Solarization of Granma Province"

Granma province has been cited as the renewable energy model for the country of Cuba, a project entitled the "Solarization of Granma Province." The purpose of this project is power this province entirely through renewables, the primary means of electrification being solar. The province currently has 1,628 small off-grid photovoltaic systems that power many hospitals, school, homes and others in remote areas without access to the energy grid. In addition to these solar systems, smaller wind systems are powering approximately 2,000 schools across Cuba (EcoWatch 2015). This is an important case because it demonstrates an example of post-development outcomes.

Cuba's motivations to expand their solar energy systems has largely been motivated by social factors. For example, Cubasolar is an NGO that is working to promoting renewable energy systems and education that work in favor of communities. "A key characteristic in the Cuban PV-programs has been that first schools and health centres are prioritized and then the next step is to target private households" (Käkönen et al. 2014, 26). This is an important distinction to be made about the solar programs in Cuba. This not only demonstrates Cuba's desire to build more efficient and accessible solar energy systems, but a desire to ensure that individuals and communities can reap the benefits of these projects as well. This is something that sets a part the Granma province from other projects because

it creates an interesting combination of traditional and alternative development. It is still important to note, however, the kinds of contracts that these projects are being built under.

### BOO Contracts

All of the contracts concerning solar projects are being negotiated and planned under are BOO (Build-Own-Operate) contracts. This means that solar power plants will be owned and operated independently by the respective foreign entity. While one would immediately classify this as a traditional development project there is more than meets the eye. Even though the power plants themselves will be operated and owned by foreign entities, the sole purchaser and distributor of energy will be Unión Eléctrica. Electricity that is produced at these power plants will be purchased a fixed negotiated rate, and then sold to Cuban entities under a tariff structure that accounts for income level of households. Others entities, such as hospitals and schools will be subsidized by the government.

I would argue that given these circumstances, these solar projects would still be classified as alternative development. Although foreign entities control the facilities and see returns on their investments; these projects still consider some of the concerns that are crucial to post-development theory. However, it is hard to say whether this has a direct impact on Cuban individuals since most of these solar farms are still under negotiations, but it does raise questions of how this will affect Cuban communities and individuals.

### Biomass Energy Generation

There is a disconnection that I have to point out between what I have in a couple reports and what is shown on the table. Biomass has been cited as a major promise for Cuba renewables (Käkönen et al. 2014; Havna Energy 2012). The materials that would be used to power biomass plants would come from bagasse (a byproduct of sugarcane production) and marabú (an invasive plant species that plagues the island) (Seifried 2013).

However, there are only two major companies that are investing in this type of renewables. ZERUS Investments is the major company that has a large investment in this type of renewable. Cubaenergía (Cuban company), on the other hand, has been a major actor in implementing smaller biomass plants across Cuba. It is unclear how electrification will change because of this kind of investment. On the one hand, the byproduct that would be used for biomass comes solely from Cuban farmers, thus they could be subsidized and incentivized to give the byproduct to foreign companies, which could result in benefits for both parties. It could also result in a power dynamic and a potential for ZERUS to take over many rural Cuban sugarcane plantations and farms. However, Cubaenergía has shown that it does assessments of renewables and is cognizant to work with provinces to ensure they provide the necessary support and energy needs for every community. Thus, having a smaller number of companies invested in working on one type of energy could be beneficial for Cuban residents.

#### Foreign presence in Cuba's Energy Revolution

There are many foreign investors interested and negotiating in Cuba. The primary players are United Kingdom-based organizations, China and the United States. ZERUS, Hive Energy and Commercial Funded Solar, which are all UK-based, have a stake in Cuba's renewable energy sector. ZERUS is the only non-Cuban company that has major plans to build a biomass energy facility in Cuba. While Hive Energy and Commercial Solar have secured solar negotiations in Cuba. China, on the other hand, has a major stake in wind energy since they are providing all the wind turbines that will be built in La Herradura.

Each of these companies would need to be assessed further on a case-by-case basis; it would also have to be examined in the future since a majority of these projects have not been built yet. In thinking about Development and Post-Development theory, the large

presence of foreign interests could indicate an exacerbation of power dynamics. Past trends have shown foreign capital cycling only within foreign entities. This often led to conflicting interests and intentions rather than macro-level development (Lie 2008, 121). Thus in the coming years Cuba will have to find a way to balance foreign interests with their own social motivations and concerns.

### So What About the Cuban Residents?

Overall, in comparing the projects that have been implemented and negotiated so far, it is difficult definitively say Cuba is developing its renewable energy sector in a way that does not harm its residents. I argue this because the energy revolution is still in its infancy stage. Many of these projects that I have listed so far only indicate predictions and potential outcomes, but no concrete outcomes. However, it is definitive to say Cuba will continue to ensure that its social programs and sector remains a priority. As stated above, schools, hospitals and households have long been an important consideration for the Cuban government.

## **Implications and Conclusion**

### Gaps

My aim in researching Cuba was uncover the kinds of renewable energy projects that are being built and how they will affect residents. I unfortunately did not have the capacity to travel to Cuba to truly see what the outcomes of these projects were. Not to mention, these projects are relatively new, so it would take some time before benefits and outcomes are fully realized. The limitations in my research were largely due to time seeing as many of these projects are recent developments. Another component that could have added to my research was possibly doing a comparison with another developing country or at least a context that had either succeeded or failed. I believe that would have added to the

discussion and rounded out the discussion of what makes Cuba an interesting case to study in regards to renewable energy.

#### Has this work elsewhere? Where Else Could This Work?

It is interesting to compare the Cuban context with other countries. It raises questions of whether these are feasible approaches in other countries. One developing country that could be influenced by Cuba's transition to renewable energy could be Venezuela. As discussed above, after the collapse of the Soviet Union, Venezuela stepped in as a major trading partner for oil. As a result of Venezuela's intervention it had caused Cuba to become dependent upon the subsidized imported oil (Vazquez et. al 2015). However, now with Cuba looking towards other means of producing energy this could indicate a massive change for Venezuela. Drawing from development, post-development theory and Cuba's history, I would argue that Venezuela could experience a similar economic crisis if Cuba is largely reduce its oil imports from other countries. Past trends could indicate that Venezuela would have to look to new trading partners or also look into their own country and assess whether renewable energy is a feasible option.

#### Challenges – What Cuba Can Learn from Other Contexts

Although Cuba is approaching the transition to renewable energy how they see fit, there are lessons they could learn form other countries. An example is how to do adjust and ensure their tariff system works for its population. Drawing from an example in South Africa, a Renewable Energy Feed-in Tariff (REFIT) was introduced. It was a program that guaranteed purchase prices for a fixed period of time; the aim was to generate a reasonable return on investment so developers and investors would be attracted to enacting renewable energy projects (Lüdemann 2012, 317). Prices set too low renewable energy systems would fail, but if prices are set too high, operators of the facilities would gain

profits while users miss out creating an efficiency loss for the economy. For the most part, this system received mixed reactions from developers and users. Project developers saw it as too pessimistic while others welcomed it and found themselves encouraged to invest more.

### One Size Does Not Fit All

Most importantly, a one-size-fits-all solution does not exist. Development theory implicitly indicates that progress and change is a blanket concept that can be applied to any country. Sovacool points out that many countries often become grouped together by common poverty classifications, but each are unique. He argues, “In light of this, planners must fully recognize the specificity of each country and region in a world that is vastly diverse” (2014, 43). This raises even more questions of whether it is feasible to compare Cuba to another country. Can generalizations can be drawn from Cuba, if at all, and be used in another country? If we cannot treat all developing countries in homogenous way, how can we approach the idea of progress and change? If there is anything that can be drawn from Cuba and its relation to other countries, what works well for country or region does not always translate for another.

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