

The Caribbean: A Possible Energetic Transition, But Complex!!

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Keywords

Caribbean, fuel importation, energy transition, geothermal potential, under-exploited

ABSTRACT

The Eastern Caribbean is made up of islands which have economical, political, social, cultural and geographical similarities. Among these islands, 11 are volcanic islands, (Saba, St Eustatius, St Kitts, Nevis, Montserrat, Guadeloupe, Dominica, St Lucia, St Vincent and Grenada) and presents great geothermal potential that has been unexploited for many years. However, for these past years, many geothermal projects have increased in the Eastern Caribbean, thanks to the financial support coming from international organizations. Furthermore, the different governments have shown their willingness to turn to cleaner energy, in order to fight against global warming. Despite their interest in renewable energies and particularly geothermal energy, the energy transition remains a slow process.

1. Introduction

Worldwide, global warming has become a major issue for humanity. This phenomenon has been affecting the islands for a number of years resulting in rising sea levels, heat waves, droughts, heavy precipitations, and more devastating hurricanes. The increased use of fossil fuel linked to human activities, contributes to the emission of greenhouse gases in the atmosphere. Many governments have decided to turn to cleaner energy sources such as renewable energy. These energies come from natural sources that are available and a sustainable alternative to fossil energy. As a result, different types of renewable energy have been aggressively developed and used. Despite this keen interest in renewable energy, only a small percentage of the world's total production is generated from renewable energy as compared to fossil fuels. By opting for renewable energy, government leaders have embarked on the path of energy transition with the prospect of integrating the goal of sustainable development for environmental protection. While some countries have a head start regarding energy transition, others such as, the Caribbean region, are struggling to replace diesel or fuel oil with renewable energy, which includes geothermal power. Many years ago, the volcanic islands were the subject of numerous geological studies to assess their geothermal potential. Although the results obtained showed very high

potential, the development of geothermal energy has been a slow process prolonging the continued use of imported fossil fuel. First, we will examine one of the obstacles to this transition. Second, we will have a general overview of the different geothermal projects that are on-going in the region.

2. Fossil Fuel Importation

The cost of electricity in the Caribbean region is estimated to be among the highest in the world (Figure 1), and can be linked to its geographical location. A similar situation exists in the Pacific Ocean where the volcanic island of Hawaii also depends heavily on the import of fossil fuel. Deriving nearly 90% of its primary energy resources from oil (Arent, D., John Barnett, J., Mosey, G., and Wise, A, 2009) .In fact, none of these islands are interconnected for, either natural gas, or by a submarine cable for electricity and it is necessary to use expensive generator systems.

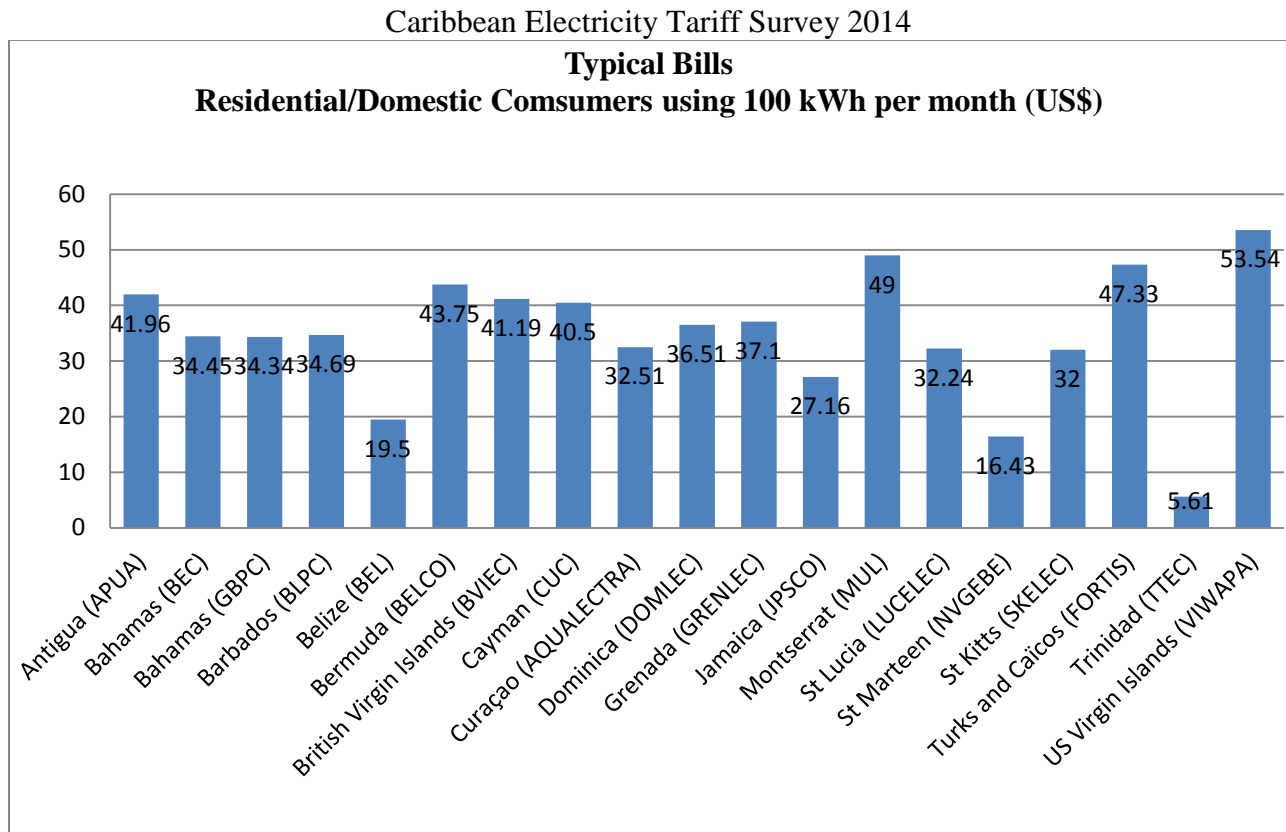


Figure 1: Caribbean Electric Utility Services Corp, 2014

Another reason that can be put forward is the size of the Caribbean market – the smaller the market, the higher the unit cost of fuel. It is worth stressing, that on the June 29 2005, an oil alliance was launched between the Caribbean islands and Venezuela, excluding Guadeloupe and Martinique, which purchase their oil from other nations. As one report points out “The PetroCaribe Agreements provide for the importing countries to be supplied with a stipulated amount of crude and refined oil products from

Venezuela at intervals through its state owned oil company Petróleos de Venezuela S. A. (PDVSA). Based on the Agreements, a percentage of the payments for oil purchases are converted into a low interest long term loan with sliding rates of interest and repayment periods depending on the price of oil,” (Caricom, 2013). In other words, the fuel oil would be sold at a preferential price, meaning at a cheaper price. However, focusing their energy development on one single source of energy presents a tremendous risk for these islands. As a matter of fact, the price of oil on the international market is falling, affecting oil producing countries like Venezuela from whom most of the Caribbean islands are importing, weakening the established agreement. In one report published by the American Security Project dealing with the energy security in the Caribbean, it was said concerning Venezuela that: “Declining oil prices over the last year have significantly harmed the Venezuelan economy. A significant portion of these revenue streams come from the country’s involvement in the Petrocaribe program. Venezuela’s declining influence in the region, presents potential problems for Caribbean energy security; it also creates a unique set of circumstances for the US to take the lead.” If the oil price decline continues, it will have an impact not only on the cost of importation but also on the cost of production as well as on the sale price of electricity. As a result, the economic situation of the Caribbean islands has been plagued by external and internal issues hindering their economic and social development, undermining regional integration and competitiveness, creating difficulties in attracting foreign capital and creating a constraint for the citizens.

Furthermore, the Caribbean is undergoing societal changes. As the world’s population increases, the demand in electricity will continue growing leading to more fuel import and financial difficulties. Therefore, the Caribbean islands must control their energy dependence on fuel import and oil products. According to the World Bank report issued July 25 2012 “Central American and Caribbean countries can reduce their oil dependency and shield themselves from high oil prices through a combination of renewable energy, energy efficiency programs and regional energy integration.” Adding to these statements, Ede Ijjasz-Vasquez, World Bank Director for Sustainable Development in the Latin America and Caribbean region said “we estimate that the implementation of a strategy that combines a more diversified power system, better energy efficiency in electricity production and use, and regional integration can significantly reduce Central America and the Caribbean’s vulnerability to high and volatile oil price.” In effect, the Caribbean region has a great opportunity to counteract their dependence on diesel and heavy fuel oil by turning to renewable energy. The question to ask is “what are the impediments to this energy transition?”

3. A Geothermal Energy Transition

Some analysts point out that oil reserves are dwindling yet still a complete independence from fossil fuels is not possible for now despite the desire for cleaner energy. During the different international conferences on the climate, the emphasis was put on the fight against global warming, goals to be achieved were avowed, developed countries committed themselves to limit the rise of the Earth’s temperature to less than 2 degrees Celsius, to reduce the emission of CO₂ and to help developing countries turn to renewable energy (COP21, 2015). In this regard, the small islands are some of the first to be concerned about rising sea levels, yet they are the countries emitting the lowest greenhouse gas. According to the Oxfam report entitled *Extreme inequalities and CO2 emissions: the Paris climate agreement must give priority to the poorest and more vulnerable populations [...]* the poorest half of the population - about 3.5 billion people are responsible for only about 10% of CO₂ emissions, while living in countries most vulnerable to climate change; At the same time, about 50% of these emissions are attributable to the 10% of the richest inhabitants of the planet (Oxfam, 2015). In line with Oxfam’s

report, the Ministry of the Environment, Energy, Sea and I4CE Institute of Climate Economics in the same vein published the 2017 edition article, entitled *the Key figures on climate, France and the World* (fr: Des chiffres clés du climat , France et Monde) which shows that in 2012 China emitted 24% of greenhouse gas; North America 13,9%; Central and South America 10,9%, whereas India an emerging country emits 5,7% greenhouse gas, (I4CE 2017). Thus, aware of their vulnerability, some islands have been engaged in energy transition while others are in a slow process of energy transition:

Guadeloupe is a French territory and also part of the European Union and the Euro zone. It is located north of the Commonwealth of Dominica, and enjoys a tropical climate. Guadeloupe is made up of two islands Grande Terre, which is flat, and limestone, and Basse-Terre, which is mountainous and volcanic. Basse-Terre is dominated by La Soufrière, also called "the Old Lady" an active volcano located in the National Park in the town of Saint-Claude. These two islands are connected by bridges, and viewed as a single island. Guadeloupe, just as the other Caribbean islands, is electrically isolated and remains heavily dependent on fossil fuels. The electric utility Electricité de France (EDF) transmits and distributes electricity on the island and operates a diesel power plant of about 220 MW. Faced with climate change, France is committed to the process of energy transition and promoting an energy mix. To this end, EDF has made the development of renewable energy a priority (See table 1), with the aim of gradually reducing their dependence on fossil fuel.

Table 1: Distribution of energy production

Guadeloupe Energy Mix	
Energy Type	Contribution (%)
Biogas	3.2%
Coal	23.1%
Geothermal	4.7%
Hydroelectric	1.2%
Petroleum	59.1%
Solar	5.8%
Wind	3.0%

EDF Guadeloupe 2015

Guadeloupe is the first and only island that currently possesses a geothermal power plant located in the town of Bouillante in the west of Basse-Terre. This first power plant was put into operation in 1986 and a second unit in 2005 bringing the capacity of the plant to 15 MW and representing 7% of Guadeloupe's electricity generation. Moreover, a project to expand the plant is under consideration. The Bouillante geothermal power plant was operated by EDF and the Bureau de Recherche Géologiques et Minières (BRGM), a French governmental geological survey company. However, due to financial difficulties 85% of the company shares were acquired by the internationally known Ormat

Technologies Inc. The inflow of foreign capital will help to renovate the plant in order to increase its capacity. Ormat's aim is to attain a total of 45 MW by 2021, which would represent 15% of the electricity needs of Guadeloupe. Guadeloupe is not the only island to be engaged in this energy transition, others are following the path. For some years, there has been a growing interest for geothermal energy in the Caribbean. Dominica is a former British colony located between Guadeloupe to the north and Martinique to the south. The island is crossed from north to south by a chain of mountains, most of which are volcanoes. The Boiling Lake, the second largest lake of its kind in the world after Frying Pan Lake in New Zealand, is situated in Morne Trois Pitons National Park. There also exists a three-peak volcano bearing the same name as the park, and the Valley of Desolation, an area of steaming vents, geysers, hot water, rivers and cascades, boiling grey mud and a crust of sulphur-stained rock (Crask 2011), and other natural attractions. Studies were conducted in the Roseau Valley in order to confirm the geothermal potential of this part of Dominica and it appears to far exceed the island's own energy demands, thus offering the potential to export a valuable product in the form of electricity. Dominica Electricity Services (DOMLEC) mainly uses two types of energy, hydropower and diesel. However, other forms of energy are used, but are under developed (See table2).

Table 2: Distribution of energy production

Dominica Energy Mix	
Energy type	Contribution %
Wind	1%
Solar	0.25%
Hydro	27.4%
Diesel	71.4%

The National Renewable Laboratory (NREL) March 2015

Hydropower was widely used in Dominica. As a matter of fact “the first two hydro-turbines were introduced in 1952 to generate electricity in Roseau. These two generators, located at Trafalgar, have a capacity of 320 kW each [...], in 1967 the second hydropower station was commissioned at Padu on the Roseau River downstream from Trafalgar” (The Caribbean Conservation Association, 1991). But, with the growth of the population and an increased demand of electricity, Domlec (Dominica Electricity Services) has relied on diesel fuel in order to satisfy the electricity needs of its customers. As a result, since 1984 the quantity of fuel used yearly has tripled. “In 1978 almost 90% of total demand was met through hydro” (The Caribbean Conservation Association, 1991). Today though diesel fuel is the primary source for electricity generation, though hydropower is still being used accounting for approximately 30% of the total electricity generated.

Recently, exploratory drilling has been carried out to confirm the quantity and quality of the geothermal resource with an aim to build a small power plant that will generate 7 MW to ensure energy independence in Dominica. A large power plant of 100 MW for electricity export to Guadeloupe and Martinique, via submarine cable, forms part of the long term plans. Following the passage of Tropical Storm Erika the project had to be suspended due to damage to the road infrastructure among other reasons. Realization of the project will have made possible an interconnection between three islands, a first in the Caribbean region. As stated in the report *Caribbean Regional Electricity Supply Options: Toward Greater Security, Renewable and Resilience for the Region* “Electricity interconnections can also unlock the potential of various large-scale renewable energy resources in the Caribbean. Through interconnections with other islands [...], there is the possibility of gaining access to the needed markets in order to transform these investments into viable option.” Indeed, interconnection will offer numerous opportunities to the Caribbean islands. For instance, it can help Dominica to increase its market size, strengthen interregional links already existing, to supply the needs for electricity, and decrease its dependence on fossil fuel lessening the effect of fluctuations in the price of oil, to better develop the inter-island energy trade, and improve or strengthen intraregional cooperation.

Saint Kitts and Nevis, like Dominica, was colonized by the British Empire. They are volcanic island located northwest of Guadeloupe. Like most of the Caribbean islands, they depend heavily on fossil fuel, in order to generate electricity. However, they are confronted with the fluctuations in the price of oil faced by the rest of the Caribbean islands. As highlighted in (See table 3), diesel fuel holds the first place whereas wind and solar energy are more or less under-developed. Similar to Guadeloupe and Dominica, these two islands have geothermal potential.

Table 3: Distribution of energy production

Saint Kitts and Nevis Energy Mix	
Energy type	Contribution %
Wind	4%
Solar	1.77%
Diesel	94.33%

The National Renewable Laboratory (NREL) March 2015

In this regard, Nevis was among the first English Caribbean Island showing a keen interest in geothermal energy. A license was granted to West Indies Power Company to explore the geothermal resource on the islands. This same company was given a license for exploration works in Dominica and Saba but they did not complete any exploration. The goal of the project was to ensure energy independence for Nevis and export electricity by a submarine cable to the island of Saint Kitts. However, the company failed to honor its commitments because of financial difficulties. Therefore, the Nevisian geothermal project was suspended until the license was awarded to another contractor. In 2015 the geothermal project in Nevis was revived with the arrival of a new purchaser, Nevis Renewable Energy International (NREI), an associate of Texas-based Thermal Energy Partners LLC (TEP). Their aim is to build a power plant that will produce 9-10 MW of electricity for the local market.

It is expected to be operational by the end of 2017, and commercialize power to other islands like Saint Kitts.

At the same time, the island of Saint Kitts, which is also interested in geothermal energy, has signed an exploration agreement with Teranov, a French engineering and services company for new and renewable energy established in Guadeloupe. From all this, it shows that both Saint Kitts and Nevis have the same goal, to generate clean energy, lower the cost of electricity, supply the needs of their population, and lessen their dependence on diesel fuel. Nevis, like Dominica, has the capacity of exporting electricity to other islands due to the quantity of resource it possess. These three islands we just examined are well advanced in their respective projects, and plan to build their power plant in the near future.

Saint Vincent and the Grenadines is a former British colony, located between Saint Lucia to the north and Grenada to the south. Economically, it depends on tourism and agriculture. Like the previous islands, Saint Vincent is a volcanic island and is highly dependent on fossil fuels. VINLEC (St Vincent Electricity Services Ltd) is the only licensed utility to produce, transmit, and distribute electricity in Saint Vincent and the Grenadines, including some dependencies. The other small islands are supplied by privately owned electricity systems. Two methods are used to produce electricity, fossil fuel and hydropower (See table 4). The high percentage of petroleum used highlights their dependence on fossil fuel.

Table 4: Distribution of energy production

Saint Vincent and Grenadines Energy Mix 2011	
Energy type	Contribution %
Petroleum	78%
Hydroelectric	22%

The National Renewable Laboratory (NREL) August 2015

Like many of the other volcanic islands Saint Vincent and the Grenadines have embarked on the development of geothermal energy. To successfully carry out its project the government of Saint Vincent and the Grenadines has formed a partnership with the Icelandic firm Reykjavik Geothermal Ltd. who is experienced in geothermal development, Emera a Scotia company, and assistance from the international community. According to Williams “the aim of the project is to bring stable pricing and a lower cost to energy consumers.”(Caribbean news now, 22 July 2015) If the project is a success Saint Vincent and the Grenadines will have a geothermal power plant with a capacity of 10-15MW to supply the local market.

The four islands that were examined are pursuing the same objective, taking full advantage of their natural resources, particularly geothermal energy so as to promote clean energy, and at the same time be on the path to energy independency. However the road leading to this process requires profound changes in the energy system. This means giving more emphasis to renewable energy. It involves social, economic, behavioral changes both individually and collectively, and adopting the concept of

sustainable development. The energy transition is a slow and lengthy process that must accommodate countries and territories. Although the Caribbean politicians acknowledge that the price of electricity is very high, the development of geothermal energy in the region can help to reduce not only the electricity rate but also their dependence from fossil fuel. The question to ask is “what are the impediments to rapid energy transition, from oil to geothermal?”

The Caribbean region is composed of 38 islands, each with a different status. Some are independent and others are not independent. Nevertheless, they all share the same colonial past that have left many footprints. However, when we closely observe the Caribbean, there exists a development disparity and a disproportionate distribution of natural resources. Indeed, among the four islands that were analyzed Dominica appears to have the most geothermal resource. However, in the energy mix Guadeloupe has a long lead over the islands, which makes it a model in the energy field to the other islands. Due to its political status as a dependent of the state of France, Guadeloupe is engaged in the energy transition in developing projects based on renewable energy. However, for others the road to energy transition will be a slow and a lengthy process that should accommodate the countries. Energy transition requires profound changes in the energy system, which means giving more emphasis to renewable energy. Therefore, the implementation of projects related to the environment is mostly financed by European funds and governments. With these aids Guadeloupe could develop its energy mix.

But others do not have these opportunities; such is the case for Dominica, Saint Kitts and Nevis, Saint Vincent and the Grenadines, all independent islands. In contrast to Guadeloupe, these islands are poorly developed and in addition do not have the financial means to develop large-scale projects despite their potential in geothermal energy. Several reasons explain why geothermal energy is undeveloped. According to George, a participant of the geothermal project in Dominica, “the islands face challenges in particular the high upfront cost for exploration and uncertainty of finding a geothermal resource.” (Interview Dominica, 2017) Indeed, the development of geothermal can be a risky investment because proving that the existence of the geothermal resource requires high upfront capital expenditure. Furthermore, the demand in electricity for Dominica, Saint Kitts and Nevis, Saint Vincent and the Grenadines are low, as George, said “this proportionally increases the drilling costs and makes it more important to be successful with early drilling. Also the total project costs become higher on a per megawatt basis than a larger project. The poor financial standing of some of the governments makes it harder to invest, or investors want a higher return on the investment,” by switching to geothermal as base load you take generation away from the utility, which means that they are less financially viable as a business. It is important to keep the utility viable as they are invested in by national insurance scheme, city councils and other local parties,”(Interview Dominica, 2017) ,These islands have a small size market, unlike Guadeloupe whose market is bigger and can generate more electricity for a larger proportion per person.

In order to carry out energy transition, it is important to have environmental laws in order to know the principles and uses of geothermal energy. Guadeloupe has been under French governance and applies environmental laws enacted by France and Europe. Some English speaking islands with geothermal resources like Dominica, have implemented geothermal legislation and regulation, which was necessary as the geothermal project develops. In this respect, the renewable energy sector particularly that of geothermal energy, is something new for them.

4. Conclusion

In conclusion, Guadeloupe, Dominica, Saint Kitts and Nevis, and Saint Vincent and the Grenadines, are all heavily dependent on fossil fuel to generate electricity to satisfy the needs of their citizens. However, the use of fossil fuel contributes to the emission of CO₂ in the atmosphere causing greater impacts to global warming and the environment. After hearing the call of different scientists who point out the need to act against the effects of climatic changes political leaders have decided to turn to clean and renewable energy and to enter into the phase of energy transition. Though this transition is important for the planet and the human race, it is difficult to put in place in certain parts of the world, especially in the Caribbean. Indeed, in the Caribbean region there exist inequality, which hampers the economic development and growth of the islands. The main reasons to explain the slowness of the process to energy transition include lack of financial means, the risk of not successfully locating the geothermal resource, and attracting investment capital. However, for some years geothermal development projects have been underway in the Caribbean improving the awareness of the politicians and their desire to take full advantage of that resource in the hope of reducing electricity rates and producing green energy so as to fight against global warming. Furthermore, with the fluctuation of the oil prices begins a big issue of the Caribbean islands. It can be said that the energetic transition in Caribbean region is on the way, but the process will be long, and much remains to be done, in order to attain the objectives set during the COP 21.

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Suggested Citation

“The world must come together to confront climate change. There is little scientific dispute that if we do nothing, we will face more drought, famine and mass displacement that will fuel more conflict for decades.”—U.S. President Barack Obama”

