THE STATUS OF RENEWABLE ENERGY IN THE CARIBBEAN:

TEN YEARS OF ISLAND INNOVATION

November 2018

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RENEWABLE ENERGY CARIBBEAN

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DISCLAIMER
The data and meta-analysis provided in this report is based on Renewable Energy Caribbean's proprietary data and regional project maps, verified through multiple regional and international sources. The authors took every care to capture the best available data covering the renewable energy markets in the Caribbean, but please be aware that inaccuracies are possible owing to reporting errors and data retention issues.

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Design & Layout: Carolina Zalles
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FOREWORD

Caribbean countries have made steady progress over the past decade toward reducing their dependence on imported fossil fuels. This is an imperative for these islands, given the negative impact of producing electricity from oil on the competitiveness of their economies. During this period, we have seen the establishment of new renewable generating capacity in all energy formats, with wind and solar photovoltaic showing the most impressive gains. This has also been accompanied, in some jurisdictions, by ambitious energy policy and efforts to create new independent electric utility regulators. However, generally, progress has been slow in the latter two areas, which is not surprising in view of the presence of long-life electricity supply acts in many countries that confer monopolies to incumbent utilities for the generation, transmission and distribution of electricity. Fortunately, several utilities in the region are aggressively seeking clean energy solutions to create grids that are independent from imported fuels and resilient to the impacts of climate change.

Perhaps now we are beginning to see that alignment of stakeholders which, ten years ago, was so sorely lacking.

Although Caribbean countries are negligible emitters of carbon dioxide, every country in the region has committed to ambitious reductions in its carbon footprint through an accelerated transition away from fossil fuels. The recent UN 1.5 Special Report demonstrates the alarming consequences that will befall islands if developed countries do not dramatically increase their ambition to curb greenhouse gas emissions and limit global warming to no more than 1.5 degrees Celsius. We hope — and as Caribbean nations we must continue to lobby hard — for increased global investment in renewable energy technology.

The challenge for the region over the next decade will be to attract high-quality investments in the energy sector that will support the aspirations of countries to achieve energy security, drive down the cost of electricity and increase the competitiveness of their economies. What we need to do now is convert the stimulating discussions into more installed renewable energy capacity on the ground; what we need now is action.

The goal of this report is to provide a snapshot of renewable energy growth in the Caribbean over the last 10 years — as demonstrated in the presented infographics. It also highlights some of the innovative renewable energy and energy efficiency projects seen in the region during this time. I hope this report will serve as a valuable resource for those in the industry and I look forward to continued development in the years to come.

James Fletcher

Managing Director, Soloricon Ltd.
Former Minister of Public Service, Sustainable Development, Energy, Science and Technology, Government of Saint Lucia

DISCUSSION

There is approximately 3.1 GW of installed and operational renewable energy in the Caribbean including hydro, whose legacy is giving way to new technologies.[1] Yet this figure only accounts for a small fraction of the region's untapped potential. It is estimated that the Caribbean holds 2,525.9 MW of potential solar energy, 800.4 MW of potential wind energy, and 3,770 MW of potential geothermal energy.[2] Collectively, clean energy could displace approximately 2.7 million barrels of oil per year in the Caribbean,[3] reducing costly fossil fuel imports which currently exceed US$4.9 billion per year.[4]

The clearest take-away from the infographic is the rise of solar and wind over the last decade. Both technologies have become significantly cheaper and more competitive, without subsidies or incentives, across the Caribbean. Solar, in particular, benefits from being relatively straightforward to construct and attractive to financiers who are well-versed in the technology.

Geothermal, which shows little progress across the region over the ten-year period, may yet have its day in the sun. Unlike waste-to-energy, geothermal has supporters with significant capital. For instance, the multilaterals, led by the Caribbean Development Bank, the Inter-American Development Bank and The World Bank, have mobilized funding to address inherent issues around geothermal resource and project risk — although this does not necessarily guarantee success. In some of the region's smaller markets, the question is not between geothermal and intermittent renewables, rather it is a question of one or the other. Which will prevail in the coming years will depend on the new regional algorithm whose key components are economics, reliability — and resilience. That debate is playing out vigorously in the region as we speak.

Comparing the Caribbean markets, we see the highest levels of installed renewable energy in the Dominican Republic and Puerto Rico.[5] Although some institutions provide varying figures on their exact capacity, revealing the difficulty in tracking reliable energy data, all agree these are the largest RE markets in the Caribbean. As the previous infographic demonstrates, overlaying the data onto a regional map gives visual context to the advantage the larger islands have when it comes to building large-scale wind or solar. It is not just the availability of land, but also the scalability of projects. A larger renewable plant comes with lower costs which, in turn, make renewables more competitive. That said, the paradigm may be changing. Bruce Levy, CEO of BMR Energy, observes that while much of the growth over the past 10 years has been on larger islands, "recent advancements in the efficiency and reduction in cost of renewable energy technology will allow all islands to increase use of renewables."

When adjusted per capita, however, the picture changes. The overseas jurisdictions are shown to have some of the highest levels of renewable energy capacity per capita. Their progress has been laudable, yet not easily replicated elsewhere given their favourable access to wider tax and economic incentives imported from Europe and the United States.

The success stories highlighted in this report demonstrate how many islands have proved to be incubators for innovative renewable energy and smart grid systems. Yet progress, at least in terms of overall investment, remains relatively conservative. The stakes could not be higher: the reliability and cost of supply are critical to national economic performance. The drive for change, however, needs to be deliberate. Robert Blenker, CEO of WRB Energy, captures the issue succinctly: "Thoughtful, respectful policy and regulatory reform based on facts and economic analysis has and will continue to drive meaningful change."

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1 Caribbean refers to all countries/territories in the Region including all CARICOM member states.
2 Koon, Randy. 2018. "Renewable Energy: A Caribbean Crossroad." Journal of Caribbean Environmental Sciences and Renewable Energy (CESaRE). Studies have shown that climate change impacts on the regional availability of solar radiation and kinetic wind energy will not be affected negatively in appreciable ways with climate change. See Angeles, M.E., J.E. González, D.J. Erickson III, and J.L. Hernández. 2010. "The Impacts of Climate Changes on the Renewable Energy Resources in the Caribbean Region." *ASME Journal of Solar Energy Engineering* 132 (3): 031009-031009-13.
3 Gischler, Christiaan, Nils Janson, Ramón Espinasa, and Malte Humpert. 2016. "Challenges and Opportunities for the Energy Sector in the Eastern Caribbean." Inter-American Development Bank.
4 Koon, Randy. 2018. "Renewable Energy: A Caribbean Crossroad." Journal of Caribbean Environmental Sciences and Renewable Energy (CESaRE).
5 IRENA. 2018. "Renewable Capacity Statistics 2018." Abu Dhabi. International Renewable Energy Agency (IRENA).

Total Installed Renewable Energy Capacity

Country | MW

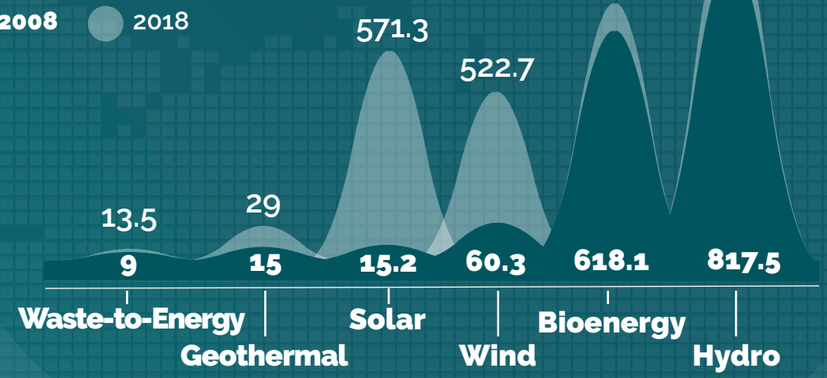
Size denotes MW capacity

0-5 6-23 24-64 65-118 119-314 315-374 375-1,297

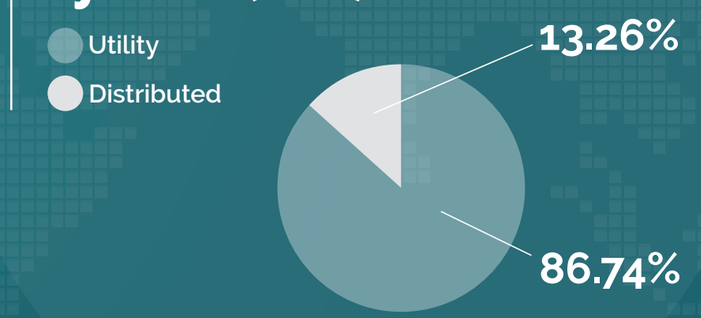
Color denotes renewable energy capacity per 1,000 people (kW)

Bermuda | 22.2
Bahamas | 1.7
Turks & Caicos Islands | 0.5
British Virgin Islands | 0.8
Sint Maarten | 0.8
Saint-Martin | 2.0
Saint-Barthelemy | 0.02
Anguilla | 2.0
Antigua & Barbuda | 6.0
Sint Eustatius | 4.1
Guadeloupe | 212.8
Dominica | 7.3
Martinique | 111.8
Saint Lucia | 3.1
Barbados | 32.1
St. Vincent & the Grenadines | 16.5
Grenada | 2.3
Trinidad & Tobago | 3.0
Cuba | 149.7
Dominican Republic | 863.0
Haiti | 40.0
Puerto Rico | 407.0
Saba | 1.5
U.S. Virgin Islands | 18.8
Saint Kitts & Nevis | 16.4
Montserrat | 0
Cayman Islands | 11.1
Jamaica | 189.0
Belize | 102.0
Curaçao | 56.0
Bonaire | 11.5
Aruba | 39.5
Guyana | 44.0
Suriname | 194.0

Total Installed Renewable Energy Capacity 2008 vs 2018 (kW)



Utility vs Distributed Renewable Energy Systems (MW)



Data includes supply-side technologies: operational hydro, solar, wind, geothermal, bioenergy, and waste-to-energy. As yet, there are no ocean thermal, tidal or wave energy systems in operation. Data reflects the most up-to-date information available for each country/territory as of 2018 and includes projects currently under construction.

NEWENERGYEVENTS

RENEWABLE ENERGY CARIBBEAN

INNOVATIVE PROJECTS FROM ACROSS THE CARIBBEAN

Renewable energy[1] first took root in the Caribbean with distributed systems such as Barbados' solar hot water heating industry which has flourished since the 1970s; or more recently, with the deployment of decentralized solar PV systems in Grenada owing to the country's 2007 *Renewable Energy Interconnection Programme.*

The first utility-scale operations in the Caribbean[2] include Guadeloupe's 1.4 MW Petit Canal I wind project launched in 1999 and Martinique's 4.7 MW Potiche II solar project in 2011. At present, the largest utility-scale operations reside in Puerto Rico with the 101.2 MW Santa Isabel Wind Farm, and in the Dominican Republic with the 69 MW Monte Plata I and II[3] solar farm, although larger utility-scale projects are on the horizon.

In the last ten years, solar and wind have surpassed hydro with approximately 1.1 GW of installed capacity in the Caribbean. While solar and wind energy systems continue to dominate new energy generation, several key geothermal projects may become operational[4] — as well as possible bioenergy, waste-to-energy, ocean thermal, wave and tidal projects — all contributing to an expanding portfolio of renewable energy in the Caribbean.

Underpinning both distributed and centralized generation is the advancement in microgrids, battery storage, and grid digitalization, which are essential to the deployment and effective utilization of renewable energy technologies, especially on smaller and more remote islands. These smart grid advancements, along with improvements in construction and energy efficiency, translate into substantial savings in upfront capital costs while simultaneously strengthening economic and climate resiliency.[5]

Below is a selection of some of the most innovative and demonstrative renewable energy projects from across the Caribbean, highlighted for various reasons either as a catalyst for other RE projects or for their pioneering use of technology, novel financing structures, resilient construction methods, and/or positive community impact. Many of these projects are award-winning, and chosen based on extensive market research and inputs from thought leaders from across the industry.

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1 Excluding large hydro.
2 Caribbean refers to all countries/territories including all CARICOM member states.
3 Phase II currently under construction and expected to become operational in late 2018.
4 For example, such geothermal projects are made possible by the Green Climate Fund's *Sustainable Energy Facility for the Eastern Caribbean* program, which offers funds for the development and exploitation of potential geothermal sites in Dominica, Grenada, Saint Kitts & Nevis, Saint Lucia, and Saint Vincent & the Grenadines.
5 Bush, Martin J. 2018. "Adapting Energy Systems." In *Climate Change Adaptation in Small Island Developing States*, 1st ed., 121–43. John Wiley & Sons Ltd.

INNOVATIVE PROJECTS FROM ACROSS THE CARIBBEAN

Solar Farm, Saint Lucia

3 MW, LUCELEC

The facility comprises approximately 15,000 panels and marks the first utility-scale solar farm on the island, coming online in April 2018. The US$20 million project is estimated to generate 7 million kWh per year (ca. 5% of electricity demand), while reducing the volume of fuel purchased by 300,000 gallons annually (ca. 19 million gallons used to generate power annually). Developed by a consortium made up of LUCELEC, GRU-POTEC, Clinton Climate Initiative, Rocky Mountain Institute, and DNV GL; this project secured a US price point under an EPC contract at a sub-scale which is critical for the Region.

Content Solar Farm, Jamaica

20 MW, WRB Enterprises

Operational since 2016, the Content solar project spanning 154 acres was the first utility-scale solar PV project in Jamaica. The 20 MW project included an investment of over US$60 million, financed by WRB Serra and Overseas Private Investment Corporation; creating 400 jobs during construction and 20 long-term post-construction employment opportunities. The facility is set to power more than 20,000 homes under a 20-year PPA with Jamaica Public Service Company; while reducing fuel imports by approximately 3 million gallons per year.

Wigton Wind Farm, Jamaica

62.7 MW, Wigton Wind Farm Ltd., a subsidiary of Petroleum Corporation of Jamaica

The Wigton facility is the largest wind power development in the English-speaking Caribbean and has seen two expansions since coming online in 2004. Wigton Wind Farm Ltd. have a mandate for technology transfer to catalyze increased usage of wind power; as well as, other forms of renewable energy. The project is a job creator, with the Wigton III expansion alone creating 145 construction jobs and three full-time engineering positions. The company also has a history of training staff members and the wider community on renewable energy; and has offered formal courses from the Wigton Renewable Energy Lab. The project included a Resource Assessment carried out as part of a program funded by the Inter-American Development Bank to help identify renewable energy potential in Jamaica. This has helped to pave the way to subsequent developments such as EREC's Paradise Park which, at 37 MW, will be the largest solar farm in Jamaica once construction is complete.

INNOVATIVE PROJECTS FROM ACROSS THE CARIBBEAN

Galion II Biomass Plant, Martinique

40 MW, Albioma

The Galion II plant is the first 100% biomass cogeneration facility in Martinique, burning bagasse produced at the local Galion sugar refinery; as well as, sourcing wood pellets from international markets. The project operates under a 30-year deal with Électricité de France, providing 15% of the island's total electricity consumption. The US$211 million project was privately financed and created 350 jobs during the construction phase, along with 32 local permanent positions and more than 200 indirect jobs.

Megapower EV Project, Barbados

The Megapower project in Barbados, combining electric vehicles (EVs) with solar-powered charging stations, has the power to be transformational. The initial roll out includes corporate and government fleets, although the project aims for market-wide adoption. Under the Public Sector Smart Energy Program (PSSE) financed by the the Inter-American Development Bank, the Government of the Barbados has initiated a pilot program with eight EVs and seeks to add at least two electric buses in 2018. Under the Smart Fund II, also financed by the IDB, there is a sub-component focused on public electric mobility with the main objective of not only expanding the public bus fleet, but also investing in the expansion of the EV charging infrastructure. The island already boasts the most comprehensive EV infrastructure in the Caribbean region with 300+ EVs and 80 charging stations.

Minigrids in Atjoni/Pokigron, Suriname

The first of its kind in Suriname, this solar PV micro-grid has displaced a diesel-based system with 500 kWp solar PV, providing 24/7 electricity. The project is a trailblazer for helping the country to develop its capabilities to deploy the technology, which has the potential to increase electricity access in the hinterland. The utility EBS is simultaneously undertaking an extensive IT systems modernization program which will allow for further integration and development of smart grid systems. Furthermore, the project partners held extensive community engagement and participatory processes in the project's execution and subsequent operation; which has led to increased awareness and community buy-in.

INNOVATIVE PROJECTS FROM ACROSS THE CARIBBEAN

PV-Hybrid Storage Project, Sint Eustatius

2 MWp, SMA

This system includes 1.89 MW solar PV and 1 MW/572 kWh Li-Ion battery storage system, constituting the largest lithium battery storage system in the Caribbean. The energy generated provides cost-effective electricity to meet 23% of the island's annual demand, while reducing diesel generation by 30%. Subsequent analysis has shown that the system actually exceeded performance expectations in its first year of operation, with relative diesel savings 3.4% higher than expected despite lower-than-average solar irradiation. As a result, the utility now seeks to expand the project in the coming years; while serving as an example and proof-of-concept for other island systems. The project will save 1.7m litres of diesel each year, along with 4,500 metric tons of carbon dioxide.

EarthSpark Hybrid Generation Project, Haiti

Amidst the lowest grid-connection rates in the world, the innovative EarthSpark project has brought electricity to thousands of Haitians. The microgrid system installed in Les Anglais is the first of its kind in the country, leveraging smart meter technology allowing for a customer prepayment model and is powered by a 93 kW solar PV array, 400 kWh of battery capacity, along with a small diesel backup generator. The project has newly introduced clean power to rural communities, and in some cases has reduced energy bills by up to 80%. EarthSpark now seeks to refine and replicate the technology in other rural communities, serving as a pilot to demonstrate its effectiveness and build capabilities among students and technicians. Other microgrid projects have been launched in Haiti through Sigora Haiti, who have installed several hybrid solar/diesel projects such as the 200 kW Môle-Saint-Nicolas microgrid; whose smart meters have a built-in capacity for data distribution which can be turned into WiFi hotspots and provide internet access to their customers.

Monte Plata Solar Project, Dominican Republic

69 MW, General Energy Solutions

At 270,000 panels, the Dominican Republic is set to host the largest solar project in the Region bringing clean energy to more than 50,000 homes on the island. Its initial development at 33.4 MW in 2016 tripled the number of solar panels on the island, creating 300 direct and 1000 indirect jobs with the majority being local to Monte Plata. Phase II in 2018 will ramp up the capacity to 69 MW, increasing solar power output in Dominican Republic by fivefold.

INNOVATIVE PROJECTS FROM ACROSS THE CARIBBEAN

PV Solar Distributed Generation Project, Grenada

937 kW, GRENLEC

This distributed solar project, spearheaded by GRENLEC and developed by Sofos, totals 937 kW across several sites. The variety in locations and technical requirements demonstrates the utility and adaptability of distributed solar PV; as one installation was atop the employee carport at GRENLEC HQ, another at the Queen's Park Power Station incorporated rooftop and ground-mounted systems, with another ground-mounted system installed in Plains Parcel. This project is one of several initiatives launched by GRENLEC in recent years to catalyze renewable energy deployment, including several other solar installations notably on schools and health care institutions.

Grid Modernization Project, Dominican Republic

In recent years, the Dominican Republic has seen significant investments from multiple sources (IDB, World Bank, EIB, OPEC Fund for International Development) to modernize their grid infrastructure. This includes the rehabilitation and adaptation of hard assets such as substations and distribution lines; but also enhanced automation controls and overhauls in operational processes around billing and payment collection, since the country "has one of the most widespread rolling blackouts in the Region due to [an] ineffective metering, billing and collecting system".[1] The project aims to enable the inclusion of more renewable energy onto the grid while simultaneously enhancing the institutional capacity and operational effectiveness of service providers in the country.

1 World Bank quoted in Casallas, David. 2016. "Dominican Republic to Launch US$3000mn Grid Program." BN Americas. 8 March 2016.

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