A Publication of the Caribbean Electric Utility Services Corporation

CE INDUSTRY Journal

ISSUE #18
NOV 2021

COLLABORATING ON ENERGY SOLUTIONS:
# OPPORTUNITIES FOR CANADA AND THE CARIBBEAN

EFFECTIVE CORPORATE COMMUNICATIONS:
## A POWERFUL RESOURCE IN THE RENEWABLE ENERGY (RE) TRANSITION

A SUSTAINABLE ENERGY FUTURE FOR
## BERMUDA

# This Journal Issue Highlights

*Energy Transition and Climate Resilience: Multiple Pathways and Different Perspectives for Achieving Two Common Goals*

CARILEC
An Association Of Electric Energy Solution Providers

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SUSTAINABLE ENERGY FOR A SUSTAINABLE FUTURE



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# Editorial Foreword

## ESTEEMED READERS,

Within recent years, the tropical hurricane season in the Atlantic and Caribbean region has only intensified, as each subsequent year continues to be the hottest on record. Tropical storms have proven to cause more damage and rainfall patterns have shown significant changes within the dry and wet seasons which contribute to a domino effect of increasing numbers and severity of impacts.

As fossil fuel prices also continue to rise, utilities across the region continue to battle feverishly with these impacts and are actively looking for worthwhile solutions which will guarantee consistent electricity supply and reduce intermittency during natural disaster events all while reducing carbon emissions. Coming off the cusps of the most recent global climate summit - the COP26 - many world leaders have once again pledged their support and efforts to combat the rise in carbon emissions and preventing any rise in global temperatures above 1.5°C. It is without question that the Caribbean region has not been exempt to the effects of these rising global temperatures and climate change. The recent impacts of heavy weather events

***We hope that as you engage in this issue of the CE Journal, your interests will be awakened, and you will acquire an increased appreciation of the Caribbean electric energy sector.***


**THOMAS MITSCHKE**
**Energy Solutions Advisor**
**CARILEC**


have caused major blows and financial damages to agriculture and relevant infrastructure in many of the Caribbean islands, which increasingly burdens the local economies and public budgets.

Widespread concern in the region is focused on those emitters that in absolute numbers contribute most to the global $CO_2$-emissions. In its entirety, the Caribbean is responsible for less than 1% of global emissions, compared to countries like China which contributes with around 26% to global emissions, the United States with nearly 24% and India with 7%[1]. Nonetheless, the grid emissions per MWh of electricity of many Caribbean countries are still among the higher ones worldwide. This applies particularly to those countries that do not possess a significant portion of traditional hydropower within their generation mix. Due to their high share of petrol-based fuels for power generation, Grid Emission Factors (GEF) here still range between 0.6 and 0.8 t $CO_2$eq/$MWh_{el}$.[2] Only

1 World Population Review – Carbon Footprint by Country https://worldpopulationreview.com/country-rankings/carbon-footprint-by-country
2 UNEP, 2015: Analysis of grid emission factors for the electricity sector in caribbean countries

countries that mostly or fully rely on coal-based power generation have higher GEFs[3]. For comparison, the USA had an average GEF of 0.45 t $CO_2$eq/$MWh_{el}$ in 2020, China 0.56 and India 0.71. Countries like the UK or France on the other hand reached an average GEF of 0.25 and 0.04 t $CO_2$eq/$MWh_{el}$ in 2020, mostly due to the diversification of their power generation mix, as well as through the high utilization of nuclear energy.[4]

Science and technology will have the biggest role to play in handling climate change, as well as assessing measures being put in place to reduce carbon emissions. Solutions and alternatives therefore do exist.

RE technologies such as solar and wind energy are already cost-competitive and have lower Levelized Cost of Energy (LCOE) than many fossil-fuel-based generation technologies in the Caribbean. The intermittency of RE generation however creates a need for additional regulatory and technical measures for grid flexibility that may lead to additional (fixed) cost for grid operation. In our recently published CARILEC Position Papers on Energy Transition[5], we stated the need for those costs to be reflected in customer tariffs for more transparency and planning purposes. However, not only does RE expansion contribute to the need for new investments into the grid, but also increasing energy consumption, the age of the grids in general and the need to make the grid more resilient towards an increased number of extreme weather events. Hence, in a way or partly, a share of these costs would also occur in a business-as-usual-scenario without RE expansion.

To increase energy affordability, customers could effectively save money by reducing their electricity consumption through well-designed energy efficiency measures, while at the same time offering new business-models for utilities. Energy management, flexible generation and smart orchestration of demand and supply can all contribute to further increasing the decarbonization and the overall efficiency of our energy systems.

On the global front in recent years, engineers, entrepreneurs, and politicians have developed a multitude of innovative technologies, business concepts and effective policy measures which allow for a high share of intermittent RE without harming the security of supply and the affordability of energy. Additionally, sector policies have already outlined the pathway for sustainable energy transition in the Caribbean. The remaining challenge on the ground now consists of designing tailored solutions and mechanisms for practical implementation of theoretical examples and recommended approaches. This specifically includes the provision or enabling of financial instruments to overcome investment barriers for technologies that will contribute to affordable and stable energy costs in the long-term.

The aftermath of the COVID-19 pandemic crisis compels us to reassess long-standing assumptions, perceived barriers, and default decisions in a joint effort to seize this opportunity and to accelerate and push the progress for energy transition. Engineers, financial managers and decision-makers of utilities, suppliers and governmental institutions are called upon to jointly reformulate the future of their energy systems. Technical planning of new and resilient energy infrastructure, as well as the related procurement will become increasingly complex, requiring more holistic

3 Typically, coal-based power generation leads to GEF of 0.9 – 1.2 t CO2eq/MWhel.
4 carbonfootprint.com: Country Specific Electricity Grid Greenhouse Gas Emission Factors, June 2020
5 https://www.carilec.org/white-position-papers/

approaches and inclusive perspectives.

Strengthening of strategic alliances, the further digitization of processes and the active participation of citizens in energy transition are therefore key success factors that will significantly contribute to overcoming the pandemic, whilst decarbonizing our energy systems and strengthening their resilience.
The region needs to adapt to climate change in order to be prepared for what is coming. At the same time, it should embrace technology to tackle and reduce the impact of climate change. Science must be woven through every single consideration in our response to this global problem we face. After playing the role of the diagnostician, science now needs to play the role of the treatment, which will be in technology, innovation, natural solutions as well as behavioral and societal change. Around 70% of the world's economy is now committed to reaching net zero emissions. More than 80 countries have formally updated their Nationally Determined Contributions (NDCs), and all G7 countries have announced new NDC targets that put them on the path to net zero emissions by 2050. Accounting for around half of the global economy, all the countries that make up the G7 have updated their 2030 targets to put them on a pathway to net zero by 2050. Concerns from many vulnerable countries were aired at COP26 and it is abundantly clear that much more work is expected to achieve the goals set out for 2030 and beyond. Plans for net-zero are not being matched by action. Policy implementation on the ground is advancing at a snail's pace. Under current policies, it is estimated that the end-of-century warming will be 2.7°C.

The Caribbean region, while actively attempting to increase its resilience in all forms, remains geographically vulnerable to not only climate change, but to the other natural hazards which threaten it. To effectively unravel and address its many challenges is no easy undertaking for any island. It is imperative that the region uses its shared vulnerability as an avenue to tackle these challenges as a united entity – utilizing the power and expertise of national and regional organizations. As a premier institution in the Caribbean, CARILEC continues to promote the agenda for Energy Transition and Climate Change mitigation under three (3) key pillars – decarbonization, security of supply and energy affordability. We strongly believe in facilitating the development of world class, sustainable electric energy and continue to lend support, expertise, and training to meet these goals.

We hope that as you engage in this issue of the CE Journal, your interests will be awakened, and you will acquire an increased appreciation of the Caribbean electric energy sector. Thank you for your resolute support and sustained interest in the work of the Secretariat. We eagerly welcome your insights into how we can further develop successful and outstanding sustainable energy solutions for the people of the Caribbean region.

# A SUSTAINABLE ENERGY FUTURE FOR BERMUDA

*By BELCO President, Wayne Caines*

**Bermuda Electric Light Company Limited (BELCO) is committed to sustainability and a renewable energy future for Bermuda. We were delighted to recently see the world leaders gathering in Glasgow for the 2021 United Nations Climate Change Conference, COP26 to advance sustainability for the world.**

*Aerial view of Bermuda island*

At BELCO, we are acutely aware that our electricity costs are too high and financially burdensome for our customers. Our goal is to not only bring down the price for energy but to massively reduce our environmental impact and carbon footprint by phasing out the use of fossil fuels as we add more renewable energy sources to our energy mix. I am confident that with the highly qualified staff at BELCO, in partnership with our parent company, we can achieve these ambitious goals.

Last year BELCO established the Bermuda-100 ("B-100") team – a team dedicated to furthering the company's alignment with Bermuda's goal to achieve 100% renewable energy for Bermuda. The B-100 team are doing critically important work exploring all renewable energy options available to provide reliable, cost-effective electricity for our customers.

While we analyse the options for economical, large-scale, renewable power, we are laying the foundation to support Bermuda's transition, which includes retiring old engines; making internal practices and efficiencies more sustainable; moving to an entirely electric commercial fleet; upgrading our transmission and distribution network and continuing to build upon what we learned when we brought our large-scale Battery Energy Storage System online.

As we move toward achieving our goal of generating 100% of our energy needs from renewable sources,

***Last year BELCO established the Bermuda-100 ("B-100") team – a team dedicated to furthering the company's alignment with Bermuda's goal to achieve 100% renewable energy for Bermuda.***

BELCO already has renewable energy generation partners. These include the solar finger installation at the airport, residential and commercial roof top solar, the Tynes Bay waste-to-energy facility and in future, any successful Regulatory Sandbox technologies.

Working in partnership with these entities, and any future renewable energy projects, will be critical as BELCO continues to manage its electrical network that transports energy from its point of generation to the homes and businesses of our customers. This process happens under the transmission distribution and retail (TD&R) licence issued by the Bermuda Regulatory Authority. The TD&R licence authorises the holder to transmit, distribute and retail electricity as well as purchase electricity from bulk generation licensees and distributed generators.

The Government recently announced that it plans to introduce a Bill to facilitate renewable energy technology developers testing their products in Bermuda. As an industry stakeholder we look forward to participating in consultation on this. BELCO understands the need for renewable sandbox technologies, such as wave technology, to develop and demonstrate their viability in a regulated environment. It is critical that BELCO is involved as a stakeholder and included in conversations to build a working relationship and ensure cohesive decision making so we can help bring these technologies on-line in a manner that is safe, cost-effective and protects the reliability of electricity for the island.

There are many factors to be considered to ensure energy generated by renewable sources is reliable.

***The Government recently announced that it plans to introduce a Bill to facilitate renewable energy technology developers testing their products in Bermuda. As an industry stakeholder we look forward to participating in consultation on this.***

For example, if there is a sudden loss of output from renewable generation, such as cloud cover over a solar farm, this electricity will need to be generated from other sources. At this time, it means backup generators, run by traditional fuels, are necessary to ensure reliability, until utility scale storage becomes available.

The requirement to remain reliable was clearly outlined by Home Affairs Minister Walter Roban when he recently stated: "To be clear, in no way should Bermuda risk the stability of its grid, rated as one of the best in the Caribbean region."

We also recognise that sustainability is not limited to the environment; our focus on sustainability extends to social impact and governance. We believe to remain socially sustainable we must equip the leaders of tomorrow to advance beyond the leaders of today. By providing scholarships, internships and apprenticeships to young Bermudians, we are committed to empowering the next generation of engineers and energy professionals. We are proud to support multiple initiatives that fund education, community development and family support, particularly for Bermuda's youth and seniors.
Our team at BELCO looks forward to working with the Regulatory Authority, the Government and existing and future renewable energy providers. We will only be successful in our journey to generating 100% renewable energy for Bermuda through partnerships, collaboration and community engagement. We believe that together we can build a safe, reliable, renewable and cost-effective energy future for Bermuda.

## ABOUT THE AUTHOR

*Wayne M. Caines was born and raised in Bermuda. Wayne graduated from Oakwood University in 1993, with a Bachelor of Arts Degree in History and a Minor in Political Science. He is also a graduate of the University of Kent, School of Law and the Royal Military Academy Sandhurst (RMAS) Territorial Army Commissioning course. He also served in the Royal Bermuda Regiment rising to the Rank of Captain.*

*Wayne was employed for 6 years as a Crown Counsel in the Bermuda Department of Public Prosecutions. He was then appointed to the position of Chief of Staff, for the Premier at the time, the Honorable Ewart F. Brown JP MP.*

*In 2006 Wayne was appointed as a Senator for the Bermuda Government, with responsibilities as the Junior Minister of Tourism & Transport, Environment and Sport*

*Mr Caines was Chief Executive Officer for Digicel Bermuda from 2008- 2014. Mr Caines was then he was employed as the CEO of Seniac Consulting from 2014-2017.*

*On July 2017, Wayne was elected as the Member of Parliament for Devonshire North West, where he served as Minister of National Security; for the Government of Bermuda with responsibility for the Bermuda Fire Service, the Royal Bermuda Regiment, The Bermuda Police Service, the Department of Corrections and the Bermuda Department of Immigration from July 2017- July 2020.*

*Wayne sits on various boards, including CARILEC, Polaris Holding Company, ILS Capital and Prospero Re.*

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# RENEWABLE ENERGY: A GREENER HEDGE?

*Authors: Zsaria Diaz, Siana Teelucksingh, Kaitlyn Bunker*

**Price volatility in the fossil fuel market is a major thorn in the sides of electric utilities that rely on fossil fuels for some or all of their electricity generation. Traditionally, financial hedging is often used to combat upswings in fuel prices thereby protecting utilities and ratepayers from large increases in cost from month to month. The uptake of renewable energy for power generation can be a new opportunity for utilities to avoid high and variable fuel costs while also reducing their emissions and increasing resilience.**

## BACKGROUND

Electric utility companies which rely on fossil fuels as an energy source often have to deal with the volatility of fuel prices in the global market. The cost of fuel is often passed through to customers via a fuel clause adjustment or surcharge on the electricity bill. This means that even if their consumption behavior is relatively unchanged, customers may experience notable differences in their final bill value from one billing period to another. Figure 1 shows how the fuel clause adjustment in Barbados fluctuates with market fuel prices. This instability can make planning and budgeting difficult for both utilities and customers. Therefore, it is understandable that companies would look for some way to mitigate these variations.

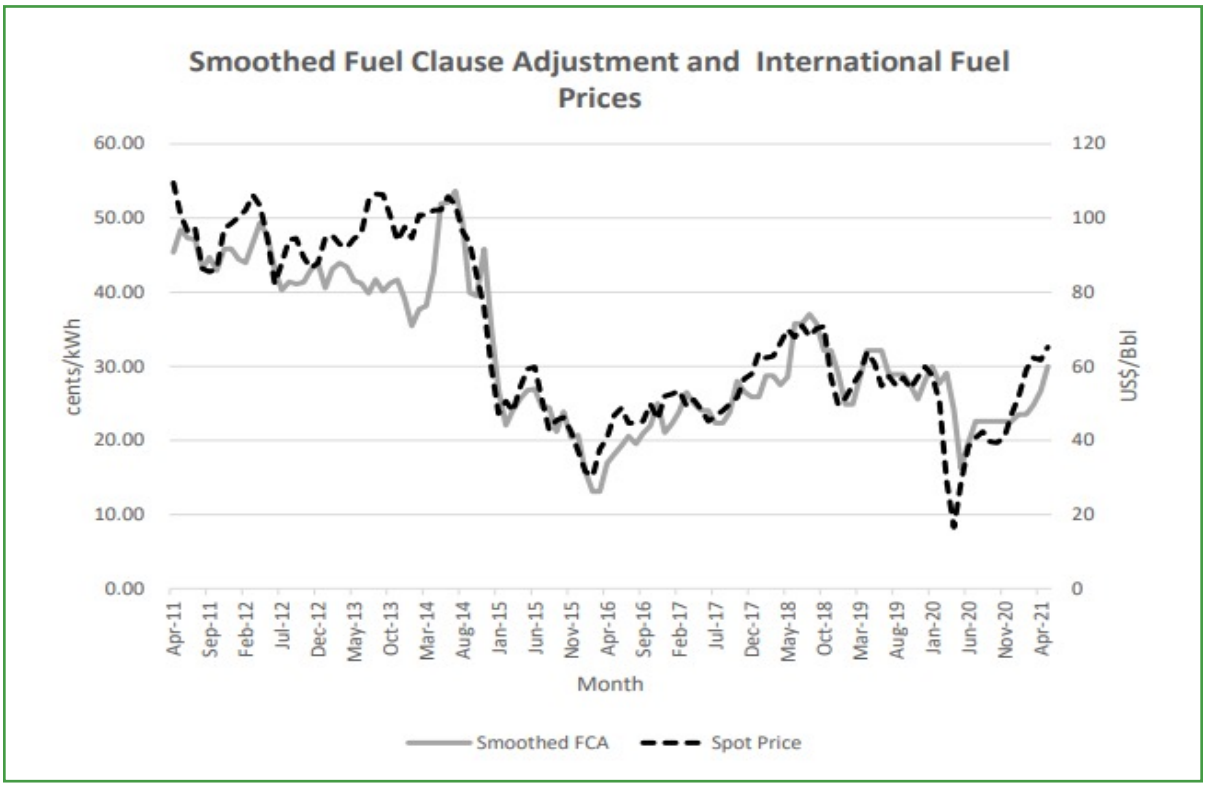


*Figure 1. Historical Variation of Barbados' Fuel Clause Adjustment with Market Fuel Prices*
*Source: Barbados Fair Trading Commission (2021)*

Hedging[1] is one strategy commonly used to address this uncertainty and gain greater control over fuel costs. However, due to its complex nature, some utilities choose not to hedge, leaving their customers exposed to the volatility of the fuel market through the fuel surcharge mechanism. This mechanism can also disincentivize utilities from seeking alternatives to hedging, as it allows them to remain unaffected by changes in the market fuel price. Rather, these changes are passed on directly to the customers. Many different methods of hedging exist, each of which uses some financial instrument to support the agreement between the parties involved. For example, several CARILEC utilities use a fixed price swap mechanism. This involves making an agreement with an entity other than the fuel provider, such as a financial institution, to pay a set price for a particular volume of fuel for a given period. If the market price increases past the set price, the utility receives payment of the difference from this entity. Conversely, if market prices fall below this set price, then the utility must pay the difference. The credits (or payments) received (or made) by the utility are often passed on to customers via the fuel surcharge. While there is still some variability in the final cost of fuel, the extent of the fluctuation is diminished, and the utility and its customers are protected against spikes in fuel prices. Figure 2 shows a comparison of the effects of hedged and unhedged fuel costs on the electricity tariff in Saint Lucia.

[1]Hedging is a financial strategy used by some utilities to offset the risk of high market fuel prices.

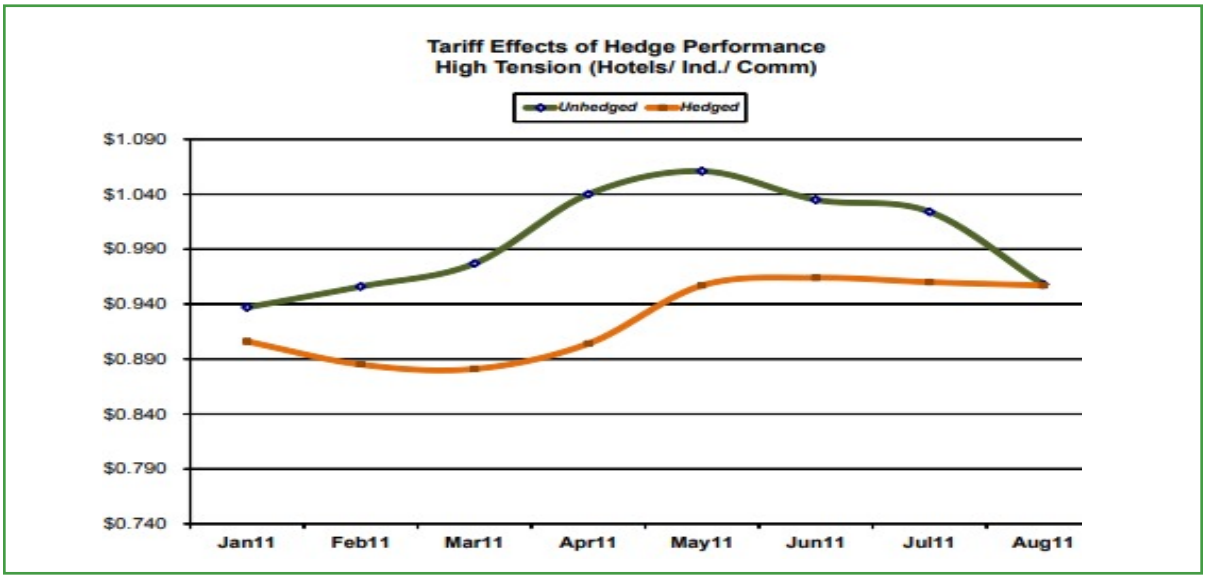


*Figure 2. Effects of hedging on the tariff for utility customers in the hotel, industrial and commercial sectors in St. Lucia in 2011*
*Source: LUCELEC monthly newsletter (2011)*

Utilities who do not wish to engage in the intricacies of hedging themselves, or lack the capacity to do so, can choose to outsource to an external organization such as a bank or firm. While such an arrangement may be useful in obtaining price stability, the advantages for the utility are limited. This is because the firm may not actively seek the utility's best interests in terms of managing costs but may rather view them as just another client. There is, however, another way that utilities may be able to manage the risks associated with fuel prices.

## DISCUSSION

This is where renewable energy (RE) comes in. When used for power generation and strategically connected to the grid in terms of capacity and location, RE can reduce the volume of fossil fuel needed and hence reduce exposure to the associated price volatility. Figure 3 illustrates this using randomized market fuel price data with an example of a utility in the process of increasing its RE capacity. The graph shows that although fluctuations are still present, fuel costs decrease when there is a higher share of RE in the electricity mix, and those peak costs are reduced significantly. In addition to mitigating some of the volatility in fuel costs, RE options are generally less expensive than operating, existing, fossil fuel resources, resulting in overall cost savings.

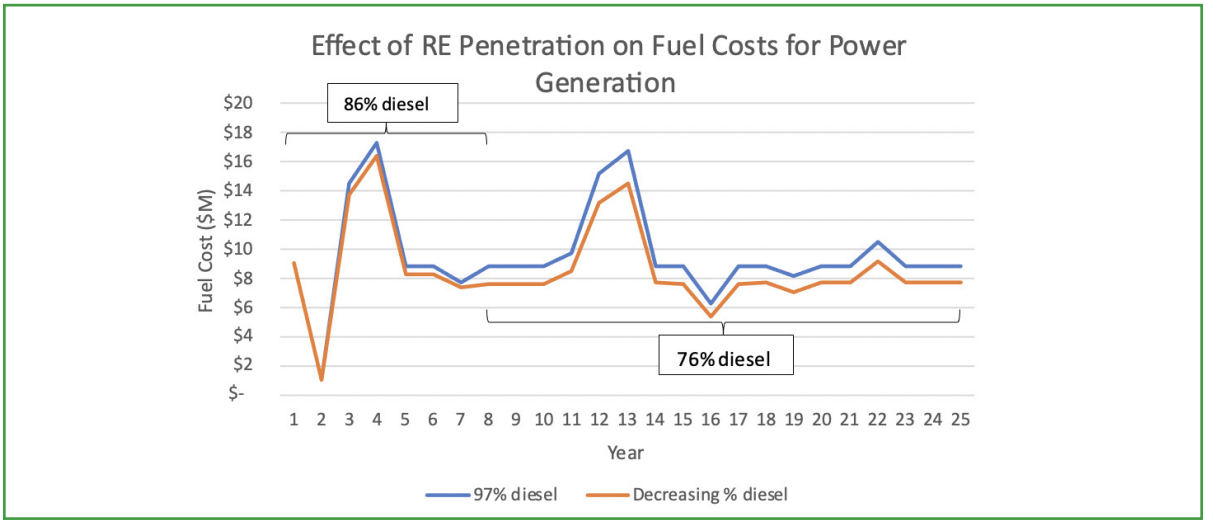


*Figure 3. Effect of Fluctuating Fuel Prices on Fuel Costs for a Caribbean Utility*

Although the risk of high fuel prices can be mitigated with RE, there would be a new risk of low or intermittent resource availability. This can, however, be managed by informed placement of the RE systems or by using energy storage, which has already been implemented in islands such as Barbados, Jamaica, and Bermuda. Battery energy storage not only mitigates the intermittency of RE, but also supports more efficient dispatch of generators by replacing some amount of spinning reserves, resulting in even more fuel and cost savings. The predictable and minimal operation & maintenance costs over the lifetime of an RE project means that some additional cost stability is also achieved. With the utility's increased control over their costs, customers are able to benefit from more stable electricity pricing.

In addition to the possible benefit of reduced risk complexity, RE has the advantage of reducing emissions associated with power generation. These emissions are known contributors to negative externalities such as climate change and environmental pollution, the costly effects of which include damage from severe weather events and degraded population health. The main question now is whether the trade-offs between traditional hedging and RE are significant enough to make the latter a better form of protection from high market prices of fuel.

An important variable in the discussion of RE's use as a hedge for fuel price volatility is the ownership of the power system – mainly whether it is owned by an independent power producer (IPP) or the utility. If an IPP owns the system and an agreement is made with the utility for electricity provision, then the IPP takes on the risks associated with the RE project while the utility simply pays them. This is akin to outsourcing the hedging to an external organization. On the other hand, if the utility owns the system, then it must assume and mitigate the risks, similar to carrying out traditional hedging themselves.

Customer-owned distributed generation can also be helpful in lowering fuel costs, as well as strengthening the operation of the grid. However, this type of scheme has many factors to consider, including whether systems are grid-tied or standalone, and the costs associated with the installation of more robust infrastructure at several points throughout the grid. The implementation of informed policies will be helpful in ensuring that this type of distributed generation is effective in reducing fuel costs and providing resilience, however this topic requires a deeper analysis than is presented here.

***Hedging is one strategy commonly used to address this uncertainty and gain greater control over fuel costs. However, due to its complex nature, some utilities choose not to hedge, leaving their customers exposed to the volatility of the fuel market through the fuel surcharge mechanism.***

## CONCLUSION

**TO RECAP:**

- Hedging is a complex strategy used by some utilities as a means of avoiding high market fuel prices.
- Renewable energy can be an alternative method of avoiding high fuel costs and can result in significant savings for a utility.
- There is a trade-off between the risks of hedging and the risks associated with RE projects, however the latter also provides sustainability and resilience benefits.
- In terms of risk management, IPP-owned projects are analogous to outsourced hedging, while utility-owned projects can be viewed in a similar light as in-house hedging.

For utilities, hedging brings the benefits of high fuel cost avoidance and increased price stability. Investing in RE can also reap these benefits along with the advantages of cleaner power generation, increased resilience, and greater energy independence. The costs may just be worth it.

**SOURCES:**

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*Louisy, Trevor. 2011. "Energised: LUCELEC Monthly Newsletter." LUCELEC, August 2011. https://www.lucelec.com/sites/default/files/documents/Energised 1 - 11 - Hedging and Renewable Policy V2.2.pdf.*

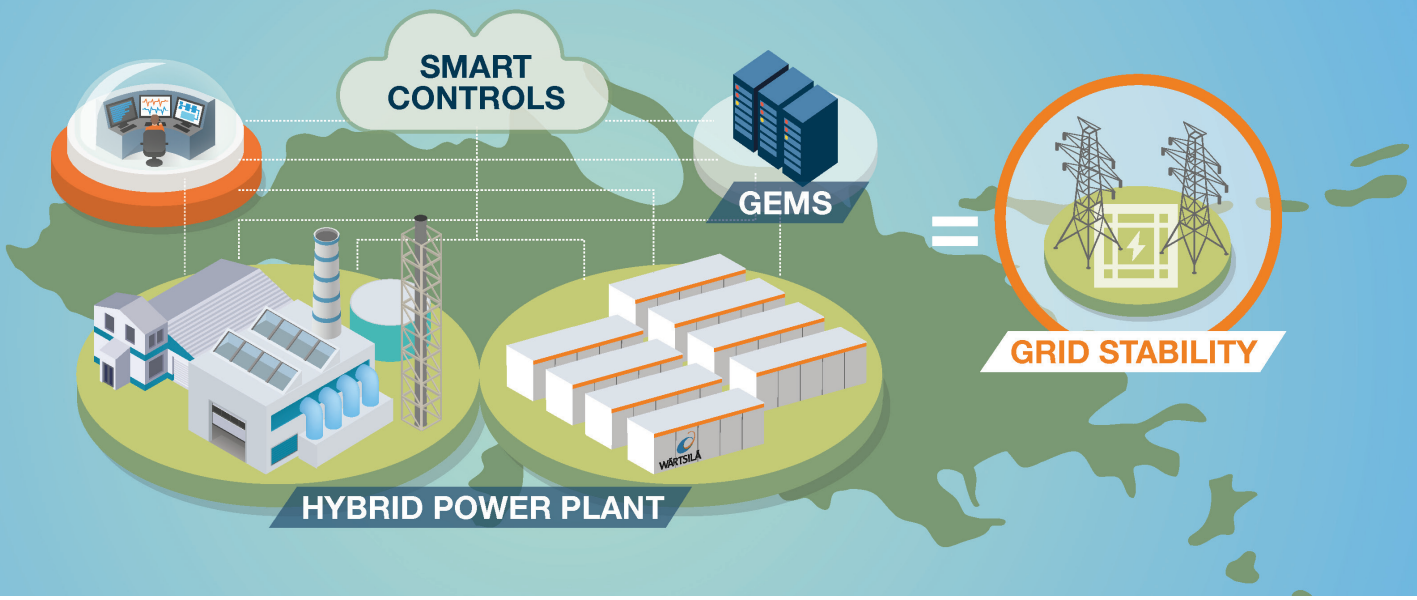
## AUTHOR BIOS

***Zsaria Diaz*** *is an Associate with the Islands Energy Program at RMI where she provides support to projects to implement solar and energy storage within the Caribbean region. She is in the final year of the MSc. Renewable Energy Technology programme at the University of the West Indies, St. Augustine and has a BSc. in Chemical and Process Engineering from the same institution. Zsaria has also written articles on renewable energy and related technologies for company websites and the CESaRE Impacts magazine.*

***Siana Teelucksingh*** *is a Senior Project Manager with RMI. She has been working in the Caribbean renewable energy space for eight years and currently supports electric utilities in designing and de-risking solar and energy storage microgrids. She has also worked extensively on Integrated Resource Plans for Caribbean Nations. Prior to RMI, Siana was a Renewable Energy Consultant with the Clinton Climate Initiative. Siana has developed the Rethinking Energy video series, in collaboration with IAMovement and has given a TEDxPort-of-Spain talk which explores opportunities in T&T's energy landscape.*

***Kaitlyn Bunker, Ph.D., P.E.*** *is a Director of the Islands Energy Program at RMI, where she leads a diverse team that partners with islands in the Caribbean to support and accelerate their clean energy transitions. The team completes energy modeling and technical analysis to develop integrated resource plans, prepares and de-risks resilient clean energy projects, and connects energy professionals in regional communities of practice. Kaitlyn completed at Ph.D. in electrical engineering from Michigan Technological University focused on microgrids and optimizing control strategies for distributed renewable resources.*

# WÄRTSILÄ'S HYBRID SOLUTION




## PAVES THE WAY FOR SUSTAINABLE ENERGY AND GRID CONTROL IN THE U.S. VIRGIN ISLANDS

*By Anna Newnham, Wärtsilä*

**Wärtsilä's recently signed contract in the Caribbean showcases the company's capabilities in combining flexible power generation assets with energy storage for grid management – precisely the combination needed in today's electricity markets.**

Assuring electricity supplies on a small tropical island is all about using imported fuel wisely and having contingency plans in place for when something goes wrong, which it often does, given the annual parade of hurricanes; or with other less predictable human events such as a household adding intermittent PV solar rooftop generation or a vehicle hitting a pole and causing a short circuit event in the grid. It can be a tricky balancing act between cost and reliability.

St. Thomas, in the U.S. Virgin Islands, is about to receive a more fuel-efficient, flexible, and reliable power supply, thanks to a contract signed in June 2020 between its utility, Virgin Islands Water and Power Authority (VIWAPA), and Wärtsilä.

Wärtsilä is to provide a smart control system – its GEMS Energy Management Platform – to optimise the entire island's electricity generation, along with a hybrid plant comprised of a multi-fuel 36 MW engine power plant and a 9 MW/18 MWh energy storage system (ESS). This new hybrid plant will be located at the existing Randolph Harley Power Plant.

In addition to being Wärtsilä's first engine/hybrid power plant sale, this will also be the first installation utilising the Wärtsilä 32LG engine – a flexible, multi-fuel engine, capable of operating with hydrocarbons in the range from propane to LFO, or carbon number C3 to C20 – a landmark in the company's development of engine solutions.

The hybrid plant will be delivered via an Engineering, Procurement and Construction (EPC) contract.

The project dovetails neatly with Wärtsilä's energy vision, which envisages the need for more flexible capacity, with energy storage, in adapting to a renewable energy future.

## FLEXIBILITY SUPPORTING RELIABILITY

The engines, energy storage and control system package for VIWAPA will improve the reliability of the energy supply, a challenge encountered in recent years. The utility has various generation assets on the island, including some ageing gas turbines, as well as newly installed engines running on propane fuel that Wärtsilä commissioned two years ago. Not only did VIWAPA need more capacity to meet its peak demand, but it also needed a flexible solution to kick in and provide electricity when older generation assets were unavailable.

Moreover, given that all fuel to the island is imported, the existing system needed to operate as efficiently as possible in order to reduce fuel costs and, as a result, the cost of electricity. The utility did not want to be reliant on a single fuel and required that the new power plant be capable of switching seamlessly between diesel and liquid propane gas (LPG) – a less polluting option. This multi-fuel capability will help the utility hedge fuel price volatility in the future.

***St. Thomas, in the U.S. Virgin Islands, is about to receive a more fuel-efficient, flexible, and reliable power supply, thanks to a contract signed in June 2020 between its utility, Virgin Islands Water and Power Authority (VIWAPA), and Wärtsilä.***

To make the most of the island's fuel storage capacities, the multi-fuel engines were specified to give the utility more flexibility and ultimately reduce the chances of being affected by shortages in either fuel type. VIWAPA wanted the fuel changeover to be seamless, a feature not often available from competing technologies.

## ENERGY STORAGE SYSTEM

As well as ensuring that generation capacity is increased, Wärtsilä is also supplying an energy storage solution and energy management system in the form of GEMS software controls and the GridSolv Max solution plus inverters, which will provide 9 MW of essential spinning reserve, frequency response and black-start capabilities.

Spinning reserves are on standby at all times, ready to provide extra power for a surge in demand or in the event that a generation asset unexpectedly goes offline. Using power generation assets for this purpose is costly, because idling engines burn fuel. Instead, the ESS will provide this service, freeing up the engines to run in their most efficient mode when producing electricity. The addition of energy storage will reduce fuel and maintenance costs for the utility.

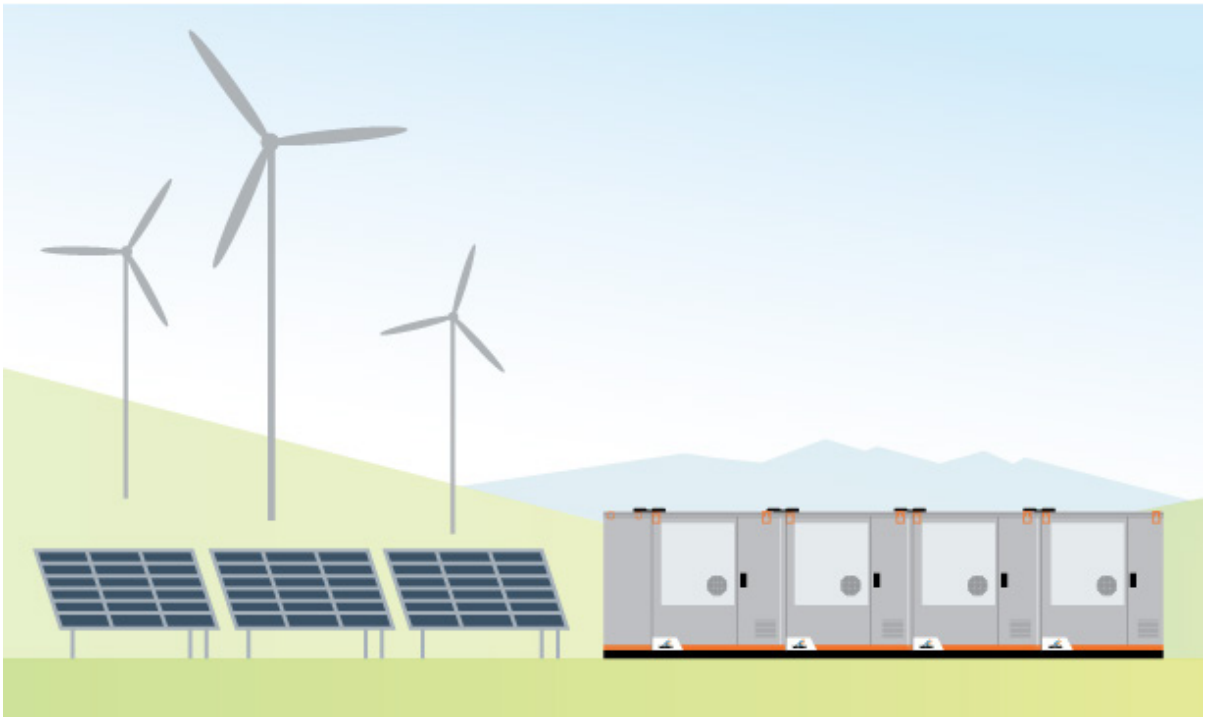
The ESS also serves as spare capacity in the case of an undesired event on the grid – for example, if a hurricane strikes and takes out transmission or distribution infrastructure, or an engine generating set becomes unavailable for short periods of time. It is not designed to replace generation assets, but to provide the vital two-hour window for the utility to bring other generators online.

to start and reach full power inside two minutes, quickly taking over the load initially supplied by the ESS.

The energy storage system is also an asset that provides voltage and frequency regulation. With an energy storage system on the grid, excess or insufficient power is absorbed or supplied to provide a 'smoother' electricity supply and preserve grid infrastructure.
All these features will effectively increase the service quality experienced by the customers of the utility.

## OPTIMAL DISPATCHING

Impressive as these individual components are, the real star of the show is the GEMS Power Plant Controller, a product of the Wärtsilä GEMS Platform Suite. GEMS is an intelligent energy asset



The ESS also offers grid forming and 'black-start' capabilities, which are critical for vulnerable regions like the island of St.Thomas, where aging generators used to restart a plant may become unavailable over time. To prevent blackouts across the island, GEMS can provide a response as fast as in 50 milliseconds. If a contingency event becomes unavoidable and causes a loss of connection between generators and the loads, the ESS black-start function allows the inverter to generate a sine wave for itself allowing, for instance, Wärtsilä's 32LG engine generating sets

management system that will not only provide a single interface to control the operation of the new multi-fuel engines and the energy storage system, but will also integrate and synchronise all the other power generation assets on the St. Thomas island grid and 'optimise' dispatching – in other words, the system will carry out full grid management.

Wärtsilä's GEMS conducts this synchronisation in the most efficient way possible, by matching the electricity load with generation, so that supply equals

demand at all times. For example, characteristics and parameters such as the length of time a power plant takes to start, the optimal running conditions of the plant, and the plant's fuel consumption under given conditions are entered into the GEMS Fleet Director. Once all the data is collected, the control system considers fuel costs, battery degradation and the multiple engines' efficiencies to meet the demand across the island, according to the GEMS economic dispatch algorithm, which constantly optimises the plant operation to deliver the lowest cost of electricity.

GEMS makes optimal decisions in real-time to maximise efficiency and minimise cost. Each calculation performed by GEMS adds to its bank of knowledge and is used to perform the next calculation, making it progressively smarter.

In addition to processing the data from the actual conditions experienced upon the island grid, GEMS incorporates load and weather forecasting alongside artificial intelligence machine learning. The combination of real and forecast data is thus progressively honed to produce increasingly optimal results.

GEMS, a fully automated machine learning control system, offers a new tool for operators that will help them ensure that all critical assets in a power system are kept running at optimal performance for maximum benefit via onsite and remote operations, with controls that can be set manually if needed from a single user-friendly interface. GEMS will maintain the health of the batteries, as well as provide grid control functions; and monitor, control and optimise the plant operation, along with aggregating all plant data for maintenance support and root cause analysis when necessary.

Wärtsilä's GEMS Power Plant Controller also conforms to the highest cybersecurity standard, IEC 62443, ensuring best practices in communication and access security. With GEMS cybersecurity, all network traffic can be monitored for incident investigation, and restrictions can be defined to allow secure access, while ensuring the safety protection of the hybrid plant operations.

## FUTURE-PROOF CORNERSTONE

The power plant is expected to move into full operation in spring 2022, with the integration of all the island's generation assets into the Wärtsilä GEMS control system carried out from then onwards. From the moment the new hybrid plant comes online, VIWAPA and its customers will benefit from reduced operation costs and improved reliability and service quality.

"The Wärtsilä engine generating units will be critical to the Virgin Islands Water and Power Authority's ability to maximize the full potential of its recent conversion from fuel oil to LPG as the primary fuel source. The Wärtsilä power plant will be a cornerstone in providing not only reliable and highly efficient power generation, but in making more affordable electricity available to our customers," said Lawrence Kupfer, WAPA Executive Director and CEO.

The beauty of this story is that it doesn't end there. The Virgin Islands, as elsewhere in the Caribbean, have a huge potential for increasing their renewable wind and solar capacity. The combination of flexible generation, energy storage and intelligent asset management means that the infrastructure is in place for the islands to take more steps towards a renewable, resilient, and reliable energy path.

*Related: LPG taking fuel flexibility to the next level.*

## ABOUT WÄRTSILÄ ENERGY

***Leading the energy transition:***

*Wärtsilä leads the transition towards a 100% renewable energy future. We help our customers in decarbonisation by developing market-leading technologies. These cover future-fuel enabled balancing power plants, hybrid solutions, energy storage and optimisation technology, including the GEMS energy management platform. Wärtsilä Energy's lifecycle services are designed to increase efficiency, promote reliability and guarantee operational performance.*

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SCHWEITZER ENGINEERING LABORATORIES

# COLLABORATING ON ENERGY SOLUTIONS: OPPORTUNITIES FOR CANADA AND THE CARIBBEAN

*Located in Nova Scotia in eastern Canada, Sustainable Marine provides coastal and nearshore renewable energy solutions by harnessing the tides.*

Canada


*Diversity and inclusion are in Canada's DNA. The Climate Ventures team fast-tracks early-stage innovators developing and implementing solutions to the climate crisis.*

Canada - a huge, snow-covered country full of polar bears and moose. What could it possibly have in common with the Caribbean, known for beautiful beaches, coral reefs, and coconut groves? Looking beyond these stereotypes, there are more similarities than you may think, particularly since both regions are now on a journey of energy transition, working to reduce their dependence on fossil fuels and move to cleaner energy systems.

Canada has an economy which has historically been reliant on natural resources, with oil and gas extraction and mining playing major roles. While Canada is working hard to decarbonize these industries, which is key to the global transition to clean energy, there is a real threat of stranded assets against changing global trends. Likewise, the Caribbean, which depends heavily on fossil fuel imports, is conscious of the volatility of that market and the urgent need to transition to low carbon and renewable energy.

Electrical utilities in the Caribbean and in Canada are facing ubiquitous challenges in their transition from centralized, carbon-heavy grids to decentralized, renewable systems. How should intermittent supply be managed? How should multiple energy sources be brought to the grid and their use optimized? How can efficiency be fostered, both in demand and supply? How can an energy system that is resilient to extreme weather events be built? With a history of friendship and understanding, it is cogent to consider how Canada and the Caribbean can continue supporting each other in addressing these challenges.

The close collaboration between Canada and the Caribbean in the Renewable Energy drive is evident in the development of projects across the region, including solar installations, battery energy storage systems, microgrids, energy efficiency programs, automation of substations, bioenergy projects, and efficient street lighting, to name just a few. This proves that there is continuous leverage of the best of the Caribbean Energy potential and local industry, and the technology and expertise of Canadian partners.

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***"Canada has given the cleantech industry a great environment to experiment, discover, and grow. We have an amazing pool of talent and innovators, along with the investment to accelerate solutions. However, great ideas need to be shared, and we have a generation of companies now with proven products and services that can be adapted across the world. I'm excited for the future of our cleantech companies and am confident we'll see their solutions make an impact globally."***

*- Jeanette Jackson, CEO of Foresight Cleantech Accelerator Centre.*

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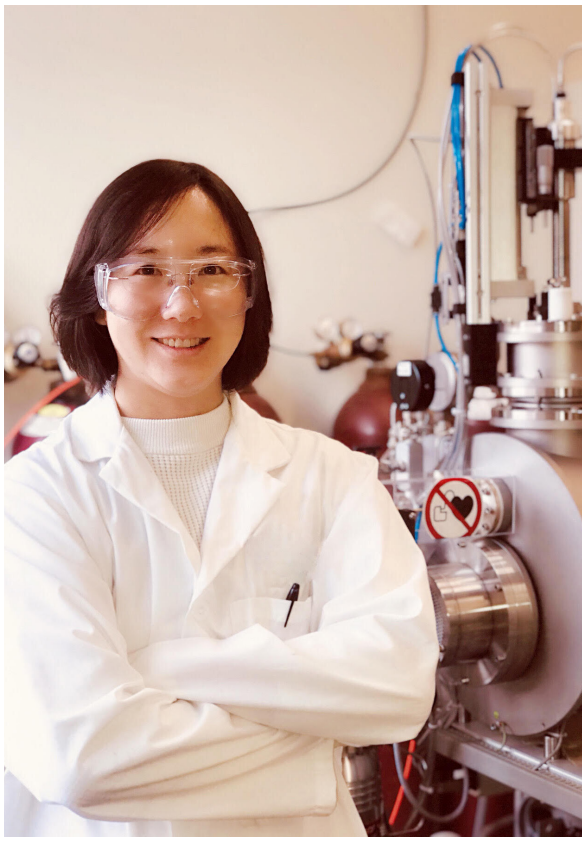

*Canada is a world leader in science and technology with strong commitments to innovation and collaboration. Nanode Battery Technologies is developing high performance rechargeable lithium-ion battery anodes.*

Moving forward, there will be significant opportunities to keep deepening these strong ties (for reference, the sector is expected to grow by almost 50% by 2030 in Canada); this article aims to explore some of them:

As more intermittent power sources come online and Climate Change accelerates extreme weather events, the need for back-up energy supply will continue to grow. The Caribbean knows this firsthand, with an increasing share of renewables in the energy matrix and being at risk of disruptions every hurricane season. In Canada, where wind and solar are the dominant sources of new capacity, representing two thirds of new generation capacity additions since 2009, and wildfires and winter storms are becoming more frequent; there has been an uptake in battery backup power and energy storage solutions, capable of providing grid, commercial and residential scale backup power.

A combination of renewable generation and storage –stand-alone or grid-connected can be set up as a self-sufficient micro-grid, particularly suitable for island-scale operations, recovery after natural disasters and increasing the power system's resiliency. This has been the case in places like Prince Edward Island in Canada and Ragged Island in the Bahamas. The Ragged Island project combines Canadian and Caribbean expertise and investment, delivering a PV and storage system that will meet 95% of the energy needs for the island community.

Canada and the Caribbean share the need to provide power to remote communities, in locations that are difficult to connect to the grid. In Canada, there has been a lot of progress made on cost-effective energy storage, net-zero developments and microgrid solutions, to support remote communities that otherwise rely on diesel generators. It must be noted however, that remoteness is not the sole reason for reliance on diesel generators in the Caribbean.

Canadian remote communities have also pioneered the rethinking of energy business models. In the Yukon, indigenous communities have partnered with the local utilities to own and operate new solar projects. Under this model, the community will benefit from their own efficiencies and smart management. This progressive, non-engineered solution requires trust and collaboration between the community and the utility and is a successful model that can be replicated in the Caribbean.

Another key opportunity for growth is the development of software to support the automation of energy systems. On the demand side, this begins with the task of understanding the complexities of energy use, so utilities can be more efficient with the energy already supplied. The collection of energy use data is a challenge, particularly when using outdated systems which are not fit for this specific purpose. Several Canadian companies have designed software package solutions that capture energy use data for commercial or domestic buildings and translate this information to identify opportunities for low-carbon building improvements.

Chris Tumpach, CEO of Rainforest Automation, points out the importance of real-time information when managing grids, particularly for smaller grids with reduced capacity, such as island grids. "When

***"Canada has a relatively small domestic market, and so Canadians are well set up to work overseas. Perhaps more than in other countries, we understand the need for flexibility. We don't arrive with one, predetermined solution, and we are ready to partner."***
*- Chris Tumpach, CEO of Rainforest Automation*

you need to control usage on tight grids, it is critical to get some idea of the usage patterns, and to share that data not only with the utilities, but also with customers so they can start to manage their own energy use. It's about empowering consumers to play their role in energy efficiency."

The next step is to empower utilities to analyze the system on their own terms. Grid management software can also optimize energy efficiency and manage demand, while accommodating for the complexity of multiple distributed energy resources. These services are critical to realizing the benefits of renewable energy and ensuring that these assets are optimized, while being flexible to the needs of their service area.

Management of the grid hardware itself has also been an area of innovation. With much of Canada—like the Caribbean—still using overhead lines that can be at risk of equipment failure and outages; grid management and maintenance also benefits from remote monitoring and automation systems. A Manitoba company has developed a safer bushing design that saves energy in transportation and can also monitor and predict bushing failures. This helps to optimize maintenance crews during an outage and is one of those 'win-win' projects with benefits for energy, costs, and safety.

Transitioning to cleaner energy is not a matter of just plugging in new supplies. Renewable energy systems are most effective when connected to smarter grids that can understand usage, optimize intermittent supplies, and manage peak loads and storage. This transition from a traditional, centralized grid, to a non-linear, distributed grid requires redefining grid management. Canadian companies have the skills and experience to bridge this gap.

If the pandemic and climate change have shown us one thing, it is that the solutions for global, system-wide problems do not arrive pre-designed in a box; complex challenges need custom solutions. In Canada, these challenges are set against an inherent entrepreneurial spirit and a government that is investing in innovation and a clean economy. This means that Canada now has one of the world's most competitive cleantech industries, with 12 Canadian companies included in the 2020 Global Cleantech 100, an annual roster of the world's top 100 companies in the field. It is an ecosystem of small, dynamic firms that thrive on working with the buyer to build bespoke solutions; an exciting and valuable network to be connected to.

As Canada continues along its own path of energy transition, many of the associated challenges will resonate with Caribbean organisations. Climate change does not stop at borders, and the need to decarbonise energy is a shared global problem that is too big to tackle alone.

If you would like to engage and partner with the thriving ecosystem in Canada, your first step should be to contact the Canadian Trade Commissioner in your market or JuanPablo.Forero@international.gc.ca. The Canadian Trade Commissioner Service is a key resource for anyone interested in doing business with Canada and we are ready to help you start a conversation about your energy systems. We can also connect you with strategic procurement, investment, innovation, or education partners in Canada. Such challenges at this scale need collaboration, and Canadian organizations are ready to take action.













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# EFFECTIVE CORPORATE COMMUNICATIONS:

# A Powerful Resource in the Renewable Energy (RE) Transition

*By Karen Piper*

*Communications and Disaster Management, Assistant Manager at CARILEC*

Renewable Energy (RE) has been termed as the fastest-growing energy source in the United States, having increased by 100% within just under two decades (between 2000 to 2018)[1]. Also noteworthy is that in 2019, RE jobs soared to 11.5 million globally, led by solar photovoltaic (PV), recording approximately 3.9 million jobs[2]. In the Caribbean context, most countries disproportionately depend on imported fossil fuels for electricity generation. Currently, petrol products still account for over 80% of the Caribbean's primary energy consumption. A large share of its power generation stems from fossil fuel imports, exposing the region particularly to fluctuations in global

1 Centre for Climate and Energy Solutions, Renewable Energy (2020)
2 International Renewable Energy Agency, Renewable Energy Jobs Continue Growth to 11.5 million Worldwide (2020)

oil prices[3]. Several Caribbean countries spend up to 10% of their GDP on imported fossil fuels. Consequently, Caribbean electricity costs are four (4) times higher than those of the United States; therefore, the region's imported-oil dependence places a heavy burden on its governments and citizens[4].

It must be noted that while RE is cost-competitive and often cheaper in its generation as compared with conventional fuel for power supply, RE's intermittent generation (solar and wind power) requires additional investment and the improvement of grid infrastructure and management in the Caribbean. Notwithstanding, RE implementation in the Caribbean would be fiscally responsible, and serves as a means of achieving increased decarbonisation and reducing the impacts of climate change. Accordingly, it is because of these colossal benefits that several energy sector stakeholders, (including independent power producers, electric utilities, governments, regulators, and environmental groups) have long sought to advocate for the transition to RE within the Caribbean region. However, the progress of RE deployment is not only determined by factors related to technologies, institutions, regulation, or finance. Of equal importance is the perceptions and awareness among the key groups who will determine the fate of renewable energy: policymakers; industry leaders; and the public.

On the global front, increased deployment of RE technologies has channeled a debate on the impacts, costs, and required resources needed to accommodate the intermittent generation of RE, without impairing the security of supply and reducing the affordability of energy. The nucleus of this debate is the need to understand the positions and motivations of those opposed to RE advancement. It can be assumed that this opposition may derive from a lack of information or misinformation. Such resistance to the RE transition is further bolstered by the fact that its transition presents imminent challenges, including high initial capital costs and unpredictable energy supply due to intermittent RE. These obstacles are often more glaring to the average customer, than the complex mixture of solutions to be obtained from the RE transition, based on financial, technology and regulatory measures.

Naturally, at the centre of RE advocacy is the communication of the multiple benefits to be obtained from its utilisation. However, given the abovementioned statistics on RE usage in the Caribbean and possible resistance to RE initiatives due to the lack of information or misinformation; it can be said that a review and bolstering of the current communication strategies employed to promote RE transition, would be quite beneficial. Ultimately, an accessible and fact-based discourse is needed to increase the support for proven RE technologies in the Caribbean and beyond.

A welcomed mediator in this debate lies in the form of corporate communications, which if applied effectively, can positively influence RE stakeholders (especially policymakers) to take actionable steps towards its implementation. 'Corporate communications are management functions which offer a framework for the effective coordination of all internal and external communication, with the overall purpose of establishing and maintaining favourable reputations with stakeholder groups upon which the organisation is dependent'[5]. An effective corporate communications strategy requires a favourable corporate image, corporate identity, and corporate reputation.

3 Economic Commission for Latin America and the Caribbean, Sustainable Energy for all in the Caribbean (2016)
4 CARICOM Secretariat, 2017 Energy Report Card – CARICOM (2018)
5 Tench and Yeomans, Exploring Public Relations (2017)

Corporate image can be described as 'the global evaluation (comprised of a set of beliefs and feelings) an individual has about an organisation'[6]. It must be stressed that corporate image is a momentary snapshot, based on a short-term, emotional evaluation of an entity. Therefore, while a corporate communications strategy is aimed at molding an organisation's image into a positive one, an isolated incident can temporarily, but negatively alter its corporate image. Corporate identity refers to 'how an organisation expresses and differentiates itself, in relation to its external stakeholders. It consists of the cues which an organisation offers about itself via its behaviour, communication, and symbolism, which are its forms of expression.' Corporate reputation on the other hand, can be viewed as 'the character background formed based on a long-term and more rational evaluation of the company. It is the longitudinal judgement of who the company is and what it stands for among multiple stakeholders'[7].

It can be said that an organisation forms a corporate reputation through its steady portrayal of a certain corporate image to its stakeholders and audiences, whether positive or negative. Accordingly, communications outputs need to portray the organisation in a consistently positive manner, in order for a good corporate reputation to be formed overtime. Moreover, corporate reputation is also a by-product of corporate identity, given that an organisation can develop its reputation based on its differentiation from other competitors, or lack thereof.

***Simply put, energy sector stakeholders need to strategically incorporate RE deployment policies and plans into their organisational corporate communications plan. The advancement of RE in the Caribbean, or worldwide for that matter, will not be accomplished through stand-alone and ad hoc media statements or occasionally disseminated press releases.***

Where does this fit into the advocacy for RE transition in the Caribbean and globally? In order for an organisation's stance or policy on an issue of national and global importance to be accepted and positively interpreted by its audiences; it has to effectively

6 Ibid.
7 Ibid.

demonstrate that it embodies those beliefs through its corporate image (the feelings and emotions the organisation transmits to audiences through everyday actions and decisions), corporate identity (the decisions and actions the organisation executes, which transmits the perception that it is committed towards a particular cause or fulfilling a specific goal) and corporate reputation (the preceding legacy that permits audiences to positively react towards the organisation's actions and even adopt and advocate towards a similar stance, belief or policy).

Simply put, energy sector stakeholders need to strategically incorporate RE deployment policies and plans into their organisational corporate communications plan. The advancement of RE in the Caribbean, or worldwide for that matter, will not be accomplished through stand-alone and ad hoc media statements or occasionally disseminated press releases. It must be embedded into the entity's corporate identity and culture, in order to become synonymous with the organisation's corporate reputation.

A few actionable steps which an organisation can employ to develop and maintain a corporate reputation which supports the RE transition in the region include: funding RE research and innovation projects, awarding grants and scholarships to RE undergraduate and postgraduate students, incorporating RE and smart energy principles into the its physical workplace or building, consistently educating its audiences on the benefits of RE transition through the publication of newsletters, journals, or white papers, and collaborating with local electric utilities, IPPs, and other energy-affiliated entities on RE advancement initiatives through financial or technical support. Most importantly, these steps need to be paired with a multi-stakeholder awareness campaign, to inform audiences of the organisation's commitment towards RE transition, mirrored through such actions. Then alone will the necessary trust be established between the entity and its publics; a healthy medium through which the correct information on RE transition benefits, costs and impacts can be effectively communicated.

For greater insight on the development of an effective RE transition campaign or communications strategy, here are a few general guidelines. Preferably, these recommendations would be most effective where a solid corporate reputation has already been established by the organisation.

**1. Development of RE campaigns strategies** should be approached as a process with clearly defined stages, to maximise effectiveness and impact;

**2. Partnering and pooling of resources** should be undertaken as often as possible to increase funding available for RE communications campaigns, as lack of funding currently represents a significant barrier to the development of more effective communication strategies;

**3. Pre-campaign research in RE communications** should be quite thorough, aimed at gaining a better understanding of public opinion about RE, more precisely defining audience segments, and the development of specific, targeted communications messages;

**4. Behavioural economics findings** should be utilised in the development of RE communications strategies, to boost campaign impacts on raising awareness, changing behaviours, and influencing attitudes;

**5. More innovative and emotive messaging in RE communications** would prompt more positive responses. For example, a communications campaign can be developed on customers' testimonies of easily visible and profitable initiatives such as small-scale, residential sustainable energy projects (i.e., roof-top solar plants for self-generation and consumption). Active citizen involvement is a prerequisite for the society's willingness to support energy transition and for the further "democratization" of the Caribbean's energy market. This involvement should also encompass the planning and adoption of RE supporting and regulatory frameworks, through multi-stakeholder and public consultation processes, which should also be highlighted as part of the communications campaign;

**Sources**


1. CARICOM Secretariat, 2017 Energy Report Card – CARICOM (2018)
2. Centre for Climate and Energy Solutions, Renewable Energy (2020)
3. Economic Commission for Latin America and the Caribbean, Sustainable Energy for all in the Caribbean (2016)
4. International Energy Agency (IEA) - Renewable Energy Technology Deployment (RETD), Communication Best Practices for Renewable Energy (2013)
5. International Renewable Energy Agency (IRENA), Renewable Energy Jobs Continue Growth to 11.5 million Worldwide (2020)
6. Tench and Yeomans, Exploring Public Relations (2017)
7. The Guardian, What is Behavioural Economics? (2017)

**6.** Ongoing and post-campaign evaluation should be consistently applied for quality control at all stages of the RE communications process;

**7.** Communication strategies should be quite proactive in responding to negative media coverage on RE and ensuring that misrepresentations of the facts are addressed through increased communication with media outlets and platforms.

While the RE transition has made significant developments in the Caribbean and globally, such progress is often curtailed by the lack of information and misinformation on its implications and costs, and general resistance from various stakeholders. Against this backdrop, it is contingent upon energy sector organisations to inform, educate and convince their audiences and society at large, of the importance of RE deployment to regional and global environmental health, financial prudence, and energy reliability. Corporate communications offer a powerful resource which can immensely aid in this instance, if it is used effectively to develop and maintain a good corporate reputation and execute a robust RE advocacy campaign. This may very well be the most impactful and altruistic campaign of our lifetime: we owe it to our people and our planet to act now!

## ABOUT THE AUTHOR

*Ms. Karen Piper is a Communications and Disaster Management, Assistant Manager at CARILEC. She is an avid communicator and public relations specialist, having attained a Master of Public Relation with Merit, at Kingston University in London, United Kingdom. During her studies in London, Ms. Piper worked with reputable organisations such as Metro Bank and the Rose Theater to develop comprehensive marketing and communications campaigns. Prior to this, she completed a Bachelor of Commerce with Honours at McMaster University in Hamilton, Canada. Ms. Piper is also one of only two recipients of the prestigious island scholarship award from the Government of St. Lucia in 2011.*

CARILEC
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# "LET'S BE HONEST ABOUT THERMAL"

*Edited transcript from 2020 Virtual 12th Caribbean Renewable Energy Forum Town Hall Discussion*


As increasingly ambitious renewable energy targets are announced in the Caribbean, the vision for a clean energy transition occasionally minimizes the ongoing role of thermal (fossil fuels). Can solar, wind and storage alone maintain a reliable, resilient electricity grid? How do we make grid upgrades to accommodate increased renewables and provide for greater resiliency during catastrophic weather events? And who pays for it?

Here's an open discussion from different perspectives about thermal: do we need it, how much, and how do we frame it in national energy targets as we transition to increased renewables and other advanced technologies? Ultimately, governments, utilities and other stakeholders need to work collaboratively to develop realistic, practical plans that balance reliability and costs for the integration of renewables in the short- and long-term.

**FEATURING:**

***Murray Skeete,*** *WRB ENERGY, Vice President of Engineering and Regulation, WRB Enterprises, and renewable energy developer WRB Energy. WRB has owned and operated vertically integrated utilities in the Caribbean, owns and operates a 28MWp solar farm in Jamaica, and actively develops solar utility-scale and behind-the-meter projects in many other markets in the Latam region.*

***Edmund Phillips,*** *WARTSILA, Business Development Manager, providing sustainable smart technologies and data analytics for the marine and energy markets.*

***Filipe Pinto,*** *EAGLE LNG PARTNERS, Vice President, Business Development, providing bulk LNG energy solutions.*

***Moderated by Christina Becker-Birck****, CADMUS, Vice President, providing energy expertise in planning, assessment, and policy development.*

**CB: Across the region, countries have set increasingly ambitious renewable targets. How does that impact thermal now and in the future? What is the role of thermal in today's energy market and diversification in the Caribbean?**

**MS:** I would like to start by saying, wearing both hats, as a utility owner-operator and a renewable energy developer owner-operator, I see thermal playing a key role going forward for certainly the medium-term and potentially into the long-term. I say that because renewables and specifically intermittent renewables, which are being developed and certainly front and center in today's market, primarily solar and wind, present enormous challenges for utilities in basically keeping the lights on.

Thermal plays a role. It is going to continue to evolve. Battery storage technology is advancing. But I don't think battery storage technology is there yet for long-term storage. By that I mean, greater than four hours. To make intermittent renewables work at grid-scale and help utilities keep the lights on, we're going to need long-term storage at a reasonable price.

In summary, yes, I see thermal playing a role. What do we mean by thermal? It could be existing liquid fuels, distillate or heavy fuels, or LNG (liquid natural gas). I think either of them will work. LNG could be a very useful transitional fuel if we can solve some of the problems of getting LNG on the smaller islands economically in the quantities that we need.

I see a role for thermal going forward for quite some time. And of course, that will change over time, but it's here for the time being.

**FP:** To Murray's point, let's start with reliability. I think everyone agrees the future, and even the present, includes renewables. Everyone is looking to reduce their carbon footprint. But today, renewables represent intermittent power, and to keep a reliable grid you'll need to have thermal as a component of the grid. A great example existing today is Bonaire. They have 14MW in thermal, 10MW in wind, and 3MW of storage batteries. The system works great, perfect, reliable, utilizes renewables, but it could be even better. The 14MW in thermal is diesel. So conversion to LNG would further reduce their emissions. When we're talking about renewables, the goal is always to reduce carbon emissions, and there's always the division between the environment and the economy. We believe that LNG is the perfect balance because you can have a reliable system that utilizes renewables and thermal while reducing the existing carbon footprint. At the end of the day, we're displacing diesel. It's reducing CO2 emissions by 20-30%, depending upon which fuel is used previously.

**MS:** I'd like to add one more thing. We have heard of all these great, ambitious renewable targets. I don't want to come across as the person who says they can't be reached because without aspirational goals we will never get anywhere. I think everyone needs to take a long, hard look at how some of those targets are going to be achieved. I say this with a degree of caution, but for the politicians to say this is our renewable target, this is what we want to do, I strongly recommend that prior to making those renewable goals, you have deep conversations with not only your incumbent utility companies, but also potential suppliers of technology and potential suppliers of fuels. Try to produce a workable plan. It's going to be unique to each island. Develop a workable plan as to how you are going to achieve these targets. Otherwise, I think we're heading for a situation where we are just going to miss. It's not a case that the system will disintegrate, we're just not going to achieve the targets, and that would be a shame.

**FP:** To add to that, we're primarily talking about the islands in the Caribbean. All of them have been battered and will continue to be battered by hurricanes. While renewables are great, if you don't have a sturdy thermal backup as well, you will most likely be without power often. The resilience of the electricity infrastructure also comes into play with the inclusion and growth of renewables.

**CB: Governments are thinking through how they can achieve their goals with 100% renewable energy, 50% or even 10%. To what extent are the**

**ways you would like to be engaged? In goal setting, there are often interim goals set for solar, wind, or storage. It's less often that we see interim goals set for thermal. Should there be interim goals? If so, from a broad perspective, what types of goals would be helpful and necessary to think about as the energy supply in many countries is shifting over the years?**

**FP:** I think Murray will be better suited to answer this question being on the grid side. However, I think to start, you will probably depend on the existing infrastructure, the existing location, the geographical landscape. There are several things that will affect how fast you can integrate renewables. You can't decide on a number, in my opinion, just because it's a great number. The grid must support the integration of renewables. Consider the economics, can the country afford to have the necessary energy storage to allow for the integration of renewables? Is there enough land available to integrate renewables? There are many things to consider.

**MS:** Yes, you've nailed the issues that we face as a utility trying to develop renewables. Specifically to the question, yes, the goals for thermal are not necessarily the same as set for renewables. Such as, we want X% of thermal energy. I think the goals to be set for thermal are determined by what is the most efficient way and least-carbon-intensive way of providing thermal generation that is flexible and can effectively support the renewable integration that everybody wants and that we're all driving towards.

The goals are not so much to say, okay, we want to put in X MW of thermal generation. It's what do we need to support our program of getting renewables in. We understand that Wartsila supports the philosophy of having reciprocating engines, potentially some working on gas and support infrastructure for renewable development. It's less setting a thermal goal as it is planning. It comes down to long-term planning and how do we support the infrastructure. How do we support our renewable energy development targets?

**EP:** It's only a matter of time that the traditional means of generating, as in thermal, will somehow go away. However, while we state that, a lot needs to happen for that to occur. First of all, there is still no sustainable way to provide balancing or even baseload in a world where renewables now takes over for the baseload. So, while I say the possibility certainly exists for thermal to be phased out, it might not happen in our lifetime, or any time soon, but considering the developments and where the technologies are going, it certainly creates the possibility that renewables will now be the new baseload for the future. Having said that, we have to be careful about how we make such statements. The facts are that today batteries are not enough in an area where you are trying to have huge renewable penetration. We are still seeing as a fact today that without traditional thermal, and for us, we're talking flexible thermal, not thermal planned to be baseload because that's gone. The thermal of the future has to be flexible, with the ability to work with the renewable penetration most governments are planning for the future.

**CB: I'm interested in hearing your thoughts regarding this audience question:**
We need to have thermal; we need to have it be flexible, we need planning, we need to take a holistic view, and decide what is the role of thermal as we're developing large electricity supply diversification plans. If we get to 80% renewables instead of 100%, or even 75%, engines will not be running as much. Is it worth making upgrades today? From your vantage point, looking at assets and how you manage them, how do you consider investments in light of some of the government goals where you operate?

**EP:** Investment in a new thermal plant, typically the design life, is anywhere between 25 to 30 years. So whatever you decide to do now you should be able to hold well with the future. Having said that, it is a big decision, however, it's a need as we see it now. Those are the facts. Yes, you can look toward installing 80% renewable in your system, but please consider the time after the hurricane passes and there is no sunshine or wind, and there is an extended period of no sunshine or no wind, no water, we still need something, to replace that 80% of renewables that just went out of your system. What we're saying today, thermal is still the best option for that because batteries are still not economically feasible to rely on over an extended period of time for storage. We have seen that the more renewables you install, you also need to look at a parallel amount of thermal.

*Content Solar, Jamaica*

You still have to generate that power that's lost from the system for an extended period of time. So, I still see the need for thermal no matter what percentage of renewable you install.

The prices for renewables have come down, so we see more renewable-related projects going in than thermal. However, you still need to have a thermal equivalent somewhere in your system to take up that slack just in case.

**MS:** Edmund raises a good point there because if you were to have a target of getting to 80% renewables, then you've got a situation where if your renewables don't produce for a significant period of time, you need to have thermal backup because there is no long-term, multi-day storage technology out there yet on a scale that we're talking about in the Caribbean. You need that thermal backup.

So now what you've got is an investment in two different types of generation, one of which is not going to be running much under optimal conditions, but nevertheless, be paid for by the consumer. So I think we have to be very careful about how we approach these ambitious targets and phase in renewables. I can give you an example for those people that say for solar, "well, you're only going to be out for a day."

For example, we operate a solar plant in Jamaica. It is budgeted to produce 110 megawatt-hours a day in October. Due to that month's weather conditions, we went for six days and never made more than 50 megawatt-hours each day. Weather happens. If JPS were relying on renewables to provide the energy needed and retired a lot of their thermal plants, it would have resulted in outages. We have got to be practical in the way we approach this and recognize that as the technology changes, we're going to long-term phase out the role of thermal but in the short-term, it is effectively the cheapest way of energy storage. We appreciate that thermal has a carbon impact, we appreciate it has a CO2 impact, but liquid fuels, gaseous fuels are effectively energy storage and are dispatchable immediately. I don't want to come across as being the one preaching for staying on oil or gas or any of the other carboniferous fuels, but I am trying to preach practicality here.

***Planners these days are not looking at the fact that injecting renewables in the system now changes the upgrading profile of the existing plants.***

**FP:** I'd like to bring up another point. I think it's about goals versus timing, meaning if you have a carbon footprint or renewable goal, you can achieve those goals with LNG. You can do waste-to-gas (energy) and have bio-LNG. In some cases, it will have a negative carbon footprint. Or neutral LNG where you're bringing carbon credits offset from the value chain. So if the goal is purely an environmental goal, there are ways to achieve those goals without necessarily going 100% renewables. And, if your goal is purely economic, based on the assumption that the output of renewables is zero, not quite, but let's say that's what it is. The fact is that today it's not economically feasible between batteries and the cost of the solar installation, and reliability. It's just not feasible. Goals and timing come to play in this discussion.

**CB: How do you monetize the cost of thermal and especially in the context where it's not operating as much, or investing in thermal today knowing that ten years from now it may not be operating as much in the future because there's a greater amount of variable renewable energy? How do you monetize it? Who pays for it? Utility-owned? Rate-based? How do you factor in those dynamics and what do you think is the pragmatic approach to take?**

**FP:** A keyword for me in life is balance or compromise. You can't run a utility without compromising, planning for the future. You're not always going to be right. You need to bring in renewables as it makes sense and not set a goal based on a number or a political goal or a banner that looks great to say, 80% renewable by 2035. That's not the way you plan. There are people running models that will understand. This is grid-specific. For this specific grid, what makes sense? How is the grid prepared to take on renewables? What makes sense for the next 5, 10, 15, 20 years? It should not be a plan based on the next year but on the next 50 years. It's all about balancing and coming up with the right plan that will need to be revised every five years.

**MS:** You are absolutely right. Let me cut to the chase, who pays for it? Consumers pay for it. There is ultimately no other source of revenue for a utility company apart from customers. The mandate of a utility company in the Caribbean is least-cost service to its customers. That is a very delicate balancing act between trying to implement the very laudable targets of shifting generation to renewables, while maintaining reliability and doing it at a least-cost basis. The question is very valid. It's difficult to plan and install assets that may require 20 years to amortize the cost of those assets, knowing that in 10 years technology may have completely changed the playing field. I think that's where everyone needs to be on board. Regulators, governments, consumer stakeholders, and utilities all need to be on board and be talking about this and understand what goes into providing reliable electricity service at the least cost.

**FP:** The principle goes both ways. If you're thinking about how you amortize a large investment in thermal today that may not be necessary in 20 years, you also have to think about how you justify spending X amount of upfront now knowing that it won't cover your energy needs for the next five years. You're going to need thermal. How you spend the capital when customers ultimately pay for it is key.

**EP:** You hit the nail on the head. Who pays for this? A couple of years ago I gave a presentation at a conference. The title of the paper was "The true cost of renewables." These are some of the things I was discussing. The customer is paying for this. If you take a holistic view of renewable integration what we're seeing in the industry today is that you have various renewable promoters offering renewables as a least-cost solution. While that can be true, if you look at it as a stand-alone system, installation costs on a dollar-per-kilowatt basis are much lower now, even lower than thermal today. However, to hit the nail on the head here, once you take that installation and put it in your system, then from our view, the right way to assess the impact is to look at it (renewables) on a system-wide basis instead of a stand-alone basis. By that I mean, how does the injection of renewables affect the bottom line to the end-user. This is often overlooked.

Planners these days are not looking at the fact that injecting renewables in the system now changes the upgrading profile of the existing plants. To the negative, now that you have renewables in the system, an intermittent form of generation, then the existing thermal is forced to operate at sub-optimal points. They are forced to operate at points in their operating profile where they are least efficient.

Because of that, again, that affects the overall production costs. From the utility perspective and when viewed with renewables in the system, you'll see the true impact of renewables on the customer. Having said that, what we propose to our clients is that: one, we believe in renewables and we say it and we're doing it. But please take a holistic approach to it. Look at how injecting a certain percentage of renewables in your system affects the overall operation and the overall operating costs of your system. If you do that, the technology of choice will become evident. You will notice that gone are the days where you are installing technologies that are inflexible. It will become evident that you want to look at thermal technology that's flexible. There's no impact with frequent starts and stops. The machine is able to ramp up fast and ramp down very quickly to follow the intermittency of renewables. This addresses technology and planning.

**CB: Filipe, could you shed some light on where you're seeing high demand for conversions to LNG?**

**FP:** Everywhere, globally. In the region we're focused on, any island country, Central America, South America, places dependent on mostly Venezuela-based heavy fuel oils and diesel. If you think about it, all these countries have been stranded for years, depending on diesel or other fuel oils. Even if we were to take aside the environment, which we cannot, just costs alone, it doesn't make any sense. Given the opportunity, every country in the region is looking to conversion as a first step from their current fuel to LNG. Not long ago we were talking internally, looking at the map of the Caribbean, Central America, North and South America, and the countries that have converted and the ones looking to convert. If you look at it, several countries have already converted. There are RFPs ongoing in the region, and then several RFPs ran in the region that went nowhere. One of the conclusions we reached was that those countries that make a decision because they run their models and believe in what they're doing and get a deal to convert, they get it done. Then you see all these RFPs go on for 3, 4, 5, 7 years and go nowhere. To answer your question, I think everyone who is running on LNG today is looking to run on LNG. Or, they have more ambitious goals for renewables so the timing impacts.

**MS:** I want to address a question that came from the audience. It relates to effectively the utilities falling back on the fact that they can pass through fuel costs. I am absolutely an advocate of changing that. I think that's the job of where regulators, utilities and stakeholders can get together and develop much better formulas and much better methods of figuring out how we integrate that thermal generation in the renewable space and not effectively say, the utilities have carte blanche just to fall back on thermal generation and pass the cost on to the customer.

I don't believe that the old-style regulation where fuel costs automatically go through, whatever it is just gets passed on to the customer. That seriously needs to change.

**CB: Final question: when we look to the future, all three of you have highlighted the need for flexibility, holistic planning, and looking at systems in a different way. You've all directly—or indirectly—alluded to the importance of stakeholder engagement. When we look to a more holistically flexible future, what role do you want to play, how would you like to shape the market, and how do you think you could best engage stakeholders to achieve this more flexible, holistic system?**

**FP:** First of all, it's about education. All the market players have a job to educate those who need to make decisions in the next few years. We have observed that while people have great goals and even if we don't agree on the goals, or how aggressive those goals are, the goals are good goals. People are driven by something positive. For the most part, many people making decisions are not educated enough on, or don't fully understand the supply chain, the value chain behind those decisions.

As Murray said, it's going to fall a lot more on the regulator than it will on the government to decide.
MS: I think the key here is to get all stakeholders to fully understand what it takes to provide a 24-7 electricity supply at the lowest possible cost on an island situation where you're not interconnected with another large utility that you can rely on as backup. In my experience over the years that is one area that I think is always underestimated as to what the utilities face in doing their job by multilaterals, consultants, by government, by regulators. They

don't fully understand what goes into everything the utilities do. I do agree, education is the key. As this trend progresses, we're all going to understand a lot more about how it all works together. And how together we can effectively come up with a solution.

**EP:** Basically, I think we need to be truthful from day one. We need to make sure all the necessary stakeholders are at the table and tell them the facts. And, not necessarily, what they want to hear so they could sound intelligent in the media. They need to hear the truth. They need to hear what is realistic. If you look now at what's happening in South Australia, they are having over-generation of renewables in their system. The utility there has the right to automatically disconnect existing rooftop solar to maintain stability in the system. It would have been good if they had communicated early in the process rather than install all the renewables and now educate the customers about that eventuality. From our perspective, as we educate stakeholders, we believe in a hybrid approach. We believe the solutions are all of the above. All we are saying is plan it right, and we believe, take the subjectivity out of it. Don't start an IRP (integrated resource plan) with preconceived results. Before you start the IRP, we believe in letting the model objectively help you strategize your future instead of hindering the model with your preconceived ideas on what you would like to see in the future.

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# HOW WÄRTSILÄ IS LEVERAGING ENERGY TRANSITION OPPORTUNITIES IN THE CARIBBEAN

**Energy transition and digital transformation are two areas that are gaining traction, particularly in the Caribbean, where having resilient infrastructure is key. To learn how one company is helping this region shore up its energy infrastructure, BNamericas interviewed Wärtsilä Business Development Manager Tganni Louisy.**

*Written by: David Casallas*

*Tganni Louisy,*
*Business Development Manager, Wärtsilä Caribbean*

**BNamericas:** Much has been said that COVID-19 has given new impetus to digital transformation, especially in the energy sector. Is this something you've seen in the Caribbean and if so, how is Wärtsilä leveraging this migration push?

**LOUISY:** For a couple years now, we have been focusing heavily on and investing in the delivery of improved digitized offerings and remote services for our energy business partners. Throughout the world, the Caribbean being no exception, the pandemic situation has boosted the need for digital transformation. This has unlocked potential and additional capabilities for us to solve customer cases remotely which has been beneficial both to us and our customers particularly as our energy experts no longer need to travel to site, which allows for quicker and cost-effective problem-solving solutions for both parties. This will certainly be a growing trend.

**BNamericas:** There is increasing talk that energy transition is accelerating, which could lead to an earlier reduction in the use of natural gas as renewable energies make further inroads. Is Wärtsilä prepared for such a scenario?

**LOUISY:** Innovation is at the heart of what we do at Wärtsilä and will be vital for us and as a matter of fact, any organization to remain relevant during this quickly evolving energy transition. We whole-heartedly believe that the solutions we provide our customers should not only be able to address the market demands of the day but also those of the future. It is with this in the forefront of our minds that we took the step of adding energy storage solutions, and by extension, integration and

optimization services to our portfolio and continue to make tremendous strides with our thermal assets in terms of equipping them with the capability to burn most synthetic or potential alternative fuels such as biogas, synthetic methane, ammonia, or hydrogen. BNamericas: What are some areas, for example on the regulatory and legislative front, that need greater attention from Caribbean energy policymakers?

**LOUISY:** Many countries simply have not established a clear regulatory framework which addresses the many new players and challenges associated with the modern power grid. Investors prefer to have a clear idea of the regulatory rules which they need to abide by as uncertainty in the market acts as a huge impediment to investment. Additionally, the need for a robust integrated resource plan has become even more important as countries continue to navigate the energy transition. These integrated resource plans also need to be created utilizing modern methods which allow for appropriate consideration to be given to the current and future grid flexibility needs.

**BNamericas:** Over the past two years, Wärtsilä has secured work in the Bahamas, Barbados, the Dominican Republic and the US Virgin Islands. What other markets in this region is the company looking at?

**LOUISY:** The entire Caribbean region has been and remains a priority for Wärtsilä, from Suriname and Guyana in the south to Belize in the northwest. However, a market which looks poised for some significant investment and transformation in the near to medium term is Puerto Rico. Not only is there a clear need for significant additions of renewable generation but complementary flexible assets will be required to fully unlock the potential of these renewables and to achieve a truly reliable and resilient grid.

**BNamericas:** What existing and new products, services and technologies does Wärtsilä plan to further roll out in the Caribbean?

**LOUISY:** Our flexible solutions will continue to play an essential role in the various markets as they continue to pursue their various renewable and decarbonization targets. There have been some tangible developments on the LNG front with a few suppliers appearing to have solved the problem of delivering relatively small cargos in an economically viable manner. This is quite significant for the region, especially in the smaller markets where liquid fuels remain prominent. There also appears to be a better understanding around not only the technical benefits of energy storage, but also the very attractive business cases enabled by the technology, so we expect to see a lot more uptake on that front.

***"Innovation is at the heart of what we do at Wärtsilä and will be vital for us and as a matter of fact, any organization to remain relevant during this quickly evolving energy transition. We whole-heartedly believe that the solutions we provide our customers should not only be able to address the market demands of the day but also those of the future."***

*- Tganni Louisy, Business Development Manager, Wartsila Caribbean*


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# DUANE MORRIS IS PROUD TO SUPPORT THE CARIBBEAN ELECTRIC UTILITY SERVICES CORPORATION (CARILEC)

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# THE SUSTAINABILITY BALLAST FRAMEWORK FOR DESIGN OF REMOTE ELECTRIFICATION

*Niebert Blair, Susan Krumdieck and Dirk Pons*

Abstract: The UN sustainable development goal No 7 aims to achieve affordable and clean energy for all, but this is not yet achieved for approximately one billion people in remote communities. Small scale systems can provide benefits, but existing approaches are primarily top-down approaches that are developed by experts, and focus on the electrical engineering, economics, and policy aspects. These are not always successful, because the sociological aspects are overlooked. A new approach to addressing remote energy development is required that better addresses the societal component. The objective was to develop a conceptual framework whereby the sociological values of indigenous communities were better included in electrification decision-making. A grounded theory approach was used to interview members of a rural indigenous community and identify key features of their world view. Several categories of values were identified, referred to as 'ballasts'. The idea of balance between these was a strong theme that emerged from the community discussion. A composite index was then constructed. Case study results are presented for a remote rural Amazonian community, Kabakaburi in Guyana. Nine sustainability ballasts were identified as part of the indigenous community's world view: biological capacity, social capacity, autonomy, equity & equality, electric utility, health, education, communication, and products and services. This paper develops a new framework to include the values and world-view aspects of indigenous communities in electrification decision-making.

## 1. Introduction

There are four aspects to rural electrification: government policy for uplift of community, economic rationale, electrical engineering, and compatibility with society.

Regarding the social uplift component, the UN Sustainable Development Goals represent the collective objectives for the global economy to "achieve a better and more sustainable future for all" as expressed by 193 signatory countries[1].This assumes that electrification will result in better quality of life and economic utility[2 3]. Hence, there is a policy-making aspect to remote electrification[4 5].

The economic model for remote power engineering projects is that the access to electricity will generate economic development[6]. The expectation is that the capital costs will be met by the Clean Development Fund or other mechanisms, which the community will use to develop their economy through access to electricity, and the residents will then pay for the electricity costs and equipment maintenance[6 7].

However, the electrical engineering aspects of delivering on government policies in developing countries are extremely challenging when attempting to provide electricity to the hinterland communities who are beyond the technically and economically feasible reach of the grid[8].

SDG-7 Affordable Clean Energy, which is the delivery of affordable, reliable, sustainable and modern energy services for all by 2030 and a just, inclusive energy transition[9], [10], is a particular challenge for the power utility engineers tasked with delivering services to indigenous people living in remote communities[11 12].

Historically the effort has been on design for micro-grid and sustainable micro-grid, and a large literature has emerged on technological innovation[13 14] and electrical engineering[15 16]. Engineers working in non-governmental organisations, government remote electrification departments and local utilities select and install robust technologies like hybrid RE, diesel generator micro-grids and, more recently, solar-battery-light household systems. Most of these implementations are well-intended top-down approaches that are developed by experts. They are created in accordance with the acquisitions of loans or grants in a haste to achieve the nationally determined contributions.

Unfortunately the experience is usually that the economic model is naive and the electrical engineering is technologically brittle (poor reliability)[17]. The systems become inoperable and residents do not pay.

The sociological aspects of remote electrification are therefore challenging. This area has received less attention than the policy, economic, and engineering aspects. There is some literature in this area but overall there is need for better approaches to include the societal component in remote energy development.

This paper develops a method to convert world views of remote communities into value systems for electricity, and then link these to their likely economic behaviours. The result is a conceptual framework called the sustainability balance. As will be shown, the sustainability balance has nine ballasts, namely: biological capacity, social capacity, autonomy, equity


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17. Government of India. Remote Village Electrification Programme, 2021.

and equality, electric utility, health, education, communication and products and services. The result is a methodology that balances community capacities with the economics of development goals. This is illustrated with a case study.

## 2. Materials and Methods

### 2.1. Research objective

The objective was to develop a conceptual framework whereby the sociological values of indigenous communities are better included in electrification decision-making.

### 2.2. Approach

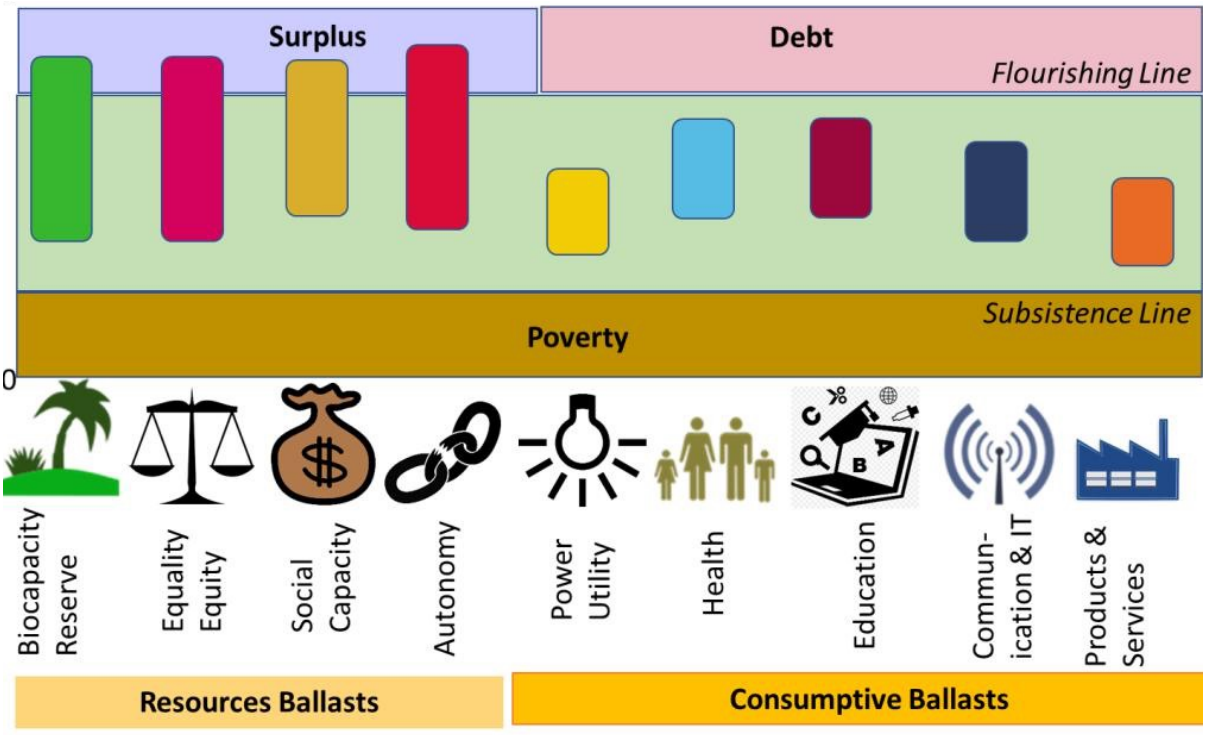
The first stage was to understand the world views of rural indigenous communities, and extract their values regrading electrification. This was achieved using a grounded theory approach. This involved the first author spending time in a rural indigenous community, listening to their needs and collecting qualitative data (N=30 to 40 participants). An unstructured interview process was applied. The community under study was Kabakabura, Guyana.

A set of values were identified using inductive reasoning, and these were validated by holding a 3-day community workshop to acquire a collective response and validation of findings. These values, or categories thereof, we refer to as 'ballasts'.

Also, quantitative data were collected in the form of the energy potentials in the area, and survey information on willingness to pay. A comparative analysis approach was used for the latter. Ethics approval was obtained from the University of Canterbury (HEC 2017/40).

The idea of balance between the values was a strong theme that emerged from the discussion with the indigenous people. Hence, we developed a conceptual framework to integrate them – the sustainability ballast framework. The conceptual underpinning is that these various categories of value need to be balanced. The participants were asked to prioritise the ballasts, which was used to derive numerical weights of importance for each ballast. The number of individual participants was N=28. A composite index was then constructed. This was informed by guideline in [18].

*Figure 1. The ballast theory of sustainability requires that the eight social ballasts and the utility infrastructure remain in the safe range above subsistence, but not overshooting prosperity by incurring unmanageable debt.*

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## 3. Results: The Ballast Model of Dynamic Economic Sustainability

### 3.1.Identification of the nine ballasts

The nine ballasts required to maintain dynamic balance are shown in Figure 1. The social ballasts are organised into two groups; four in which surplus capacity is ideal, and five in which surplus represents overshoot, particularly incurring unmanageable debt. The further characterisation of the ballasts levels followed from the review with the community to adequately translate the data gathered so as to better inform engineering design.

We propose that sustainability logically requires that the results of both enterprise and cultural activities provide for subsistence at a minimum. A community below the poverty line is not sustainable and may fall further into decline.

Bio-capacity is the source of food, water, fibres, building materials and tools. Social capacity provides for care of infants, elderly and infirm, without monetary transaction, but through sharing of goods, tools and labour. Social capacity also includes culture, religion, governance organisation, respect, and shared knowledge[19].

Thus, bio-capacity and social capacity in abundance support resilience and re- sourcefulness that form the foundation for sustainability. Remote residents recognise income inequality and social inequity as a threat to sustainability when the gap between highest and lowest is too large. In the ballast model, large inequality: puts unsustainable pressure on relationships, pushes more people into poverty, while, egalitarianism brings prosperity for the majority. Surplus equity represents a fluidity of benefits between haves and have-nots according to need. This is the type of "giving" economic behaviour observed amongst many indigenous groups[20]. Autonomy is a new idea proposed in this work, and derived from observations made in the case study described in Section 4.

*Figure 2. The village of Kabakaburi located on the Pomeroon River in the North Western Guyana. Top left – the village office and community market. Top centre – the location on the hill where the residents go to get cellphone coverage. Top right – the Angelica church that was established in the 1800s and the primary school which houses 110 pupils and staff. Bottom left – some of the family members in a typical household. Bottom centre – one of the domestic dwellings. Bottom right – local resident displaying the art and craft developed for sale.*

19. Skoufias, E.; Lunde, T.; Patrinos, H.A. Social Networks Among Indigenous Peoples In Mexico: Social Networks Among Indigenous Peoples In Mexico; The World Bank, 2009; [https://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-4949].
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We are including autonomy as one of the four ballasts that can be in surplus in a sustainable society. Autonomy is self- determination and being able to control one's own means of production. The most unsustainable lack of autonomy would be slavery. The condition of poverty of autonomy would be an indentured servant. Subsistence level of autonomy would entail being reliant on some entity outside of the culture for resources or sustenance, but with a good relationship with the providers. Prosperous autonomy would be economic freedom. We tend to think of this in terms of being debt free. But consider the indigenous perspective. Everything they need is available from their territorial bio-capacity or from their own labour, exerted according to their own decisions, in order to produce trade goods to acquire the remainder of their needs from trading partners.

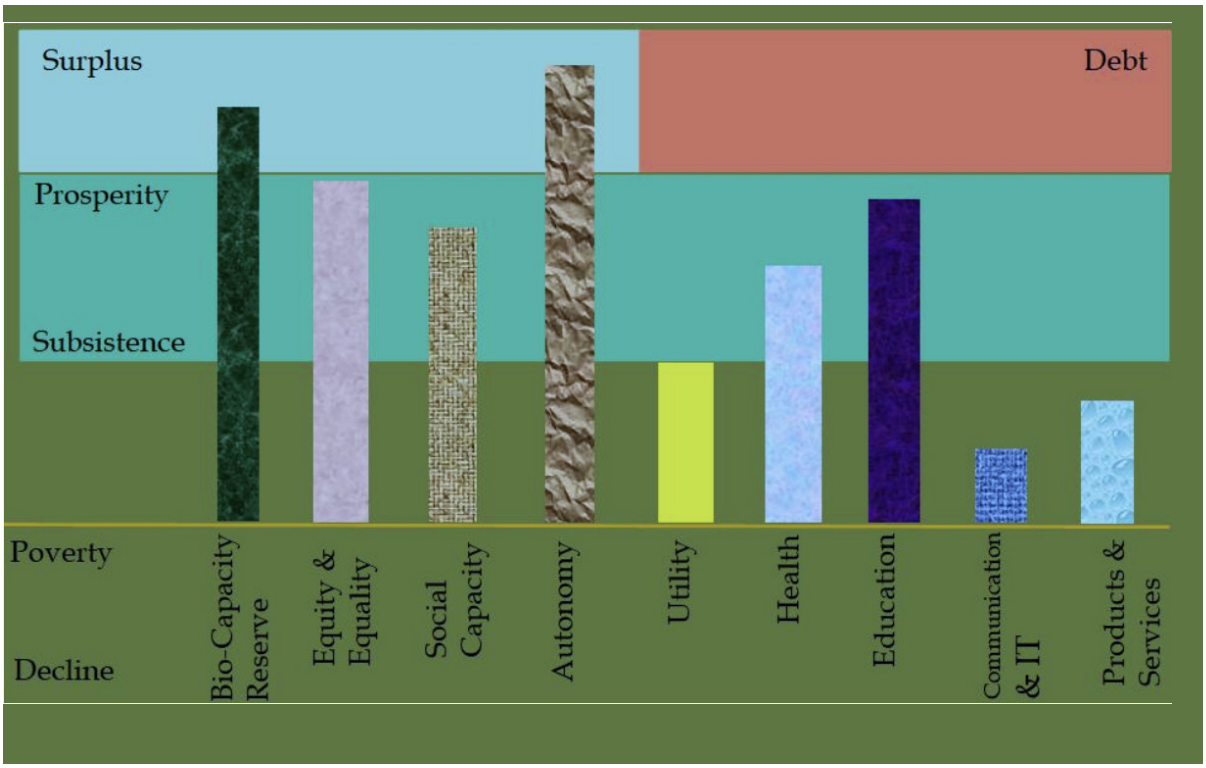
## 4. Case study – Kabakaburi, Guyana

This section presents case study results of the sustainability balance applied to the village of Kabakaburi in Guyana. The sustainability index is established and the scope for development is identified. The assessment also indicates areas for policy, utility engineering design and economic initiatives.

### 4.1. Kabakaburi

Kabakaburi is an Amerindian village that is located on the bank of the Pomeroon River in Guyana. This area is within the Amazonian region. It consists of predominantly Amerindian natives who are the descendants of the Arawak tribe and have been living there for more than 200 years. The literacy rate in the village is about 85% and the human development index is 0.67 [21]. There has been a steady increase in dwellings (114 at the time) and population. The average life expectancy is 68 years [22]. The number of residents per household is approximately 6, and the average age per household is 31 years. Figure 2, highlights the people, activity, and major places in Kabakaburi.

*Figure 3. The ballast theory of sustainability requires that the eight social ballasts and the utility infrastructure remain in the safe range above subsistence, but not overshooting prosperity by incurring unmanageable debt.*




21. United Nations. Human Development Report 2019 Beyond income, beyond averages, beyond today: Inequalities in human development in the 21st century; The United Nations, 2019.
22. United Nations. Annual Government of the Co-operative Republic of Guyana/United Nations Country Results Report; The United Nations, 2018.

*Table 1: The sustainability balance index for Kabakaburi village.*

| No. | Sustainability Ballasts | Indices |
|---|---|---|
| 1 | Bio-capacity Reserve | 0.87 |
| 2 | Equity & Equality | 0.89 |
| 3 | Social Capacity | 0.78 |
| 4 | Autonomy | 0.7 |
| 5 | Utility | 0.5 |
| 6 | Health | 0.67 |
| 7 | Education | 0.75 |
| 8 | Communication & IT | 0.25 |
| 9 | Products & Services | 0.4 |
| **Sustainability Balance Index** | | **0.60** |

### 4.2. Kabakaburi's Sustainability Balance

The development of the sustainability balance is an outcome of the CARES approach presented by Blair et al[23]. The results of the CARES workshops and participatory approach inspired the development of the social ballasts. The ballast assessments as described above were introduced to the residents and presented during a community meeting. The sustainability balance evaluation of Kabakaburi in Figure 3 presents the current condition of the community. This evaluation is a pre-assessment that would form the basis for comparison to any new interventions. Table 1, displays the scores of the different ballasts and the overall sustainability balance index.

### 4.3. Results

The sustainability balance index for Kabakaburi is 0.60 which is within the prosperous operating range between the subsistence and prosperity lines. The low to medium consumptive ballasts have 2 ballasts (education and health) above the subsistence line. Electricity utility is at marginal subsistence while the communication and products & services ballasts are impoverished. The medium to high resource ballasts, social capacity and autonomy are greater and equal to 0.7, respectively and below the prosperity line. The main areas of surplus are in the bio-capacity and equity/equality. The community is debt free and shows no sign of decline.

The communication ballast was the lowest since they were no reliable telephone services in the area. In addition, they were no large scale manufacturing or industries available locally, nevertheless, the supply of income was addressed by residents leaving the community to take up jobs in towns, cities and overseas. While every home except for new builds had solar PV systems and a small generator the village did not have a small operational mini/micro grid system that could allow for reductions in energy supply cost compared to the individual power supply systems that existed.

The ballast presented here can further inform the remote electricity engineering design process which can help in the implementation of appropriate mechanisms for sustainable, remote electricity development that can provide for an improved standard of living.

## 5. Discussion

The ballasts system points out a range of conditions where investment may be most beneficial and how

23. Blair, N.; Pons, D.; Krumdieck, S. Electrification in Remote Communities: Assessing the Value of Electricity Using a Community Action Research Approach in Kabakaburi, Guyana. Sustainability 2019, 11. Multidisciplinary Digital Publishing Institute: Basel, Switzerland https://www.mdpi.com/2071-1050/11/9/2566 accessed 1 June, 2019, doi: 10.3390/su11092566.

the donations or foreign interventions into the remote human development may find common ground with the residents and succeed. The adoption of the sustainability ballasts for policy makers, government economists and electrical engineers will result in a change in the way these professionals conduct their work. For policy makers more consultation with the community will be necessary to understand the resident's perspectives so that financial allocations will go into systems which the citizens will be able to support in the long term. Engineers will need to become more multi-faceted/ multi-disciplinary and open to understanding, relating and translating local residents desires and aspiration into tangible devices and systems that will not incur unmanageable debt in remote villages. Economists may have to rethink the non-tangible measure of wealth similar to such measures of remote residents happiness, well-being [24] and resilience to natural disasters and climate change.

This research reinforces the need for an all inclusive approach by developing countries' governments, economists, policy makers, engineers and remote residents to ensuring that the remaining communities that have no access to electricity will have affordable, sustainable, modern and reliable energy services by 2030.

## 6. Conclusion

We learn why the projects fail because they refuse to assume the economic practices in the developed world. The remote residents way of life supports them providing for their basic and essential needs. Electricity, education, health, communication and productivity in a remote community will continue to demand expensive capital investments. The operational upkeep of these systems is often jeopardised due to lack of motivation for operating in a regimented manner as their urban counterparts. This paper does not present a solution to making remote residents pay for development services, however, it highlights why residents will continue to avoid payment of rents for top-down installations and how a new method for remote development through a the sustainability balance can be beneficial especially if donor organisations can coordinate the grants and have local community involved in the development discourse prior to implementing programs.

Since the sustainability balance originated from the remote residents participation, it will be empowering if similar exercises can be done when planning project development initiatives. This suggestion is made to facilitate more local involvement so that ownership and responsibility of the system can remain with the community and support local autonomy. In addition, the participation from the community can inform changes and provide efficient techniques. Altogether, the sustainability balance provides a plan and check process in the project roll-out since the assessments can be completed before and after the implementation.

The novel contribution of this paper is the development of an alternative framework, whereby the values and world-view aspects of indigenous communities are better included in electrification decision-making. The sustainability balance is a tool for policy makers, economists, local residents and engineers to co-design a successful remote electrification system that will result in system-level designs for utility services, policy framework and suitable technologies.

**Author Contributions:**
NB developed the conceptual draft. NB provided data for development of the sustainability balance, SK and DP reviewed the manuscript, added sub ideas, and edited. All authors reviewed the final manuscript.

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**Institutional Review Board Statement:**
The study was conducted according to the guidelines of the Ethics Approval committee of the University of Canterbury (Protocol Code HEC 2017/40 28 June, 2017)

**Informed Consent Statement:**
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**Data Availability Statement:**
The data is stored in the College of Engineering, University of Canterbury, database.

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**Conflicts of Interest:**
The authors declare no conflict of interest.

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