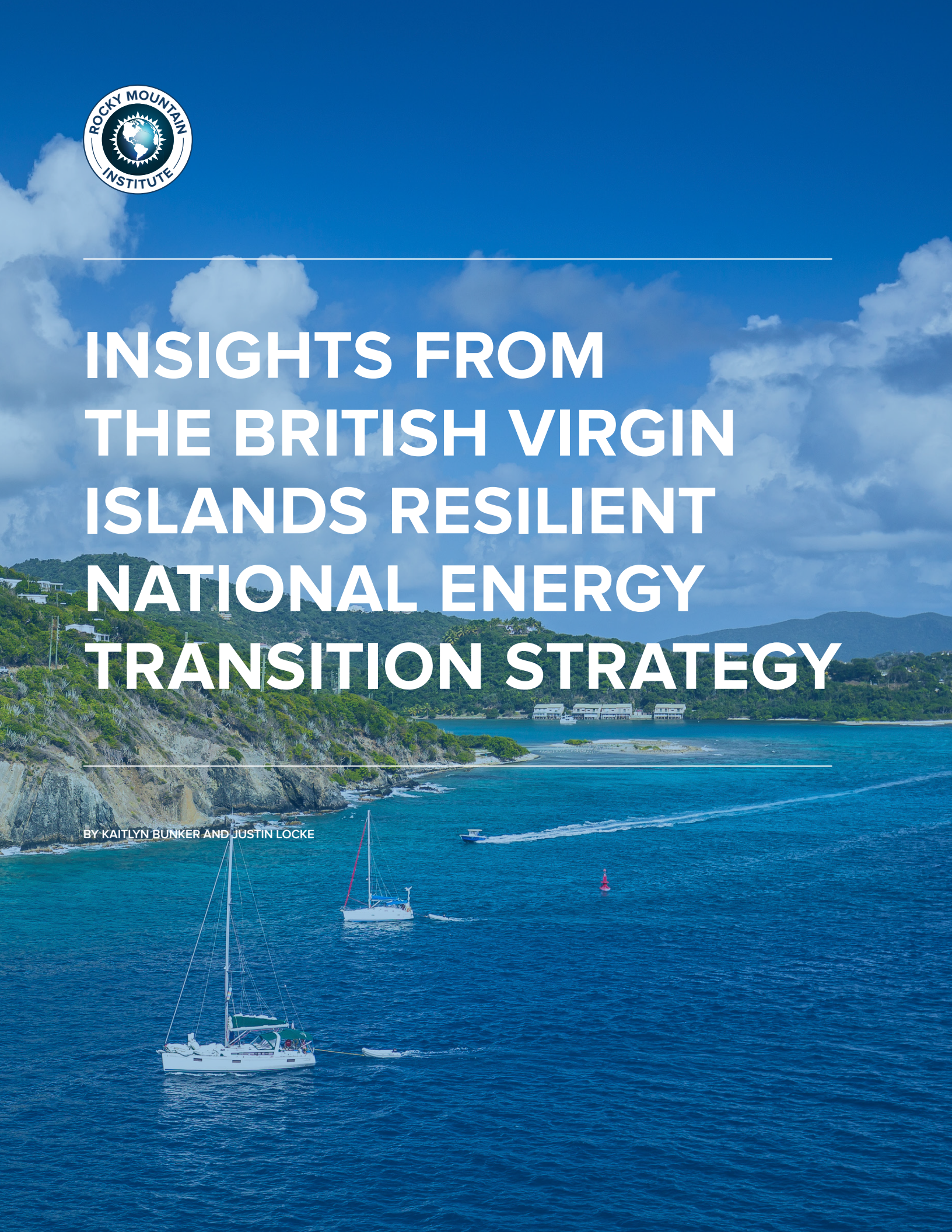

INSIGHTS FROM THE BRITISH VIRGIN ISLANDS RESILIENT NATIONAL ENERGY TRANSITION STRATEGY

BY KAITLYN BUNKER AND JUSTIN LOCKE

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ABOUT ROCKY MOUNTAIN INSTITUTE

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has offices in Basalt and Boulder, Colorado; New York City; the San Francisco Bay Area; Washington, D.C.; and Beijing.

British Virgin Islands ELECTRICITY CORPORATION

ABOUT BRITISH VIRGIN ISLANDS ELECTRICITY CORPORATION

The main goal and objective of the British Virgin Islands Electricity Corporation is to provide the best possible service to its customers, and to aid in the development of the Territory's electrical infrastructure by adequately supplying a reliable and continuous electrical supply to the entire British Virgin Islands population at an affordable cost.

GOVERNMENT OF THE VIRGIN ISLANDS

ABOUT GOVERNMENT OF THE VIRGIN ISLANDS

Regulated by the Virgin Islands Constitution Order 2007, the British Virgin Islands is a British Overseas Territory of the United Kingdom and is located in the sunny Caribbean. It is 59 square miles of land mass which consists of 60 islands, cays, and islets. The four main islands are: Anegada, Jost Van Dyke, Tortola, and Virgin Gorda; with Tortola being the main island and central business district of the Territory. While the British Virgin Islands relies on imported oil and gasoline for nearly all of its energy and transportation needs there is a wealth of untapped renewable energy resources such as solar, wind, and wave. Recognizing this fact and the importance of energy to the Territory's economic and environmental sustainability, the Government has taken steps such as this Strategy to forge ahead with specific energy goals. Wind turbines are already in use and expanding, businesses and homes are incorporating solar energy, and electric cars are climbing the hilly terrain in formidable opposition to the gas-powered car.

R-NETS OVERVIEW

Electricity continues to be a main pillar of economies, both locally and globally. As electricity systems begin to face greater threats of external disruption—including from weather events such as hurricanes and wildfires, and from cyber and other security threats—incorporating resilience considerations with electricity planning will be crucial. Caribbean islands are already tackling this challenge, including defining what resilience means for their communities, considering how to measure resilience in the energy sector, and enhancing the resilience of the electricity infrastructure, as they work toward other important goals like reducing costs. The experience of the British Virgin Islands (BVI) provides insights for the global community on integrating planning for resilience with electricity planning and taking action.

On September 6, 2017, the BVI took a direct hit from Hurricane Irma—a Category 5 hurricane. On September 19, less than two weeks later, the BVI was hit by Hurricane Maria—also a Category 5 storm. The two hurricane events caused widespread destruction across the BVI and minimal loss of lives. While processing their own personal losses due to the storms, local leaders stepped in to guide the BVI through the initial days and weeks, using crucial external support to provide food, water, and shelter to those in need while restoring electricity service where possible.

The devastation caused by the storms offered an important window of opportunity following the immediate recovery efforts to leapfrog from the current electricity system architecture, characterized by centralized diesel generation, to a 21st-century electrical grid using high levels of decentralized energy efficiency and renewable energy (RE).

The BVI electricity system has traditionally used a centralized, fossil fuel-based architecture: a single diesel generating plant provided electricity to 11 islands, including the largest island of Tortola, through transmission and distribution (T&D) lines that were mostly overhead with undersea cables between islands (connected to their own overhead distribution systems). Although the newest portion of the main generation plant (commissioned in May 2017) survived with only a small amount of flooding, the rest of the electricity system took a direct hit from both hurricanes, compounded by a previous flood event, which collectively damaged the older portion of the power station and 90% of the T&D grid, including approximately 12,000 poles, 400 miles of conductor, 2,200 pole-mounted transformers, and 3,500 streetlights. Structural damage to buildings also meant that many electricity users would be unable to reconnect to the grid in the following weeks and months, even if that system had been available. These events highlighted the vulnerability of an electricity system that is highly centralized—creating a single point of failure such that even though the generation plant was not severely damaged, the destruction of the overhead T&D grid meant that no one had access to power.

Andrew St. Hilaire, Acting Deputy Secretary in the Ministry of Transportation, Works, and Utilities, noted that *"transitioning to a more energy efficient environment in BVI began before the dawn of Hurricanes Irma and Maria, and now that the sun has set on the devastation, we are forging ahead to implement more of the transition through LED public lighting, solar farms, wind turbines, and reduction of overhead transmission lines, to name a few target areas—not only for an economical energy bill but for a more resilient infrastructure that can be functional in the wake of natural disasters."*

Leaders in the BVI recognized an opportunity to rebuild in a new and different way. In response, local stakeholders developed the Resilient National Energy Transition Strategy (R-NETS) while demonstrating clear leadership in defining and advancing their own energy transition and providing a blueprint for other communities and countries. The destruction from the storms created the opportunity to accelerate the transition of the electricity system to harness the islands' resources and reflect residents' priorities. The BVI saw the value of a whole-systems approach with multiple key stakeholders involved and embarked on the R-NETS process to pursue an integrated approach to energy and resilience planning.

During the R-NETS process, leaders in the BVI tackled key questions related to integrating resilience into long-term energy planning, including how to best measure the resilience potential of various energy generation options and how to balance resilience with other priorities. The House of Assembly of the Virgin Islands approved the R-NETS in June 2019, making the R-NETS an official government document—and formalizing the government's commitment to move forward with its ongoing transition to an electricity system that meets its shared priorities of being more resilient, reliable, low-cost, sustainable, and locally derived. The R-NETS demonstrates that distributed RE resources will form the future system that achieves these priorities.

This document provides an overview of the R-NETS and several unique aspects of that process, as well as what it means for the BVI—focusing on key takeaways that can inform similar efforts for integrated energy and resilience planning in other locations.

KEY RECOMMENDATIONS FROM THE BVI R-NETS

The R-NETS is a comprehensive plan that identifies clear actions to pursue in order to best balance the shared priorities established by the Government of the Virgin Islands and the BVI Electricity Corporation (BVIEC). These actions include the following:

- **Aggressively pursue energy efficiency**—using the lowest-cost option first to reduce the total amount of electricity that is required in the BVI;
- **Investigate energy storage**—considering energy storage resources to support grid operations as well as critical infrastructure during an extended outage;
- **Expedite regulatory changes**—building on the recently passed legislation to allow consumers to install RE and connect to the grid, and continuing to advance a regulatory framework to enable a quick and inclusive transition to renewable options;
- **Pursue specific solar photovoltaic (PV) projects**—including multisite aggregation to use the space available in the BVI optimally and to bolster resilience by diversifying electricity generation locations; and
- **Investigate the national wind resource**—completing a more detailed review of the opportunity following initial studies that show wind as a promising option for the BVI.

Most importantly, the BVI R-NETS established a common fact base about the state of the electricity system today and opportunities for the future, including the shared electricity sector priorities of the government and utility summarized in Exhibit 1: resilience, reliability, low cost, environmental stewardship, and jobs and industry creation. To understand the joint vision for the future, from both government and utility perspectives of the electricity system, it is important to start with the overarching priorities. In the BVI, as in other islands, there are multiple key priorities that need to be balanced; understanding how these priorities compare to the others gives stakeholders a common language and framework to use in assessing options for informed decision-making. Aligning key stakeholders on the facts of the system and what projects should be pursued ensures ownership in the process, which is proven to accelerate implementation.

EXHIBIT 1

Electricity sector priorities and strategic objectives shared by the BVI R-NETS team

Priority	Strategic Objective
Resiliency	Build a robust electricity system that can withstand, respond to, and adapt to external shocks
Reliability	Improve reliability of electricity delivered by BVIEC
Low Cost	Reduce generation costs
Environmental Stewardship	Increase renewable penetration and energy efficiency savings
Jobs and Industry Creation	Increase job creation and economic development

The R-NETS focused on solar PV projects that are distributed in their location and aggregated together to form utility-scale projects to achieve competitive pricing through economies of scale (these projects could be owned by BVIEC or by a third party that sells electricity directly to the utility). In most locations, utility-scale RE projects are installed in one location, such as a multimegawatt solar PV farm. Adapting to the BVI context—with multiple islands as part of the same electrical system and challenging terrain limiting the space available for large RE installations—required taking a different approach. In investigating the need to distribute RE across multiple locations, the R-NETS team uncovered additional potential benefits of this approach, including bolstering the overall resilience of the electricity system with different generation options in different locations, limiting the possibility of a single point of critical failure to stop the system from operating.

To identify opportunities to best incorporate solar PV within the BVI context, the R-NETS team developed a solar PV tool based on geographic information system data. The tool included both rooftop and ground-mounted solar PV potential. It incorporated hazard information coupled with basic site characteristics such as site size and topography as well as factors that would impact the exposure of a potential installation (such as distance to the coastline and susceptibility to landslides). This information added another layer of consideration—although distributed

generation resources can improve system resilience by eliminating a single point of failure, this hypothesis holds only if those generation resources are designed and installed to withstand external shocks themselves. RMI's 2018 publication ***Solar Under Storm*** discusses the root causes of PV system failures from hurricanes and describes recommendations for building more resilient solar PV power plants. The BVI tool helped identify promising sites that can be investigated further with feasibility studies.

The project opportunities highlighted in the R-NETS will play an important role in establishing initial RE projects in the BVI and will give the utility the opportunity to experience interconnection of new resources at different locations on the grid. In addition, smaller distributed installations at customer sites will be a critical part of the BVI's overall energy transition. Recently passed regulations enable customer-owned generation and establish a process for applying for and then connecting these systems.

UNIQUE ASPECTS OF THE BVI R-NETS PROCESS THAT CAN INFORM ELECTRICITY AND RESILIENCE PLANNING IN OTHER LOCATIONS

Many countries have completed similar integrated energy planning processes, but there were some key differences with the BVI R-NETS that are applicable in other locations as energy and resilience planning become more intertwined. First, it included additional, nontraditional energy stakeholders in the process, and second, it evaluated energy scenarios for their impact on system resilience. Key considerations of these two components include the following:

- **Inclusion of stakeholders beyond the utility and ministry responsible for energy:** Although typical energy planning exercises include these two main stakeholders, the BVI team included other key voices throughout the R-NETS process. Including the Ministry of Natural Resources ensured that other potential uses for land were considered beyond RE development; having two ministries highly involved also helped in the approval process for the final R-NETS. Including representatives from the H. L. Stoutt Community College meant that the R-NETS team had the perspectives of both the stakeholders at one potential site for including solar PV and also the educators who could provide input into training and education opportunities related to the future of the electricity system.
  - **Alignment on priorities:** One of the key initial steps of the R-NETS process which may differ from other planning exercises was to better understand the top energy sector priorities of each of the major stakeholders, and facilitate a discussion to find alignment among the many perspectives at the table to build a consensus of the relative ranking of various priorities. This was especially important to both determine where resilience fits among other top priorities in planning for the BVI's energy future, and to highlight alignment that already existed but hadn't been confirmed among various stakeholders.
- **Evaluation of each scenario's resilience performance, which was the top priority:** The R-NETS evaluated the impacts of each scenario on overall resilience through several metrics.
  - **Diversity of resource mix**—although an external shock may affect one resource, it is less likely to affect all resources to the same extent. Different technologies involve different levels of uncertainty related to price and availability. Diversifying a country's portfolio of generation technologies hedges the electricity system against volatility in price and availability of any one specific technology.
  - **Potential for volatility in operating costs**—separate from the up-front capital cost requirements, operating cost volatility largely caused by rapid changes in fuel prices represents an external shock to the electricity system that can lead to instability in electricity rates or, if costs are not fully passed on to consumers, in the utility's ability to recover its costs. Cost volatility is a function of the amount of diesel used in a scenario and the price of diesel.
  - **Adaptability to changing conditions**—making predictions on which to base decisions is more difficult in a context with a greater number of exogenous shocks. A measure that captures

how easy it is to modify and tailor the selected pathway to changing conditions provides a valuable perspective to assess scenarios. The BVI considered three components of adaptability:

- **Modularity** refers to the flexibility to tailor and modify total technology size to a system's needs.
- **Lead time** refers to the time between the beginning of a project and its completion—commissioning of the generating unit.
- **Diversification of location** refers to the potential to avoid having single points of failure at one location in the electricity system.

These resilience metrics provided a good start for evaluating the BVI's generation options and changed how key decision makers in the BVI think about resilience as it relates to energy. As resilience and energy planning efforts continue together in other locations around the world, there is an opportunity to establish more standard ways to measure resilience in existing systems and in planning for the future.

IMPACT OF THE BVI R-NETS

The BVI demonstrated strong leadership in developing the R-NETS and bringing its energy and resilience planning together through a holistic and collaborative process. In a foreword to the document, former Premier Dr. the Honourable D. Orlando Smith states that "the R-NETS provides the architecture for the future of the electricity sector in the British Virgin Islands." The approval of the R-NETS by The House of Assembly of the Virgin Islands confirms the clear commitment from the Government of the Virgin Islands to carry forward its energy transition in alignment with multiple ministries and the utility company—to build stronger, smarter, and cleaner as it creates an energy system that is more sustainable and resilient.

Read the full R-NETS report here

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For quite some time the BVI Electricity Corporation has had as one of its strategic objectives the diversification of energy production with the Virgin Islands, utilizing renewable energy. A blended mix of energy sources harnessing the natural resources of the sun and wind creates a myriad of benefits such as energy security, cost reduction, and bolstered economic activity for the Territory.

The events of 2017 highlighted the need to incorporate resilience in the traditional Integrated Resource Planning (IRP) process usually conducted by electric utilities, and led BVIEC to transition to the Integrated Resource & Resilience Planning (IRRP) model that we first implemented in partnership with other stakeholders through this R-NETS process.

BVIEC is extremely pleased to have particated in this R-NETS process, which resulted in an agreed and defined strategy which depicts the course to transition the energy sector in the BVI.”

- Leroy A. E. Abraham
  General Manager *BVI Electricity Corporation*

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