Territory ENERGY SECURITY PLAN

TERRITORY OF THE U.S. VIRGIN ISLANDS

September 30, 2024

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PROCESS AND IMPLEMENTATION

This document is the 2023 version of the U.S. Virgin Islands (USVI) Territorial Energy Security Plan (TESP). This TESP supersedes the TESP submitted in 2022. It provides a clear, concise, and comprehensive framework to respond to potential or actual energy emergencies caused by a variety of energy emergency situations. This TESP recognizes the need for ongoing energy assurance and security planning by all departments and agencies within the Government of the Virgin Islands (GVI).

This TESP complies with existing federal, state, and local statutes. It has been approved by the Director of Virgin Islands Energy Office (VIEO) and Director of Virgin Islands Territorial Emergency Management Agency (VITEMA) and will be revised and updated as required. All recipients are requested to advise the Director of VIEO of any changes that might improve or increase the usefulness of this TESP. The VIEO Director, or a designee, is authorized to make modifications to the TESP to reflect changes in responsibilities, capabilities, and organizational structure.

RECORD OF CHANGES

The USVI TESP will be strengthened and enhanced over time as it is activated during energy emergencies or tested during exercise and training activities. In concert with the plan maintenance section, VITEMA, Office of the Governor, and Water and U. S. Virgin Islands Water and Power Authority (VIWAPA) will review this TESP as necessary. Revisions to this TESP will be implemented as needed per the results of post-activation review recommendations, a post-activation Corrective Action Plan, or to correct identified deficiencies.

Each revision to this plan will be numbered and documented. As new versions are created, they will be distributed to participants and will supersede all previous versions. The table below is used to record revisions made to the TESP after the final draft is published.

CHANGE NUMBER	DATE OF CHANGE	SUMMARY AND SECTION CHANGED	RECORDED BY
1	September 2023	All sections	Kyle Fleming
2	SEPTEMBER 2024	Added Risk Assessment Section 5 Updated 2.2.1 Legal Authorities, Roles, & Responsibilities - Now Inlcudes Mutual Aid Plan	Kyle Fleming

Government of the United States Virgin Islands
VIRGIN ISLANDS ENERGY OFFICE

WEB: WWW.ENERGY.VI.GOV | EMAIL: KYLE.FLEMING@EO.VI.GOV

"The goal of Energy Security Planning is to achieve robust, secure and reliable energy infrastructure and a resilient supply chain that enables rapid restoration of energy services in the event of a disruptive event or energy emergency."

Kyle D Fleming, Director

Dear Community Stakeholder,

As Director of the Virgin Islands Energy Office, I am proud the present the Virgin Islands Territorial Energy Security Plan (TESP). This is a historic milestone for the Virgin Islands and a testament to VIEO's commitment to creating a sustainable energy environment within the Territory. The development and implementation of the TESP are important to the Virgin Islands, where we've been evolving our energy profile, and our energy systems have been tested by natural hazards and unprecedented stressors like the COVID-19 pandemic. Additionally, the growth in threats to energy security has evolved, due in part to climate change, cybersecurity risks, and dynamic energy supply chains and markets.

The evolution of the Virgin Islands energy profile and energy security threats present both challenges and opportunities. The TESP seeks to identify both aspects while providing a roadmap for the necessary solutions required to mitigate the effects of adverse scenarios. The development of the original TESP was nearly a twelve-month cycle of stakeholder engagement, tabletop exercises, research and data collection. The result of this effort is the foundation of a living document that will continue to evolve in line with the increased energy security risks the Virgin Islands face on an annual basis.

The Territorial Energy Security Plan is also a testament to the absolute necessity for collaboration to holistically address the challenges of resilience and disaster recovery. I would like to thank all stakeholders who have provided the insight, data, feedback, and perspectives found within the TESP and the teams involved in creating the plan.

On behalf of the Virgin Islands Energy Office, I would like to thank U.S. Department of Energy for the opportunity to develop a critical resource that aims to serve the best interest of the Virgin Islands for decades to come.

Sincerely

Kyle Fleming, Director

EXECUTIVE SUMMARY

The Territorial Energy Security Plan of the U.S. Virgin Islands (TESP) is a functional annex to and incorporates the guidelines identified in the 2019 Virgin Islands Territorial Emergency Operations Plan (TEOP) for Emergency Support Function (ESF) 12 – Energy, updated in 2022. The TESP provides a framework for how the USVI Energy Office (VIEO) will address energy assurance and security before, during, and after energy disruptions. Information included in the TESP was created in reference to the National Association of State Energy Officials (NASEO) State Energy Assurance Guidelines and the U.S. Department of Energy's State Energy Security Plan Guidance.

Table 1 below provides a high-level overview of the VIEO's roles and responsibilities to promote energy assurance. These roles and responsibilities are supplementary to those outlined in the TEOP for ESF-12. Detailed information about these roles and responsibilities can be found in Sections 2 and 4 of this TESP. This TESP: a) describes energy emergencies facing the USVI and parties responsible for preparedness, response, recovery, and mitigation strategies; b) provides an energy profile of the USVI including a detailed description of energy infrastructure and energy supply networks; c) outlines an Energy Data Tracking Plan that provides a roadmap for how the VIEO can collect, monitor, analyze and disseminate key energy supply, demand, and disruption data; and d) provides an overview of planned and ongoing resilience measures designed to protect the Territory from future energy disruptions. The following summarizes each section included in this TESP:

Section 1. Introduction

The purpose of the TESP is laid out at the outset of this document as stated above. VIEO's Director is responsible for ensuring the USVI TESP is maintained and updated. The maintenance of the TESP will be done in close coordination with other GVI departments and agencies identified as stakeholder agencies in this plan; the plan will be reviewed and updated annually and after disruptive events warrant updates.

Table 1. VIEO's Roles and Responsibilities

PRE-EVENT	DISRUPTION	RECOVERY
Engage key contacts along the energy supply and distribution chain Develop communication protocol to gather information from key contacts and disseminate to VITEMA, the general public, and other organizations Develop energy demand baseline for all-Island as well as critical systems and infrastructure Monitor energy disruption indicators	Gather data from key contacts along the energy supply and distribution chain related to disruptions Disseminate pertinent information to VITEMA, the general public, and other organizations Collect energy disruption data to incorporate into Post-Event After Action Report	Gather recovery status data from key contacts Disseminate recovery information to VITEMA, the general public, and other organizations Develop Post-Event After Action Report, updates to the TESP and provide lessons learned to pertinent organizations.

EXECUTIVE SUMMARY

USVI's unique geographical location (a Caribbean island exposed to natural hazards) and dependence on off-Island suppliers for 100% of its nonrenewable energy sources expose the USVI to the risk of energy disruptions associated with all hazards. Though there are many types of threats to which the USVI is susceptible, hurricanes and major storms remain the largest, noting Hurricanes Maria and Irma in 2017 left much of the islands significantly damaged.

Section 2. Response to an Energy Emergency

The USVI is vulnerable to multiple types of natural hazards and human-caused threats that have the potential to cause disruptions in the supply and delivery of energy across the Territory. Hurricanes and major storms remain the largest threat to the USVI energy infrastructure and cause the majority of energy disruptions across the islands. In addition to major storm events, the USVI is at risk of energy disruptions caused by earthquakes/tsunamis, equipment failures, terrorist/active shooter events, cyber-attacks, petroleum price fluctuations and geopolitical upheaval. The Territorial Emergency Operations Plan (TEOP), as developed by the Virgin Islands Territorial Emergency Management Agency (VITEMA), establishes guidelines for how the Territory will respond to emergencies or major disasters.

Response guidelines for energy emergencies are outlined by VITEMA and led by the ESF-12. As noted in the TEOP, the VIEO will work primarily with VITEMA and the USVI Water and Power Authority (VIWAPA) to perform the duties outlined. In addition to the duties assigned to ESF-12, this TESP outlines supplementary roles and responsibilities as they relate to collecting, monitoring, analyzing, and disseminating key energy disruption data. These roles and responsibilities are further described in Section 4, USVI Energy Data Tracking Plan.

Section 3. Energy Profile of the USVI

The USVI relies on imported fossil fuels to meet the vast majority of its energy needs.[1]. Over 90% of electrical and retail fuel demand is met by imported petroleum products and the remaining is met by a small but increasing number of renewable assets feeding the electric grid, including a 4-megawatt (MW) utility-scale solar plant on St. Croix, a 5-MW utility-scale system on St. Thomas, and customer-owned distributed generation equipment spread across the USVI. This includes about 15 MW of systems interconnected under net metering and other additional capacity installed under the current net billing program.

VIWAPA is responsible for generating and delivering electricity to the Territory across two electrical grids: one on St. Croix and one on St. Thomas. Each system is supplied by a primary generation station powered by combustion and steam turbines powered with fuel oil or propane, solar photovoltaic (PV) facilities owned by independent power producers and customer-sited rooftop PV panels. VIWAPA purchases petroleum products directly from foreign sources and this fuel is shipped directly to docks serving the generation stations. This fuel is also used to power USVI's desalination plants to provide potable water to the islands, also owned and operated by VIWAPA.

Commercial fuel retailers either purchase fuel from Ocean Point Terminal (formerly, Limetree Bay Fuel Terminal), which stores and distributes fuel across the Territory, or from off-island sources and sells it to end users. End users include USVI government agencies for emergency vehicles and generators, commercial users, hotels and hospitals, and households for personal vehicles and generators.

[1] U.S. EIA, 2023, "US Virgin Islands: Territory Profile and Energy Estimates," accessed Sep 26, 2023, https://www.eia.gov/state/analysis.php?sid=VQ.

Section 4. USVI Energy Data Tracking Plan

The description of an Energy Data Tracking Plan (EDTP) serves as a framework for gathering, monitoring, and analyzing key energy supply, demand, and disruption data. Although the EDTP is not yet implemented, it provides a roadmap for how to track, monitor, and analyze energy information to develop a baseline during blue sky days and to provide accurate and timely energy information to VITEMA, the general public, and other organizations during and immediately following energy disruptions. The framework also describes how energy disruption data should be collected and analyzed in a Post-Event After Action Report to identify lessons learned that could be incorporated into future iterations of the EDTP and other emergency planning documents.

The roles and responsibilities outlined in the EDTP are summarized in Table 1 and are supplementary to those identified for the ESF-12 in the TEOP.

Section 5. USVI Plan for Energy Resilience

Section 5 summarizes the planned and ongoing energy resilience measures identified in the wake of the 2017 hurricane season. Sweeping changes were identified to help the Territory promote energy resilience. Strategies outlined in this section include grid hardening measures, electrical generation transformation, the development of an integrated resource plan (IRP) and VIWAPA Strategic Transformation Plan, energy efficiency and sustainability strategies, and others.

To complement grid hardening and further energy resilience, WAPA has developed a strategic plan that consists of more renewable energy systems, is less dependent on fossil fuels, and is built around distributed energy resources, to help the USVI move toward a more resilient and secure system.[2]

[2] VIWAPA, 2023, "Strategic Plan," accessed Sep 25, 2023, https://www.viwapa.vi/strategicplan/.

LIST OF TERMS

ACEEE	American Consortium for an Energy Efficient Economy
AMI	Advance Metering Infrastructure
BESS	Battery Energy Storage System
CIKR	Critical Infrastructure and Key Resource
DLCA	Department of Licensing and Consumer Affairs
DOE	US Department of Energy
DPW	USVI Department of Public Works
EDTP	Energy Data Tracking Plan
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	US Environmental Protection Agency
ESF	Emergency Support Function
IRP	Integrated Resource Plan
KWH	kilowatt-hour
LPG	Liquified Petroleum Gas
MW	Mega Watt
MWH	Mega Watt Hour
MOU	Memoranda of Understanding
NASEO	National Association of State Energy Officials
ODR	USVI Office of Disaster Recovery
PA	USVI Port Authority
RICE	Reciprocating Internal Combustion Engine
SCADA	Supervisory Control and Data Acquisition
STP	Strategic Transformation Plan
TESP	Territorial Energy Security Plan
VIEO	Virgin Islands Energy Office
VITEMA	Virgin Islands Territorial Emergency Management Agency
VIWAPA	Virgin Islands Water and Power Authority

1. INTRODUCTION

1.1 INTRODUCTION TO THE TESP

The purpose of this TESP is to describe how the VIEO promotes energy assurance in the USVI before, during, and after energy emergencies. The plan identifies the organizations and departments responsible for each stage of response and recovery; provides a detailed description of the Territory's energy infrastructure and energy supply networks; and provides an overview of planned and ongoing resilience measures designed to protect the Territory from future energy disruptions.

This document outlines the following in pursuit of helping the USVI anticipate emergencies and develop a formalized plan to respond to and recover from different types of disruptive events that can occur in the USVI. The TESP includes the following topics:

- Overview of energy infrastructure and supply networks
- Courses of action and responsibilities during an energy emergency
- Courses of action and responsibilities for long-term recovery and follow-up
- Overview of resilience strategies

1.1.1 Key Premises of this TESP

This TESP is based on the following premises of emergency response in USVI:

1. The USVI Territorial Emergency Management Agency (VITEMA) is responsible for initiating overall emergency response.
2. Each agency is responsible for initiating and following through on its respective emergency response and recovery tasks outlined in the Territorial Emergency Operations Plan (TEOP).
3. USVI's electricity provider, USVI Water and Power Authority (VIWAPA) is responsible for restoring service to the grid.
4. The USVI Energy Office (VIEO) is responsible for collecting and analyzing energy disruption and recovery data before, during, and after energy disruptions and ensuring the data are disseminated to the pertinent parties.

1.1.2 TESP Development Process

The information provided in the original TESP was gathered through independent research and stakeholder interviews with key USVI organizations. The full stakeholder list is provided in Section 1.15. After an initial draft was developed, feedback was solicited via a formalized tabletop exercise and incorporated into the final TESP.

1.1.3 Maintaining and updating the TESP

VIEO's Director is responsible for ensuring USVI's TESP is maintained and updated. The maintenance of the TESP will be done in close coordination with other GVI departments and agencies identified as stakeholder agencies in this plan.

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The process used to develop and maintain the TESP will be based on nationally recognized energy assurance planning principles and best practices. The TESP is designed to be a flexible, dynamic document subject to revision as appropriate. Revisions may result from a variety of sources, policies, or technologies, such as:

- New information provided by stakeholders
- Lessons learned from an actual event or exercise
- Feedback during training or case study review
- To accommodate new organizations, organizational structures, or systems.

Major revisions are considered revisions which significantly alter or establish new policy and will be approved by the VIEO Director and presented to VITEMA. VIEO Director will coordinate quarterly review of the TESP to incorporate suggestions and changes from VITEMA as needed. New versions of the TESP will be disseminated to relevant stakeholders and the current version will be posted on VIEO's website, energy.vi.gov.

1.1.4 TESP Training

VIEO Director in coordination with VITEMA will conduct semi-annual training and exercises to ensure VIEO staff, key stakeholders, and partners are familiar with the TESP Exercise. Improvement Plan(s) and After Action Report(s) will be developed and kept on file by VIEO following each exercise for a period of 7 years to be used for future improvements and updates to the TESP, helping improve processes and procedures. Trainings will be the same for all Territorial agencies.

1.1.5 Stakeholders and coordinating agencies

VIEO coordinated and interviewed 13 Territorial stakeholders to develop this plan. These stakeholders will be instrumental in the implementation of the TESP, as well as updating the plan in future years. Table 2 outlines the stakeholders and coordinating agencies interviewed to develop this plan.

Table 2. USVI TESP Stakeholders

Virgin Islands Water and Power Authority (VIWAPA)	**Department of Finance**
VI Territorial Emergency Management Agency (VITEMA)	**Public Service Commission**
Department of Human Services	**Department of Justice**
Department of Health	**USVI Port Authority**
Department of Public Works	**University of the Virgin Islands Continuing Education and Lifelong Learning (UVI CELL)**
Bureau of Information Technology	**Ocean Point Terminals**

1. INTRODUCTION

1.2 USVI OVERVIEW

1.2.1 Population

According to 2020 Census data, the total population of the USVI is just below 87,150, with 41,000 residents on St. Croix, 42,260 on St. Thomas, and 3,880 on St. John. Charlotte Amalie, the Capital on St. Thomas, is the most densely populated region with roughly 14,477 people.[3] The population decreased between 2010 and 2020, most likely in part due to Hurricanes Irma and Maria in 2017 and residents choosing not to return to the USVI. Figure 1 shows the population distribution among the three islands; these maps can be used to directly correlate the areas of highest demand for energy.

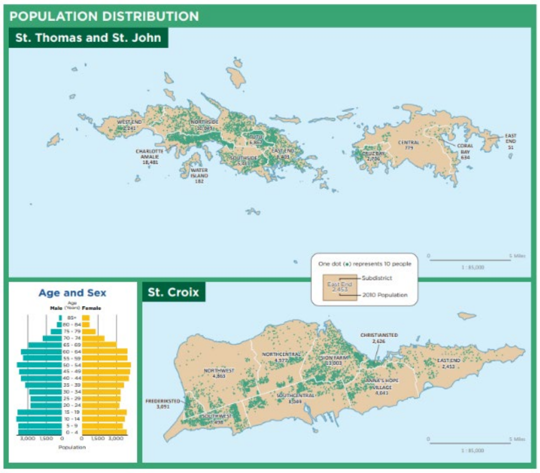

Figure 1. USVI Population Distribution
Source: U.S. Census Bureau, 2010 Census, U.S. Virgin Islands

1.2.2 Economy

The USVI economy is primarily sustained by the tourism industry and government expenditures. Other contributors are a) storing and shipping petroleum products and b) producing and exporting rum. The real gross domestic product (GDP) for the USVI increased 2.8% in 2021 (Figure 2). The size, economic homogeneity, high degree of dependence on international trade, and lack of natural resources with exception of solar and wind energy resources make the USVI economy particularly vulnerable to natural disasters and economic shocks.

The economy's vulnerability to natural disasters and economic shocks can be seen in Figure 3, which shows the percent change of the Real economic growth rate over time (adjusted for inflation) between 2008-2018. The graph shows several external milestone events that have negatively impacted the growth rate. The notable events are the financial recession of 2008-2009, the closing of the Hovensa Refinery on St. Croix spanning 2011, 2012 and 2013, and Hurricanes Maria and Irma in 2017. As an example of the USVI's economic vulnerability to disasters, the USVI 2018 GDP was $3.9b and the cost of the damages from the hurricanes of 2017 was $10.96b.

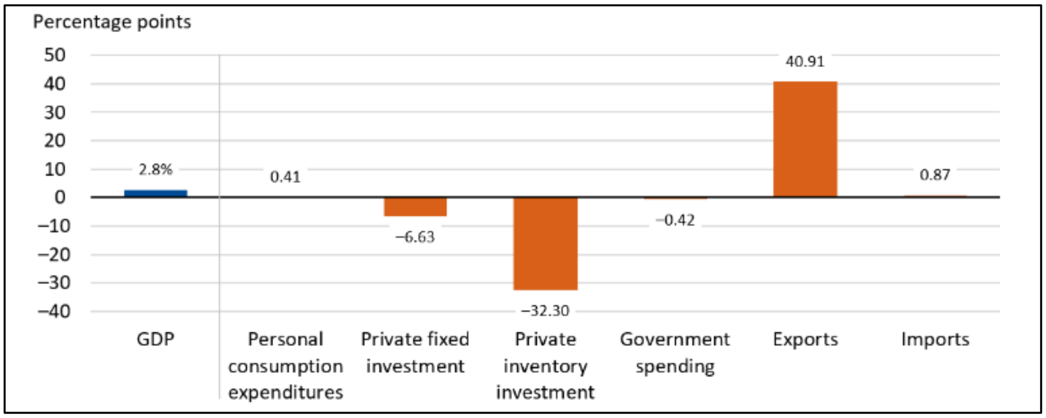

Figure 2. USVI Contributions to the Percent Change in Real GDP, 2021
Source: U.S. Bureau of Economic Analysis, Gross Domestic Product for the U.S. Virgin Islands, 2021

[3] U.S. Census Bureau, 2022, "2020 Island Area Censuses: U.S. Virgin Islands," accessed Sep 26, 2023, https://www.census.gov/data/tables/2020/dec/2020-us-virgin-islands.html.

1. INTRODUCTION

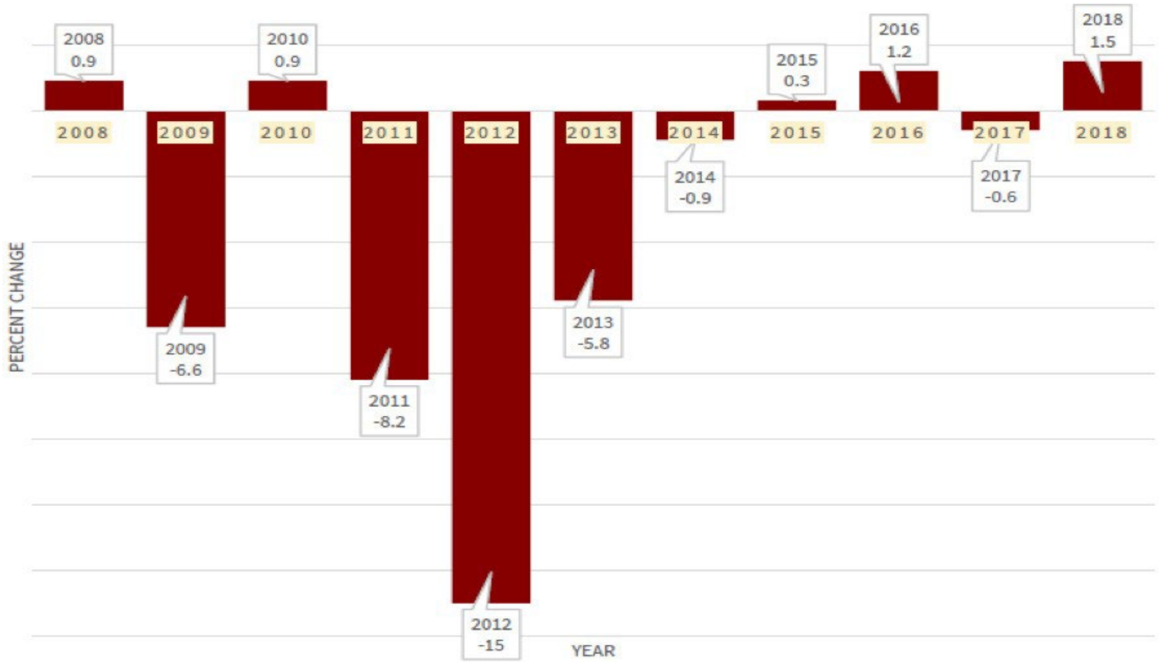

Figure 3. Real Economic Growth Rate (2008-2018)
Source: U.S. Department of Commerce, Bureau of Economic Analysis

PRIMARY THREAT	IMPACT
External - Pandemic – Covid-19	"Recessionary threat posed by the novel coronavirus (COVID-19) pandemic that is dampening international travel and disrupting global supply chains anchored in China and other East Asian countries and threatening to push major economies into recession. "Other risks, such as hurricanes and earthquakes are present but not as concerning as a COVID-19 induced recession.
Internal – Unfunded liabilities to the Government Employee Retirement System, (GERS)	The assets of GERS are being depleted to make payouts to retirees, and the unfunded liability of $4.4 billion exists, which could eventually force a restructuring of the central government debt, after 2023.
Internal – Liquidity of USVI Water and Power Authority	WAPA is facing liquidity problems, a high debt load of $550 million, and exclusion from capital markets.

Table 3. USVI Economy Threats and Impacts
Source: USVI Bureau of Economic Research, *Review of the USVI Territorial Economy 2019*

1. INTRODUCTION

The financial stability of the Territory is dependent on the unfunded liability of the GERS and the debt load of VIWAPA. High volatility reduces investor confidence and contributes to government revenue volatility, which in turn complicates budgeting and heightens the likelihood of fiscal instability and increased budget deficits.

1.2.3 USVI's Unique Geographical Position

USVI is positioned in the Caribbean Sea about 1,100 miles southeast of Miami, FL. It is in geographic isolation from the rest of the United States and, as a result, is heavily dependent on imported petroleum as its primary source of energy. The USVI is highly vulnerable to petroleum supply chain disruptions and shortages that could occur as a result of natural and man-made hazards such as natural disasters (especially hurricanes, tsunamis, and earthquakes), political, economic, or labor actions that effect production or distribution of petroleum, as well as acts of terrorism. These disruptions affect not only the electricity grid and fuel oil for boats and vehicles, but also the public water supply, as petroleum is used to fuel the USVI's desalination plants.

The USVI is comprised of four islands: St. John, St. Thomas, St. Croix, and Water Island, as well as multiple minor islands. The USVI is powered by two main electricity grids that are managed by VIWAPA. Unlike the mainland United States network of interconnected grids, the USVI's unique geographical position makes it highly dependent on shipping and transoceanic cargo for its energy supply and internal fuel distribution.

1.3 WHAT ARE THE SOURCES AND USES OF ENERGY IN USVI?

In 2018, the USVI was 100% dependent on imported petroleum for electricity until 2014 when propane, solar, and wind became more substantial sources of energy.[4] Currently, more than 90% of the USVI's energy is sourced from petroleum, with a small but increasing percentage coming from renewable sources. Renewable sources, particularly solar, are on track to provide a growing percentage of USVI's energy supply. Roughly 80% of USVI petroleum supply is used to power the electricity grid and the VIWAPA's water desalination plants. Retail fuel accounts for the remaining portion, which consists of jet fuel, marine fuel, diesel, gasoline, and others.

1.3.1 Petroleum Supply Chain

The USVI does not produce crude oil and is 100% dependent on outside suppliers for its petroleum supply. All fuel enters the Territory at one of the two main ports, the Container Port on St. Croix and the Cargo Port on St. Thomas. Fuel arrives to St. John by ferry once it has been received by retailers on St. Thomas. It should be noted that there is a large oil refinery on St. Croix, Limetree Bay Refinery, that imports crude oil and refines it to marine grade fuel for exporting. Limetree Bay refinery exports all its refined products to outside markets and produces little to no petroleum products for use by USVI.

1.3.2 Electricity Supply Chain

Electricity is distributed by two separate grids—the St. Thomas system and the St. Croix system—managed by VIWAPA. Interconnecting the two grids is difficult due to the depth of the seabed. Most of USVI's electricity is generated by combustion turbines and reciprocating engine generators powered by fuel oil or propane. An increasing percentage of USVI's electricity grid is powered at solar facilities operated by independent power producers, as well as solar PV installed on roofs of USVI homes and businesses. "In 2009, the USVI's legislature approved a renewables portfolio target that aims to have 25% of VIWAPA's peak demand generating capacity from renewable sources by 2020, 30% by 2025, and increasing after that until a majority of generating capacity comes from renewable energy."[5]

[4] Corrie Clark, Richard Campbell, and D. Andrew Austin, 2018, *Potential Options for Electric Power Resiliency in the U.S. Virgin Islands*, Congressional Research Service, https://sgp.fas.org/crs/row/R45105.pdf.

[5] U.S. Energy Information Administration, 2023, "US Virgin Islands: Territory Profile and Energy Estimates," accessed Sep 26, 2023, https://www.eia.gov/state/analysis.php?sid=VQ.

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WAPA's fuel-powered generation fleet includes newer reciprocating engine generators and combustion turbines, and some combustion turbines that are very old (installed in the 1970s, 1980s, and 1990s).

The St. Thomas system has a generating capacity of about 167 MW to supply load on St. Thomas and St. John. These two islands are interconnected through underwater cables. The St. Croix system has a capacity of about 91 MW. Connecting these two main grids by undersea cable is difficult due to seabed depth. The St. Thomas system has significant capacity reserves (about 178%) while the St. Croix system's capacity reserve is closer to 100%. More information about the USVI's electricity grid can be found in Section 3 of this TESP.

1.4 HAZARD AND THREAT OVERVIEW

The USVI energy infrastructure is threatened by multiple natural and human-caused threats. Table 4 outlines each of the major hazards facing USVI. Section 2 of this TESP provides a more in-depth assessment of each threat.

1.4.1 Energy Emergencies in the Territory

The USVI TESP is designed to address all hazards identified in FEMA'S Threat and Hazards Identification and Risk Assessment (THIRA) and covers the full range of complex and constantly changing requirements in anticipation of, or response to threats or acts of terrorism, major disasters, other emergencies, and events within or affecting the Territory. USVI's approach and focus in this plan is to identify a response plan to hazards and emergencies that can cause both immediate and long-term problems.

Historically, the greatest risk of energy disruption is from natural hazards such as hurricanes and earthquakes—which are compounded by the USVI's aging energy infrastructure. These threats may trigger disruptions in the energy supply chain or energy distribution networks (e.g., power outages, blackouts, and brownouts).

1.4.2 Past Notable Energy Disruptions in USVI

In September 2017, the USVI was struck by two back-to-back storms, Hurricanes Irma and Maria, which were both category 5 hurricanes with sustained winds of more than 156 miles per hour. The hurricanes significantly damaged most of the USVI's electric distribution and transmission lines and damaged several power generating facilities. Hurricanes Maria and Irma left approximately 46,000 utility customers without power amounting to the longest blackout in US history (Figure 4).

Figure 4. Largest Electric Blackouts in US History by Million-customer Hours of Lost Electricity Service

Source: Peter Marsters and Trevor Houser, 2017, "America's Biggest Blackout," Rhodium Group, Oct 26, 2017, https://rhg.com/research/americas-biggest-blackout-2/

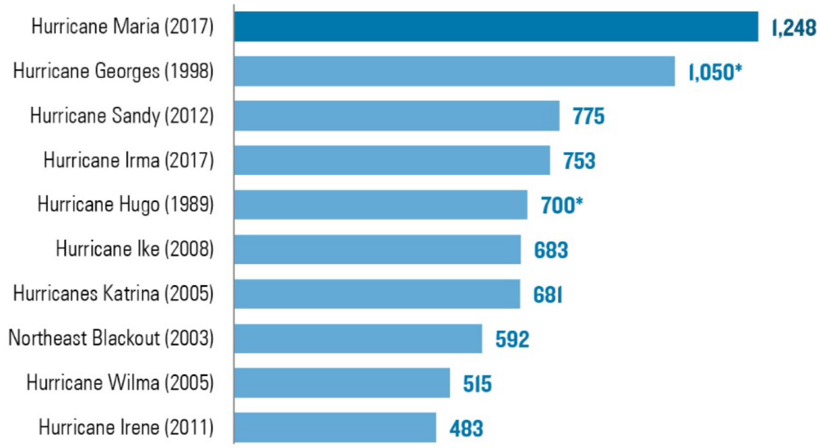

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Table 4. USVI Hazards and Threats Overview

HAZARD OR THREAT	OVERVIEW
Hurricane	Hurricanes pose the largest threat to the USVI grid. The Caribbean hurricane season brings major storms from June to November. "On average, a hurricane passes near the USVI every three years, and one directly hits the islands about every eight years.".[6]
Equipment failure	Equipment failure in electrical generation or distribution infrastructure caused by old equipment, flooding and wind, downed trees, and other disruptions can cause power outages across the Territory.
Earthquake/Tsunami	The USGS estimates Puerto Rico and the USVI's seismic risk "at probability levels of 2 percent in 50 years and 10 percent in 50 years." The last tsunami that hit the USVI was caused by an earthquake in the Anegada Trough in 1867..[7]
Terrorist/Active Shooter	Terrorism and active shooter situations remain an active threat to the USVI energy infrastructure. These threats could be on-island or disrupt the energy supply chain and infrastructure.
Cyberattack	The USVI relies on information technology to manage the electricity grid, making it vulnerable to cyber-attacks.
Hazmat/Chemical Release	VIWAPA LPG storage facilities as well as Ocean Point Terminals are both at risk of large-scale damage should the facility suffer any explosion or chemical weapon attack of any kind.
Pandemic	As demonstrated by COVID-19, pandemics have the potential to disrupt all facets of life. Major pandemic-related threats to the USVI energy infrastructure include disruptions in fuel supply chains, fuel price instability, and economic depression.
Geopolitical Upheaval	The USVI currently receives most of its oil by boat from Europe and South America. Any geopolitical or economic upheaval threatening the oil or shipping industries could disrupt the USVI fuel supply chain.

[6] U.S. Energy Information Administration, 2023, "US Virgin Islands: Territory Profile and Energy Estimates," accessed Sep 26, 2023, https://www.eia.gov/state/analysis.php?sid=VQ.

[7] U.S. Geological Survey, 2019, "U.S. Seismic Hazard Maps – Puerto Rico and the U.S. Virgin Islands, Samoa and the Pacific Islands, and Guam and Northern Mariana Islands," accessed Sep 26, 2023, https://www.usgs.gov/programs/earthquake-hazards/science/us-seismic-hazard-maps-puerto-rico-and-us-virgin-islands-samoa?qt-science_center_objects=0&qt-=.

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In addition to blackouts caused by major storm events, the Territory regularly experiences power outages due to aging infrastructure.[8] Both of VIWAPA's power plants are subject to instability events and can result in several major and district-wide service interruptions.

The toll of constant power disruptions weighs heavily on residents as well as businesses. For example, in 2019 five schools on St. Croix closed early due to power outages.[9] These constant energy disruptions demonstrate the overall vulnerability of USVI's grid and its compounded vulnerability to major shocks like hurricanes.

1.5 DEFINING CRITICAL ENERGY INFRASTRUCTURE

The following section identifies the critical infrastructure that is necessary to maintain normalcy in the daily life of Territory residents, based on guidance from the U.S. Department of Homeland Security's Cybersecurity and Infrastructure Security Agency. This infrastructure should be prioritized first during response and recovery, as prolonged energy disruptions to this infrastructure could cause significant harm to USVI residents. The following provide a high-level summary of critical infrastructure in the Territory:

- Electrical infrastructure
- Hospitals
- Desalination plants
- IT infrastructure
- Transportation infrastructure

Critical Infrastructure and Key Resources (CIKR) Listing

VITEMA maintains a Territory-wide Critical Infrastructure and Key Resource (CIKR) listing in its Fusion Center. The list is shared with FEMA and updated annually prior to the start of hurricane season. Each agency is responsible for verification of and changes to their list.

The specific infrastructure outlined on the CIKR listing is protected, and only authorized personnel are permitted to access this information. Due to the sensitive nature of the critical facilities list and the critical infrastructure protection plan, this information has not been included in this version of the TESP.

CIKR includes critical facilities for agencies within GVI and the USVI Private Sector. The list is prioritized by Tier and is designed to support emergency power/ telecommunications resource distribution and restoration effort.

- Tier 1 – Facilities that are primary or without redundancy that could cause significant damage to the Territory's economic stability or ability to respond to a disaster if they are directly compromised or damaged. Their loss may also affect additional interdependent sectors.
- Tier 2 – Facilities that are more robust in that they may have alternate sites and redundancies that allows them to function at some level of capability.
- Tier 3 – Facilities that are important, but their loss would not immediately impact response operations either by necessity or, while they do not have documented alternate site personnel, facility operations are able to function remotely for a limited time from an alternate location.

[8] Sal Gagliardi, 2019, "Constant Power Outages are Disturbing Life in the US Virgin Islands," *Pasquines*, Oct 1, 2019, https://pasquines.us/2019/10/01/constant-power-outages-are-disturbing-life-in-the-us-virgin-islands/.

[9] VI Consortium, n.d., accessed Sep 26 2023, https://viconsortium.com/VIC/?p=78739.

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Electrical Infrastructure

- St. Croix – Estate Richmond Generating Station
- St. Thomas – Randolph Harley Generating Station

There are two generating stations owned by VIWAPA, one on each island: Estate Richmond on St. Croix, and Randolph Harley on St. Thomas. These two resources provide over 90% of electricity to USVI and are considered Tier 1 critical resources. Electrical generation is supplemented by one utility-scale solar farm on St. Croix and distributed generation provided by solar panels on personal residences; however, these renewable assets, though important, could not be relied on to provide Territory-wide electrical generation in the event of a significant energy disruption at one of the plants. More details about these facilities can be found in Section 3 of this TESP.

Hospitals

- St. Croix – Governor Juan F. Luis Hospital
- St. Thomas – Schneider Regional Medical Center

Hospitals represent some of the most critical infrastructure in the USVI. Their dependency on reliable power can make the difference between life and death. Hospitals must maintain operation during an energy emergency and have redundant measures in place to do so. In addition to patients staying at the hospital, patients staying off-site must be considered as well. Especially sensitive outside the hospital are dialysis patients as they can only go a few days without medical support.

Figure 5. Estate Richmond Generating Station

**ST. CROIX
ESTATE RICHMOND
GENERATING STATION**

**ST. THOMAS
RANDOLPH HARLEY
GENERATING STATION**

Figure 6. Randolph Harley Power Plant

1. INTRODUCTION

Hospitals, by law, are required to keep one backup generator per building, and the USVI hospitals keep two emergency generators per building. As of 2021, the generators are in line to be upgraded. This may be outlined and cataloged in the Hospital Emergency Operations Plan (EOP). As part of the recovery effort, hospitals should identify the priority of restoration in conjunction with generator support from the local and federal government partnership. The US Army Corps of Engineers will be the key federal agency to conduct evaluations and size generator requirements with assistance from VIEO.

Communication restoration is one of the most important components for the hospital system. Historically, VIWAPA has always had a clear communications pathway to the hospitals during emergency events, though particular communications protocols should be noted in the EOP.

The hospital's emergency vehicles are currently contracted as private transport that rely on private access to fuel. The hospitals could set up a direct supplier for transportation fuel as a redundancy in case of emergency. All current memorandums of understanding (MOU's) are for delivery truck and staffers.

Desalination Plants

- St. Thomas Desalination Plant
- St. Croix Desalination Plant

VIWAPA operates two water desalination plants within the power generation stations on St. Thomas and St. Croix. These vital resources provide the majority of clean drinking water to USVI residents. VIWAPA provides electricity directly to the desalination plants with petroleum imported directly to the plant. Residences also collect rainwater through catchment systems integrated into their homes.

IT Infrastructure

- St. Croix Data Center
- St. Thomas Data Center
- 13 tower sites providing Voice Over IP (VOIP)

The USVI Bureau of Information Technology (BIT) manages government data connection and voice communication. These assets are critical to emergency response efforts as they provide the primary platform for emergency communications. Emergency generators are maintained to come online in the event of an energy disruption (some owned by the BIT, some by landlords), but delivering fuel to some of the more remote tower locations across minor roadways after a major storm event is a concern. In the event of an emergency, the BIT coordinates with DPW and VIWAPA as documented under VITEMA's TEOP.

1. INTRODUCTION

Transportation Infrastructure

- Ports serving the Estate Richmond Generating Station, Randolph Harley Generating Station, and co-located desalination plants
- Limetree Bay Container Port
- Crown Bay Cargo Port
- Bridges, tunnels, and roadways leading to critical infrastructure

Maintaining ports, roadways, bridges, tunnels, and other transportation infrastructure is key to disaster recovery. These roadways not only provide access for emergency responders to provide vital services to critical sites and vulnerable populations but enable fuel supply chains to operate across the USVI. In the event of a natural disaster, this infrastructure may become compromised or unnavigable. In these cases, it is essential that transportation infrastructure serving critical infrastructure are prioritized by response crews to ensure fuel suppliers and transporters can resupply fuel for emergency generators.

Congregate Sheltering

St. Croix

- STX Educational Complex
- DC Canegata

St. Thomas

- BCB School
- Lockhart School
- VIFS Water Island

St. John

- Julius Sprauve School

Image Source: VI Port Authority

2. RESPONSE TO AN ENERGY EMERGENCY

Image Source: https://abcnews.go.com/International/us-virgin-islands-ruins-hurricane-maria/story?id=50178300

As outlined in the 2022 VITEMA TEOP: "The Virgin Islands Energy Office (VIEO) is the lead agency designated for coordinating energy management, including all ESF 12 administrative management, planning, training, preparedness, response, recovery, and mitigation activities, and the maintenance of the ESF 12 Standard Operating Procedures . WAPA is responsible for the activation of plans for appropriate allocation of resources of personnel, equipment, and services to maintain or restore utility service under their control. ESF 12 supporting agencies will assist the VIEO and WAPA in the planning and execution of energy restoration and management operations." [10]

2.1 WHAT TYPES OF ENERGY EMERGENCIES CAN OCCUR IN USVI?

Preparedness, response, recovery, and mitigation strategies are largely based on analyses of natural, man-made, and technological hazards with a history of, or potential for, impacts in the USVI. VIEO uses the definitions of an emergency and a major disaster as defined in the Robert T. Stafford Disaster Relief and Emergency Assistance Act [11] (as Amended), along with The Virgin Islands Territorial Emergency Operations Plan (TEOP).

Emergency—any occasion or instance for which, in the determination of the president, federal assistance is needed to supplement state and local efforts and capabilities to save lives, protect property and public health and safety, or lessen or avert the threat of a catastrophe in any part of the U.S.

Major disaster—any natural catastrophe (including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion in any part of the United States, which, in the determination of the president, causes damage of this Act to supplement the efforts and available resources of states, local governments, and disaster relief organizations in alleviating damage, loss, hardship, or suffering. An emergency, including a fuel shortage emergency, may sever key components of the Territory's energy infrastructure. This may constrain fuel supplies in the affected areas and will adversely impact adjacent areas, especially those with supply links to the directly affected areas. Such an event also could affect transportation, water desalination, communications, and other infrastructure necessary for sustaining public health and safety. It also could affect continuity of government operations as well as several critical infrastructures within the Territory.

[10] VITEMA, 2022, "The Virgin Islands Territorial Emergency Operations Plan," https://vitema.vi.gov/docs/default-source/key-documents/virgin-islands-territorial-emergency-operations-plan-(teop-2022-version).pdf?sfvrsn=ad4b59a3_2.

[11] U.S. Federal Emergency Management Agency, 2019, "Stafford Act, as Amended, and Related Authorities," https://www.fema.gov/sites/default/files/2020-03/stafford-act_2019.pdf.

2. RESPONSE TO AN ENERGY EMERGENCY

2.2 WHO RESPONDS TO AN ENERGY EMERGENCY?

VITEMA is the lead emergency management agency for the Territory as defined in the Virgin Islands Code, Title 23, Chapter 10. VITEMA is the sole Virgin Islands government agency designated to supervise, administer, and coordinate all-hazards response and recovery operations, and is the lead agency formally designated with coordinating emergency response in the Territory. VITEMA is responsible for developing and maintaining a comprehensive emergency management plan and establishing emergency management training and exercise programs to sustain a cadre of well-trained emergency personnel to prepare for and respond to an emergency or major disaster. To meet potential threats, in 2009 The Territory reorganized emergency management in the Virgin Islands by consolidating VITEMA, the Virgin Islands Office of Homeland Security, the 9-1-1 communication centers, and the Public Assistance Grant Program.

In the event of an energy emergency, the Emergency Support Function #12 (ESF-12) will be activated and VIEO, in coordination with VIWAPA, will serve as the lead agency. Each entity made a member of the ESF-12 is required to establish a point of contact (POC) and submit to the VIEO Director. The ESF-12 is the primary group responsible for responding to energy emergencies. Per the 2022 VITEMA TEOP, the ESF-12 consists of the following agencies:

- Coordinating: VIEO, VIWAPA
- Supporting: Office of the Governor, Department of Property and Procurement, Department of Public Works, VI National Guard, VI Police Department, VI Port Authority
- Private Energy Partners: Ocean Point Terminals operated by Gulf Oil

2.2.1 Legal Authorities, Roles, & Responsibilities

The 2022 VITEMA TEOP identifies several policy guidelines that the Territory follows in response to an emergency event, and it provides the roles and responsibilities for all Emergency Support Functions, including ESF-12 for Energy. The authorities, roles, and responsibilities are fully laid out in the 'Emergency Support Functions Responsibilities Assignments' section and Table C-1 of the 2022 VITEMA TEOP.

The energy sector of the U.S. Virgin Islands (USVI) is highly dependent on external resources and support due to its geographic isolation and vulnerability to natural disasters. Mutual aid resources play a critical role in ensuring that the territory can recover from disruptions, whether physical or cyber-related.

The 2017 Hurricanes highlighted a key Mutual Aid resource for the Virgin Islands in the form of the American Public Power Association. American Public Power Association (APPA) coordinated mutual aid to restore power to the U.S. Virgin Islands after the territory was hit by back-to-back Category 5 hurricanes (Irma and Maria) in 2017. APPA rallied its members to provide mutual aid over six months' time. Because the three islands' electric systems were severely damaged, more than 90 percent of residents lost power for extended periods. The local public power utility, U.S. Virgin Islands Water and Power Authority (WAPA), reached out to the APPA for assistance in the long and complex process of restoration.

Through the APPA's mutual aid program, electric utilities help each other in times of need. When a major disaster hits a utility's territory and the utility knows that its own crews and equipment won't be enough to restore power quickly, it calls for mutual aid. It provides its best estimate of how many people it needs and what type of skills they should have. The association coordinates the national public power mutual aid network of more than 1,100 not-for-profit, community-owned electric utilities across the country.

2.2.2 Relationship to Other Emergency Response Plans

The TESP supplements the emergency response plans developed by VITEMA, VIWAPA, the USVI Office of Disaster Recovery (ODR), VIEO, and VIHFA and serves as a reference document to review energy infrastructure, as well as a framework for gathering and communicating energy data related to disruption, response, and recovery. Table 5 lists the local emergency plans that guide emergency response in the Territory. Many of the plans have been updated, or are currently being revised, to keep them relevant and timely.

2.2.3 Decisions Regarding the Nature of an Event

In the event of an energy shortage or disruption, Territory personnel will refer to three broad categories of measures that can be implemented—demand reduction measures, supplier/distributor support measures, and user/consumer support measures.

The 2022 TEOP classifies emergency events that occur under the following conditions:

- State of Emergency
  - When an emergency or disaster has occurred or is imminent, the Governor may issue an Executive Order proclaiming a State of Emergency or activate the emergency response, recovery, and mitigation.
  - A State Executive Order is required for the deployment and use of Territorial personnel, supplies, equipment, materials, and/or facilities.
  - VITEMA will provide recommendations to the Governor and assist in formulating the Executive Order.
- The Governor or his/her designee may execute the TEOP to support local situations when local resources are not adequate to sustain an effective response operation or when a significant Territorial presence is required for immediate assistance.
- If disaster threatens prior to the ability of the Governor to issue an Executive Order proclaiming a State of Emergency, the VITEMA Director is authorized to activate the Plan and implement any emergency response actions necessary for the immediate protection of life and property.

Table 5. Title of Applicable Documents and Plans

TITLE OF APPLICABLE DOCUMENTS AND PLAN	LEAD AGENCY	DATE OF PLAN
TEOP	VITEMA	2019, revised 2022
Comprehensive Energy Strategy	VIEO	2021, undergoing revision
VIWAPA Strategic Plan	VIWAPA	2022
Territorial Hazard Mitigation Plan	USVI ODR	2022, undergoing revision
Disaster Recovery Action Plan	VIHFA	2019, revised 2023
Hospital Continuity of Operations Plan	Private Hospitals	2020

2. RESPONSE TO AN ENERGY EMERGENCY

Figure 7. Response to Energy Disruptions (TEOP)

NATURE OF AN EVENT

- Type of event
- Level of severity of event
- Duration of event
- Remediation of event

MEASURES TO IMPLEMENT

- Supplier/distributor support measures
- Demand reduction measures
- User/consumer support measures
- Other measures

TYPES OF SUPPORT NEEDED

- District
- Regional partners
- Federal government
- International organizations
- Voluntary disaster relief organizations
- Private sector

2.3 VIEO'S RESPONSE TO AN ENERGY EMERGENCY

It is important to note that there are distinctive shifts in lead coordination and support roles as related to VITEMA, VIWAPA, and other agencies. This distinction is characterized by the nature of the event, triggering a formal gubernatorial declaration or activation of the ESF-12 by VITEMA.

2.3.1 VIEO's Roles & Responsibilities At-A-Glance

VIEO's primary lead role is under ESF-12 (co-lead with VIWAPA). ESF-12 helps restore the Virgin Islands energy systems during and/or following an emergency. The VIEO is the primary agency responsible for coordinating with all other governmental department response elements and utilities to restore the Territory's energy systems.

Per the U.S. Department of Energy (DOE), ESF-12 gathers, assesses, and shares information on energy system damage and estimates the impact of energy system outages/ shortages. The purpose of this ESF is to facilitate restoration of energy systems and fuel supplies during and/or following an emergency. Power and fuel are critical to protecting lives and property and maintaining the continuity of the government. ESF-12 has the following roles and responsibilities:

- Coordinate information flow
- Assist in determining the level of event severity
- Assist in identifying measures to be implemented
- Monitor and track energy supply prior, during, and after an event
- Conduct follow-ups after the event.

Table 6 shows a baseline list of Essential Elements of Information (EEI) needed for response operations as detailed in Section 4 of this TESP. Table 6 also represents VIEO's primary and supporting responsibilities outlined in the 2019 VITEMA TEOP, updated in 2022. VIEO is the primary lead agency under ESF-12, and supporting agency under ESF-1, 5, and 7.

Supporting Roles for VIEO During an Energy Emergency

The VIEO is a member of the Hurricane Integrated Telecommunications (HIT) Team. The HIT Team is led by the Director of USVI Bureau of Information Technology (BIT) and is a Public/Private working group that consists of FEMA, VITEMA, BIT, VIEO, PSC, VIYA, VINGN, and local ISPs.

The HIT Team was formed by the USVI PSC Commission during the storms in September 2017, after learning of the critical information that needed to be gathered by the DHS FEMA National Communications Center Watch of ESF-2. The entire spectrum of telecommunications providers (LMR, Ham operators, Radio, TV, Wireline, Wireless, Broadband and TV Whitespace) worked together under the customer service provisions of the USVI PSC's jurisdiction. The immediate restoration HIT Team disbanded, and mitigation efforts are currently being led by the Director of BIT.

2. RESPONSE TO AN ENERGY EMERGENCY

Table 6. Essential Elements of Information (EEI)

2019 VITEMA TEOP	2020 EDTP
• Status of electrical generating facilities • Status of the transmission grid • Status of the distribution grid • Population without electric power • Energy demand for population and critical facilities • Petroleum supply and reserves • Status of natural gas transmission facilities • Status of the distribution pipeline • Population without natural gas • Status of gasoline and oil distribution systems • Establishment of power restoration	• Establish communication protocol with petroleum, electricity, renewables, and retail fuel suppliers • Work with VITEMA and other key agencies to outline a framework for communicating energy disruption data • Identify and track energy disruptions including supply and demand disruptions, energy infrastructure failures, price spikes, weather-related disruptions, and other disasters • Develop post-event after action report to analyze energy disruption data and incorporate lessons learned into relevant emergency planning documents • Impact of energy disruption

Supporting roles for VIEO, outlined within ESF-12 are as follows:

- Implement near-term mitigation effort to diversify on-site energy resources at communication towers throughout the territory.
- In coordination with VITEMA, VIEO will conduct a rapid needs assessment of infrastructure access points (roads, bridges) to major pieces of critical infrastructure for debris clearance in order to provide access to those facilities.
- Review and firm prioritized list of critical facilities for power restoration. Reinforce public service announcements (PSAs) concerning the dangers associated with downed power lines and the procedures for reporting them, boil water advisories, and other critical public safety messages.
- Assess and maintain power restoration Memorandum of Understanding with off-island agencies to ensure the anticipated resource capabilities needed for recovery are available.
- Contact American Public Power Association to identify and coordinate availability of support resources, line crews, safety officers and damage assessment teams.
- Establish conference call schedule and participate in conference calls with appropriate agencies.
- Provide personnel to support the ESF-12 station at the Emergency Operations Center.
- Precautionary Boil Water Notice, Safe Use of Alternate Power Supplies, General Safety and Emergency Tips, and VIWAPA’s Emergency Notification Process.
- Provide up-to-date power outage information and power and water supply needs to identify generator requirements and relate those requirements to VITEMA Emergency Operations Center (EOC).
- Activate contracts to move all power-related debris to a designated site in order to facilitate reuse of salvageable parts and materials and dispose of waste.

- Issue advisories and warnings to the Joint Information Center for public dissemination.

Related activities that fall within other ESF responsibilities include:

- ESF-7: Develop an emergency power fuel and maintenance prioritization plan based on power grid assessments and adjust the plan accordingly as island power is restored. PRTF communicates fuel requirements with the Fuel Task Force (FTF).
- ESF-10: Coordinate with VIWAPA to monitor public water systems and advise on the issuance of boil water notices.

2.3.2 Demand Reduction Measures

VIEO will develop recommendations for voluntary and mandatory demand reduction measures for government agencies as well as private stakeholders. VIEO will work with VIWAPA to distribute the voluntary demand reduction measure program information to large users on both islands. In times of an energy emergency, VIEO and VIWAPA will use external media channels, in addition to direct outreach, to notify these users of opportunities to reduce their energy demand.

In extenuating circumstances, the Governor may sign an executive order to instate certain mandatory demand reduction measures on the Territory's largest users during an energy shortage or emergency. Both voluntary and mandatory programs need to be detailed out by VIEO and VIWAPA and coordinated with the Governor's office, as well as the Territory's largest energy users.

2.3.3 Follow-up to be Conducted after an Energy Emergency

After recovery from an energy disruption is complete, the VIEO should develop a Post-Event After Action Report that analyzes data collected during disruption and recovery. Lessons identified in this report should be incorporated into future iterations of the TESP and other emergency planning documents as necessary.

The process for data collection and a framework for developing a Post-Event After Action Report can be found in the Energy Disruption Tracking Plan, detailed in Section 4.

Table 7. Example Demand Reduction Measure Framework

DEMAND REDUCTION MEASURES	SUPPLIER/DISTRIBUTOR SUPPORT MEASURES	USER/CONSUMER SUPPORT MEASURES
• Voluntary measures • Mandatory measures	• Personnel • Equipment • Supplies • Facilities • Managerial/technical	• Information • Advice • Appliances (e.g., portable fans, heaters, and generators) • Supplies (e.g., ice and sandbags)

2.4 COMMUNICATIONS PROTOCOL

The following section outlines the necessary internal and external communications protocol in the event of an energy emergency. This section will be further developed and can be partnered with the Bureau of IT and the Hurricane Integrated Telecommunications (HIT) team which includes the private telecommunications partners and VIWAPA. Other private energy partners should be included.

VIEO will also have access to the Energy Emergency Assurance Coordinators (EEAC) programs and contacts. The EEAC provides points of contact in each state and serves to share, and exchange, information on planning for, and responding to, energy emergencies. It supports a secure and cooperative communications environment to provide state and local government personnel with access to information on energy supply, demand, pricing, and infrastructure. Designated members have expertise in electricity, petroleum, and natural gas. The current membership of nearly 200 professionals is made up of representatives from state energy offices, public utility organizations, state legislators, emergency management agencies, homeland security agencies, local governments, and Governors' offices.

2.4.1 Internal

Through the joint information system, ESF-15 will ensure that disaster and emergency information to USVI residents and visitors will be clear, concise, timely, and accurate regarding the existing situation, actions being taken by the authorities, and actions to be taken by the affected populations. The energy incident communications protocols for government, including its concept of operations, are implemented at the Territory level. Per the VITEMA TEOP, the Office of the Governor's Communications Directorate, in coordination with VITEMA's Public Information Office, is responsible for all ESF-15 administrative, managerial, planning, preparedness, response, and recovery activities.

VIEO will coordinate within ESF-12 to help facilitate the restoration of energy systems and fuel supplies following an emergency. VIEO will also provide the necessary representation at the Emergency Operations Center (EOC), and an emergency liaison officer (ELO) will remain at the EOC until deactivated or released by the VITEMA Director. VIEO will also coordinate with the USVI Integrated Hurricane Telecommunications Team, a group dedicated to telecommunication resilience/restoration.

2.4.2 External

External communications primarily refer to disseminating information to the public. According to the NASEO Guidelines, "A strong public information program is a key crisis management tool. Timely and accurate information helps prevent confusion and uncertainty and enlists public support and cooperation."[12]

External communications are described in strong detail in the VITEMA TEOP. The current notification systems are existing and presented in the TEOP:

- Alert VI
- All-Hazards Siren Warning System
- Integrated Public Alert and Warning System (IPAWS)
- Wireless Emergency Alert System
- Emergency Alert System
- Joint Information Center (JIC)

[12] National Association of State Energy Officials, 2009, *State Energy Assurance Guidelines*, https://www.naseo.org/Data/Sites/1/documents/energyassurance/eaguidelines/State_Energy_Assurance_Guidelines_Version_3.1.pdf.

3 USVI ENERGY PROFILE

Image source: https://vifreepress.com/2019/12/usvi-businesses-interested-in-energy-office-rebate-program-can-apply-vieo/

The purpose of this section is to provide a clear understanding of the Territory's energy profile and identify vulnerabilities and available energy assurance options. Understanding how energy is bought, sold, and consumed will help VIEO identify and engage the key organizations that power the USVI and provide context in the event of energy disruptions. In the USVI, with relatively high petroleum use and a complete dependence on imports, assessing energy supply, consumption, and expenditures is critical to energy assurance. Painting a clear picture of the Territory's energy market helps inform decision making for business leaders, researchers, community action groups and emergency response personnel and will help assure future energy reliability and availability.

3.1 PETROLEUM

With the exception of some small-scale renewables, the Territory is almost entirely dependent on fossil fuel imports for all its energy needs. Distillate fuel (#2 fuel oil), residual fuel (#6 fuel oil), and liquefied propane account for about four-fifths of all petroleum products consumed in the USVI, which are used for electricity generation and the production of drinkable water supplies. Jet fuel, motor gasoline, and diesel make up the remaining one-fifth of the island's petroleum consumption.[13]

The USVI has no known crude oil reserves and does not produce crude oil, although a 2012 U.S. Geological Survey assessment identified the potential for undiscovered crude oil resources in a subsea formation south of the islands.[14]

All petroleum products are imported to the islands by ship. The USVI Department of Property and Procurement is responsible for fuel delivery during energy emergencies. Petroleum is imported to the islands in the following forms:

- Distillate fuel (#2 fuel oil) is used by VIWAPA for generation and ground and marine transportation. It is also used by utility customers for backup generators and some businesses that have their own power generation systems.
- Liquified propane gas (LPG) is used for electricity generation by VIWAPA.
- Gasoline is used by cars and trucks.
- Jet fuel and kerosene are used for air transportation.
- Residual fuel (#6 diesel) may be used for marine transportation and self-generation.

Figure 8 describes 2021 total petroleum imports to the USVI, as reported by EIA. Note that it does not include crude oil processed through Limetree Bay Refinery, since it is currently closed.

[13] U.S. Energy Information Administration, 2021, "Total energy production and consumption by state, 2021, accessed Sep 26, 2023, https://www.eia.gov/beta/states/overview#24.

[14] U.S. Geological Survey, 2012, "An Estimate of Undiscovered Conventional Oil and Gas Resources of the World, 2012," https://pubs.usgs.gov/fs/2012/3042/fs2012-3042.pdf.

3 USVI ENERGY PROFILE

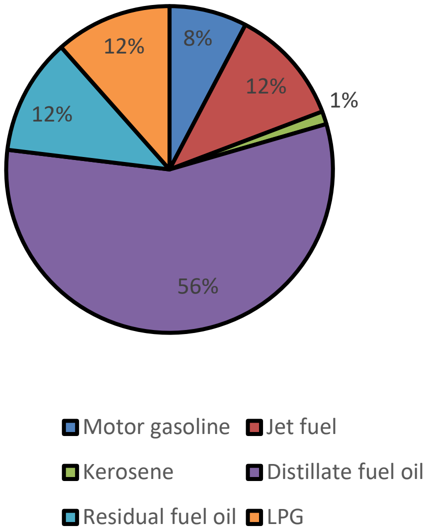

Figure 8. USVI Total Petroleum Imports 2021
Source: U.S. EIA, 2021, “U.S. Virgin Islands: 2021 primary energy data in quadrillion Btu,” accessed Sep 26, 2023, https://www.eia.gov/international/overview/country/VIR .

All petroleum is shipped in by cargo vessel to St. Thomas and St. Croix. St. Croix is home to Ocean Point Storage Terminals and Limetree Bay Refinery. The refinery has been closed since 2012. If it re-opens, it will produce marine fuel for export and residual fuel for powering the refinery. It does not produce any refined petroleum consumed by the USVI.

Transportation fuels, gasoline, diesel, and jet fuel are imported by tankers to St. Croix Ocean Point Terminals in Limetree Bay and Krum Bay, St. Thomas.

3.1.2 Regional Demand for Petroleum

It is important to consider global and geographic demand when considering the USVI petroleum market. The Caribbean Sea includes multiple island nations, Territories, and protectorates with their own demands for imported petroleum. Each of these islands may compete for petroleum in the event of a hurricane or other natural disaster, impacting the entire region and causing region-wide energy disruptions.

3.1.2 Liquid Propane Gas Terminals

Liquid propane gas (LPG) is shipped via tanker to the LPG terminals that were built at the electrical generating stations on St. Thomas and St. Croix. This LPG is used to power each of the generation stations. The terminals were built in 2015 by Vitol, and they are operated by its subsidiary Island Project Operating Services, LLC, IPOS, for VIWAPA. VIWAPA is currently seeking to procure the Vitol infrastructure using federal U.S. Housing and Urban development Community Development Block Grant Hazard Mitigation (CDBG-MIT) funds.[15] The request is currently being reviewed by HUD. The specifications of the two terminals are as follows:

- The Estate Richmond Terminal capacity is 10,400 cubic meters, held in a total of eight tanks, which provides 19.2 days of effective supply.
- The Randolph Harley Terminal capacity is 14,000 cubic meters, held in a total of 10 tanks, which provides 18.23 days of effective supply.

Figure 9. Caribbean Political Map. Image Source: Wikipedia

[15]VIHFA, 2023, “1st Substantial Amendment to CDBG-Mitigation Action Plan Public Hearing,” https://cdbgdr.vihfa.gov/wp-content/uploads/2023/08/Public-Hearing-Mitigation-Substantial-Amendment-VITOL-07.12.2023-FINAL.pdf.

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Figure 10. LPG Terminal at Estate Richmond Power Plant, St. Croix

Image Source: VIWAPA

3.1.3 #2 Diesel Fuel

Distillate fuel, also called #2 diesel fuel and #2 fuel oil, plus LPG represent 68% of all petroleum imported and it is used for electrical generation and water desalination. This fuel is shipped directly to ports located at VIWAPA.

Richmond Generating Station on St. Croix and the Randolph Harley Generating Station on St. Thomas.

St. Croix-Richmond Estate Generating Station

- #2 Fuel oil is shipped via tanker ship to VIWAPA under contracts through wholesale company Glencore and is brought directly to the generating station's port. It is stored on-site in storage bunkers.

St. Thomas-Randolph Harley Generating Station

- #2 Fuel oil is shipped via tanker ship to VIWAPA under contracts through wholesale company Glencore and is brought directly to the generating station's port. It is stored on-site in storage bunkers.

3.1.4 Gasoline & Diesel

The following section outlines the energy supply chain for gasoline and diesel on St. Croix and St. Thomas.

Figure 11. EPIC Curacao at Richmond Terminal, 2015

Image Source: VIWAPA

3 USVI ENERGY PROFILE

St. Croix-Limetree Bay

- Gulf Oil supplies gasoline and diesel fuel to the rack at Ocean Point Terminal (formerly Limetree Bay Terminal). Retailers purchase products through the rack and take delivery at the storage facility via tanker trucks. From there it is delivered to gas stations and users across the island.
- USVI Department of Public Works (DPW) has contracts with Bunkers Fuels to supply fuel for emergency generators and vehicles. See Table 13 for Agency and Retail fuel suppliers.

St. Thomas-Crown Bay Cargo Port

- Gasoline & Diesel: Wholesale companies on St. Thomas and St. John do not purchase gas and diesel from the rack at Ocean Point Terminals on St. Croix. Rather, they purchase from different wholesalers outside of the Territory with different rack rates.
- Fuel arrives at the Crown Bay Cargo Port and is offloaded immediately to retailers who use ferries to deliver fuel to St. John. Fuel is delivered on tanker truck via ferry from Red Hook, St. Thomas to Cruz Bay St. John. See Table 13 for Agency and Retail fuel supplier.

3.1.5 Jet Fuel

Jet fuel is purchased by the USVI Port Authority and delivered to USVI's two main airports: Henry E. Rohlsen Airport in St. Croix and Cyril E King Airport on St. Thomas. The following details the jet fuel supply chain for the airports on St. Croix and St. Thomas.

St. Croix-Henry E. Rohlsen Airport

- Jet fuel is delivered to the Container Port at Ocean Point Terminals and shipped via tanker truck to storage bunkers at the airport.

St. Thomas-Cyril E King Airport

- Jet fuel is delivered to the Crown Bay Cargo Port and shipped via tanker truck to storage bunkers at the airport.

3.2 ELECTRICITY

VIWAPA is responsible for generating and delivering electricity to the USVI. VIWAPA operates two separate electricity grids: one on St. Croix and another on St. Thomas. The St. Thomas system supplies electricity to nearby St. John Island and to Water Island via underwater cables.

Each system has a generation station: Randolph Harvey on St. Thomas and Estate Richmond on St. Croix. Generating units include reciprocating engine generators, combustion turbines fueled by diesel or propane, as well as some solar power facilities owned by independent power producers (IPPs). Many residents and business have customer-owned rooftop solar panels and battery energy storage (see Renewable section below for more details).

Major electrical infrastructure includes:

- Two electrical generation stations
- Renewables including a 4-MW solar array, a 5-MW array, and 15 MW of customer renewable energy generation provided mostly by rooftop solar
- 1,000 miles of aboveground and buried power lines.
- Eight substations (five on St. Thomas, two on St. Croix, and one on St. John)

Electricity generation in the Territory is almost entirely dependent on imported petroleum. This has in part led to electricity rates that are three to four times the average rate in US, adding to the Territory's financial distress. As of September 2023, electricity rates were approximately \$0.41 per kilowatt-hour (kWh) for residential customers (for the first 250 kWh) and approximately \$0.47/kWh for commercial customers.[16] In comparison, the U.S. average price of electricity in May of 2023 was approximately \$0.16/kWh for residential customers and \$0.12/kWh for commercial customers.[17]

[16] VIWAPA, 2022, "Electric Rate as of March 1, 2022," accessed Sep 26, 2023, https://www.viwapa.vi/customer-service/rates/electric-rate.

[17] U.S. EIA, 2023, "US Virgin Islands: Territory Profile and Energy Estimates," accessed Sep 26, 2023, https://www.eia.gov/state/analysis.php?sid=VQ.

3 USVI ENERGY PROFILE

Overview of Vulnerabilities

Both the St. Thomas and St. Croix electrical grids are vulnerable to energy disruptions from both chronic equipment failures during blue sky days and widespread damage during major storm events such as hurricanes. Efforts are underway to harden the grid and make it more resilient by undergrounding distribution cables, installing composite distribution poles for overhead lines, and replacing older generation units.

Major storm events pose the greatest threat to the USVI electrical grid. This was exemplified during 2017 when Hurricanes Irma and Maria destroyed over 90% of the transmission and distribution systems and 20% of the generation capacity, including over 20,000 poles, 1,100 miles of distribution cable and 5,300 pole-mounted transformers.[18] In addition to equipment failure from storm surge, high winds pose a major threat to electrical reliability. Prior to the 2017 hurricane season, most distribution lines were aboveground along with pole-mounted transformers. These lines and poles are vulnerable to hurricanes, and this has been a source of multipoint failure across the island.

Chronic equipment failure during blue sky days also compromises the reliability of both electricity grids. More than 40% of WAPA's generation capacity that runs on fossil fuels is more than 25 years old.

Overview of Electricity Demand

The USVI energy sector provides electricity to the Territory population of 87,000.[19] This is approximately 46,000 residential, 7,500 commercial customers, and 2,386 industrial customers across five islands: St. Croix, St. Thomas, St. John, Water Island, and Hassel Island.[20]

43% of VIWAPA's electricity is consumed by the residential sector, and 41% is consumed by large power users that consume more than 25 kilowatts. 16% of electricity sales go to commercial users that consume less than 25 kilowatts. The average price of electricity paid by USVI residents in 2023 was about three to four times higher than the average power price in the mainland U.S. The figure below shows electricity consumption by sector.

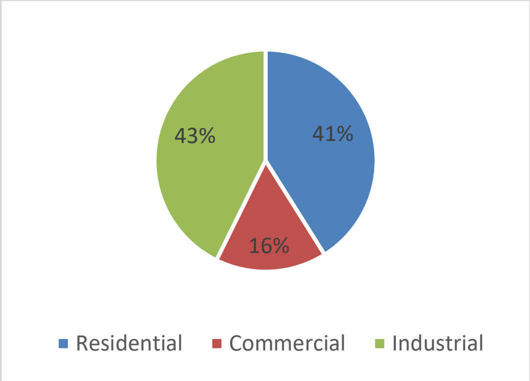

Figure 12. USVI Electricity Consumption by Sector

Source: U.S. Energy Information Administration (EIA). 2022. "Table 12.8 Virgin Islands, by Sector, 2011-2021." Accessed September 1, 2023. https://www.eia.gov/electricity/annual/html/epa_12_08.html

3.2.1 Electric Grid St. Thomas

The electrical grid on St. Thomas serves a total population of around 46,000 including residents on St. Thomas as well as nearby St. John, Water Island, and Hassel Island.[21]

Electricity Generation

Electricity is generated at the Randolph Harvey Generating Station at Krum Bay. The Harvey Plant consists of a generating station, a fuel port for vessels delivering #2 diesel and LPG, fuel storage bunkers, LPG storage terminal, transmission yard, and desalination plant that provides fresh water to the residents of USVI.

[18] USVI Hurricane Recovery and Resilience Task Force, 2018, "USVI Hurricane Recovery and Resilience Task Force: Report 2018," https://cfvi.net/wp-content/uploads/2019/05/USVI_HurricaneRecoveryTaskforceReport_DIGITAL.pdf.

[19] U.S. Census Bureau, 2022, "2020 Island Area Censuses: U.S. Virgin Islands," accessed Sep 26, 2023, https://www.census.gov/data/tables/2020/dec/2020-us-virgin-islands.html.

[20] U.S. Energy Information Administration, 2022, "Table 12.8 Virgin Islands," accessed Sep 1, 2023, https://www.eia.gov/electricity/annual/html/epa_12_08.html.

[21] U.S. Census Bureau, 2022, "2020 Island Area Censuses: U.S. Virgin Islands," accessed Sep 26, 2023, https://www.census.gov/data/tables/2020/dec/2020-us-virgin-islands.html.

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ADDITIONAL CRITICAL INFRASTRUCTURE

- LPG Storage Capacity- 14,000, 18.2 days
- LPG Terminal
- #2 Fuel Oil Storage Capacity
- Fuel Terminal
- Desalination Plant Water Storage Capacity- 35 MG

Figure 13. Randolph Harley Generating Station, Krum Bay

Image Source: Google Earth

Figure 13 shows an aerial of the generating station at Krum Bay and key data regarding its LPG and water storage capacity.

The Randolph Harvey Generating Station has 153 MW of generating capacity, which exceeds the system's peak demand of around 60 MW. The plant has capacity that is currently 2.5 times the system peak. A list of the units is shown in Table 8 below. The units are a combination of new reciprocating internal combustion engines (RICE) that are fueled by LPG, and older, less efficient combustion turbines (CT) fueled by #2 fuel oil.

The primary and secondary fuels listed in Table 9 reflect VIWAPA's fuel enhancement of selected units over the past few years. LPG is considerably less expensive than #2 fuel oil.

Table 8. Randolph Harley Generating Units

ST. THOMAS, RANDOLPH HARLEY	UNIT TYPE	MW OUTPUT	PRIMARY & SECONDARY FUEL
Wartsila 1	RICE	7	LPG
Wartsila 2	RICE	7	LPG
Wartsila 3	RICE	7	LPG
Wartsila 4	RICE	9	97% LPG + 5% #2FO
Wartsila 5	RICE	9	97% LPG + 5% #2FO
Wartsila 6	RICE	9	97% LPG + 5% #2FO
Wartsila 7	RICE	9	97% LPG + 5% #2FO
STT 14	CT	14	#2FO
STT 15	CT	21	LPG& #2FO
STT 23	CT	40	#2FO
STT 27	CT	21	#2FO
TOTAL CAPACITY		**153**	

3 USVI ENERGY PROFILE

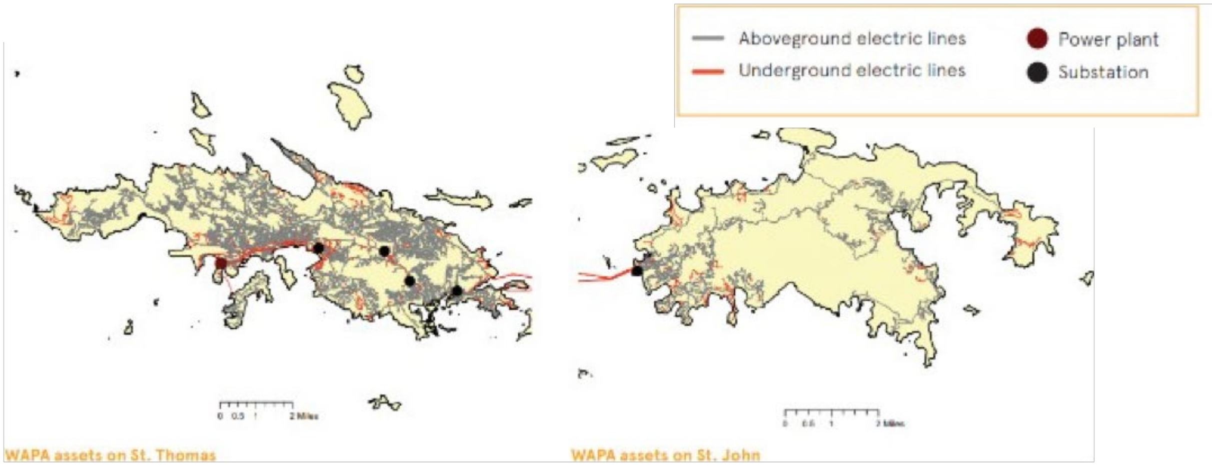

Figure 14. Electric Grid St Thomas: St. John-Water Island

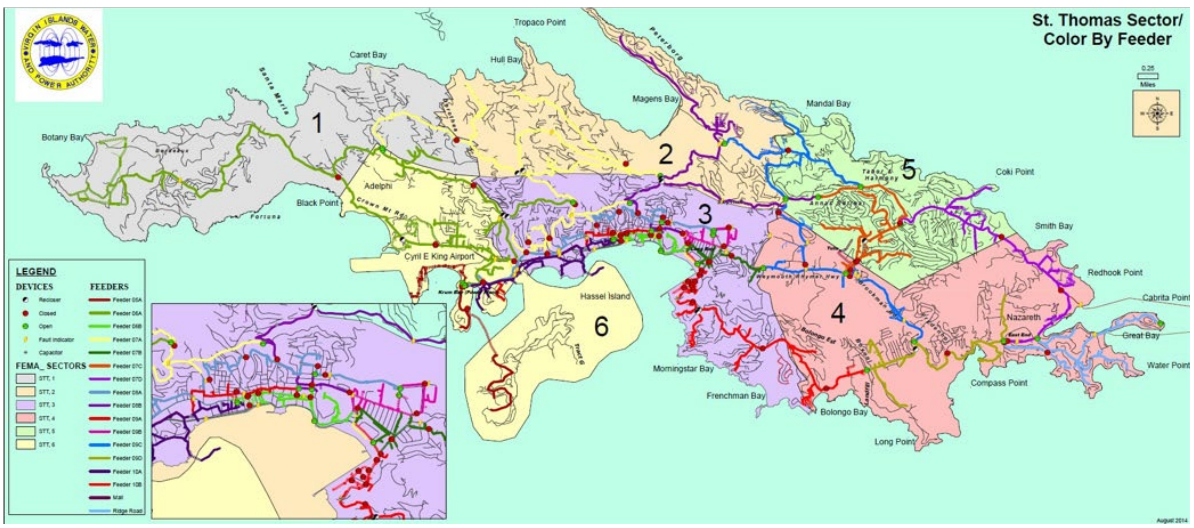

Figure 15. St Thomas Sector and Feeders. Image Source: VIWAPA

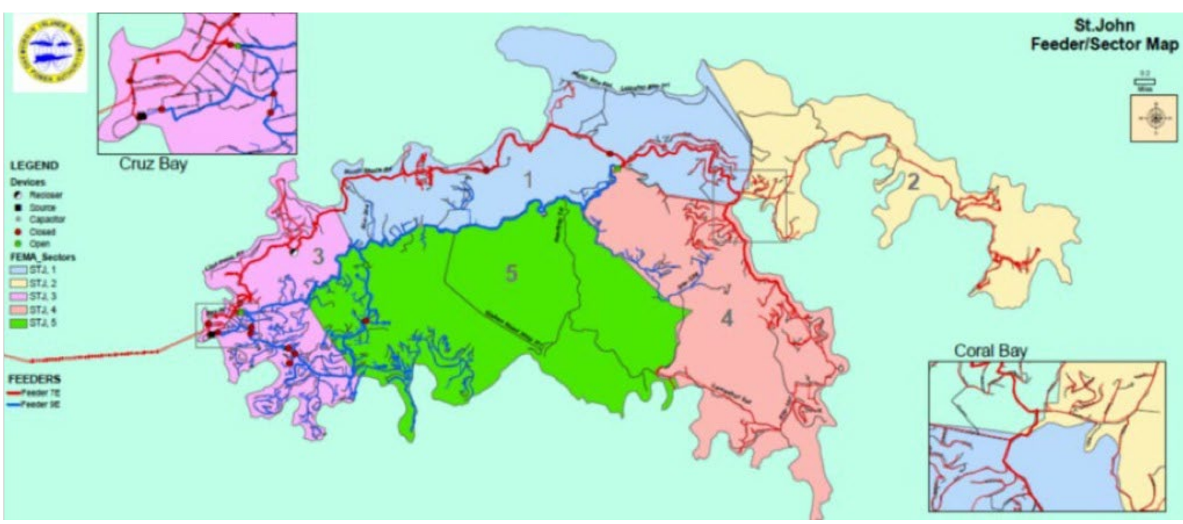

Figure 16. St John Sector and Feeders. Image Source: VIWAPA

Transmission and Distribution

Power is delivered to St. John, Water Island, and Hassel Island via undersea cable. Once generated at the plant at Krum Bay, power travels to the high voltage transmission yard at the plant, where it runs through one of five substations that distribute electricity across the Islands, as shown in Figures 14-16.

The transmission and distribution system on St. Thomas and St. John are comprised of 34.5 kV primary lines and 13.8 kV distribution lines. There are five substations located across St. Thomas and one on St. John.

There are 17 feeders across St. Thomas, with seven located in the highest populated area, Charlotte Amalie, as shown in the Figure 15. Aboveground cables and transformers are the most vulnerable to high winds and there is a major effort to reduce this vulnerability on the electrical grid by burying cables, using stronger poles, and padding pole-mounted transformers.

There are three undersea cables running from St. Thomas to St. John at Cruz Bay. Two main feeders stretch across St. John. Feeder 7E runs across the northern length to the east end past Coral Bay. Feeder 9E serves the most populated southeast portion and branches through the center of the island until it terminates with Feeder 7E. All these cables run through jungle terrain.

3.2.2 Electrical Grid on St. Croix

The St. Croix electrical system serves a population of approximately 41,000 and has a peak demand of about 45 MW.[22] Power originates at the Estate Richmond Generating Station on the coast just northeast of Christiansted and is distributed via two substations interconnected via a 69kV buried transmission line.

Currently, there are no undersea cables that connect St. Croix and St. Thomas. Recent research suggests that cables may be feasible and would increase energy resilience, though they are not currently being pursued.[28]

Electrical Generation

The Richmond plant consists of a generating station, fuel port for vessels delivering #2 fuel oil and LPG, fuel storage bunkers, LPG storage terminal, transmission yard, and a desalination plant for producing potable water. Figure 18 shows an aerial of the Estate Richmond Generating Station and key data regarding its LPG and water storage capacity.

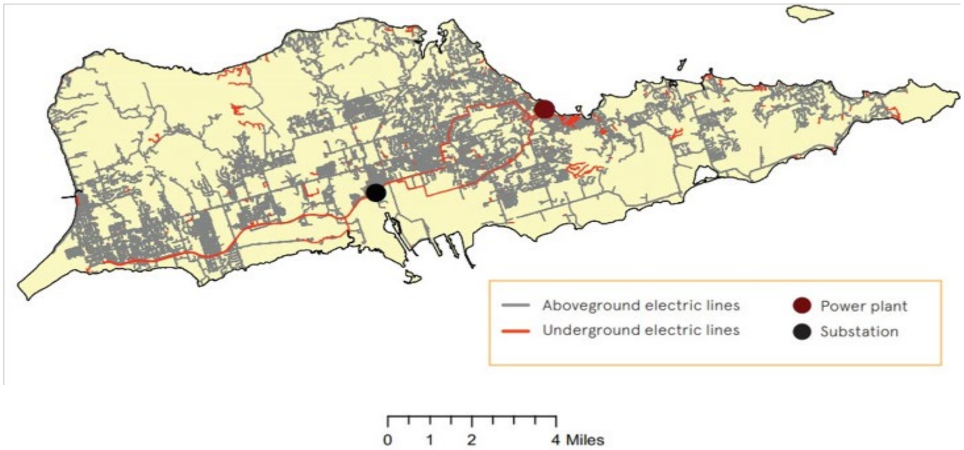

Figure 17. Electric Grid St Croix. Image Source: VIWAPA

[22] U.S. Census Bureau, 2022, "2020 Island Area Censuses: U.S. Virgin Islands," accessed Sep 26, 2023, https://www.census.gov/data/tables/2020/dec/2020-us-virgin-islands.html.

Figure 18. Estate Richmond Generating Station, St Croix

ADDITIONAL CRITICAL INFRASTRUCTURE AT ESTATE RICHMOND GENERATING STATION

- LPG Storage Capacity- 2, 4-tank bunkers, 10,400 cubic meters, 19.2 days effective supply
- LPG & Fuel Oil Port & Jetty
- Diesel Fuel Storage Capacity
- Desalination Plant Water

The plant has fossil generating units consisting of CT and RICE units, as described in Table 10 below. All but one of these units can operate on LPG. Some can also run on #2 Fuel Oil. The 19.8-MW Aggreko power plant is made up of 18 separate 1.1 MW (appx.) units, that provide the utility with greater flexibility.

Additional capacity comes from a utility-scale solar array, the Spanish Town Solar farm at the Willocks Substation, and VIWAPA's net metering program which is explained in subsection 3.2.3 Renewables.

Transmission and Distribution

The transmission and distribution system on St. Croix is comprised of a 69kV buried transmission line that links the only two substations on the island: Richmond Substation to the Willocks Substation. The remaining primary lines are 24.9 kV sub transmission lines and 13.8 kV distribution lines.

Most distribution lines are aboveground, along with pole-mounted transformers. These lines and poles are vulnerable during hurricanes, and this has been a source of multipoint failure across the island. There are multiple efforts to reduce this vulnerability by burying cabling, using stronger composite poles, and installing pad-mounted transformers.

Table 9. Estate Richmond Generating Units

ST. CROIX, ESTATE RICHMOND	UNIT TYPE	MW OUTPUT	PRIMARY & SECONDARY FUEL
STX 17	CT	21.9	LPG/#2FO
STX 19	CT	24.5	#2FO
STX 20	CT	24.5	LPG/#2FO
Aggreko	RICE	19.8	LPG
TOTAL CAPACITY		**90.7**	

3 USVI ENERGY PROFILE

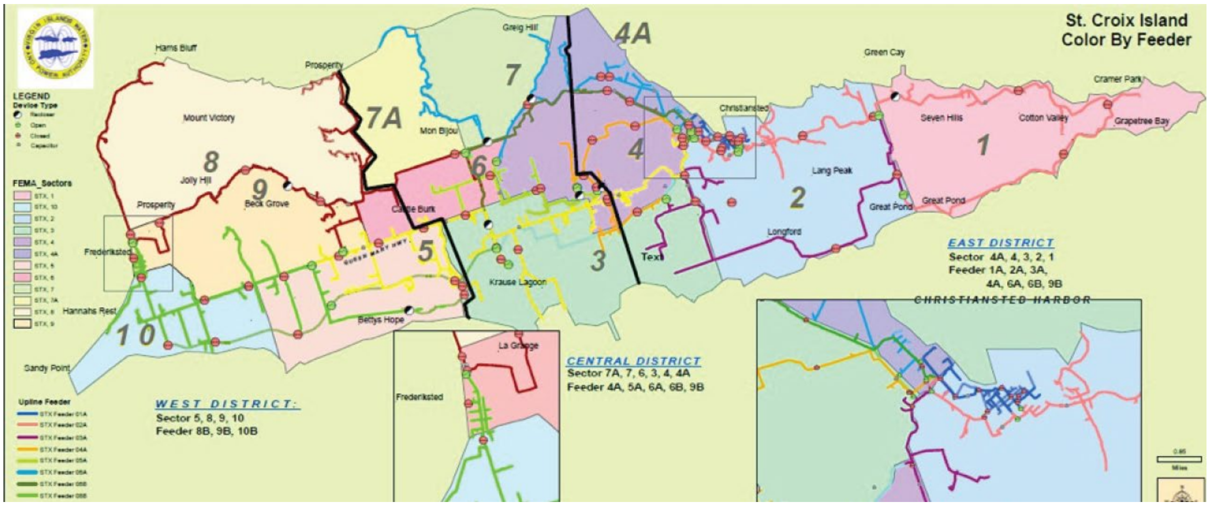

Figure 19. Feeder Map, St. Croix. Image Source: VIWAPA

3.2.3 Renewables

A small but growing percentage of USVI's electricity generation is provided by renewables. Currently, there are two utility-scale solar plants: 4-MW Spanish Town Estate Solar 1 on St. Croix and a 5-MW system located at Donoe on St. Thomas. Both are owned and operated by BMR Energy through a power purchase agreement (PPA) with VIWAPA. Additional renewable capacity come from distributed generation equipment spread across the Territory that accounts for 15 MW of Net Energy Metering and approximately 9MW from the Net Energy Billing Program territory-wide.

Future renewables include a waste-to-gas system planned for the new landfill and a 5MW solar array planned for St. Thomas (the Donoe Solar Farm) that is being rebuilt by BMR Energy. Additional plans for utility-scale renewables can be found in VIWAPA's Integrated Resource Plan.

Table 10 below lists the renewables and capacity of each renewable system currently operating, or soon to be operating, in the USVI.

The following paragraphs provide an overview of the two current and one planned source of renewables across the USVI:

Net Metering and Net Energy Billing

The NM program, codified in Law 7075 in 2009, allowed utility customers to interconnect renewable energy, small wind and solar PV. Aggregate capacity limit of all net-metered systems is 5 megawatts (MW) on St. Croix, and 10 MW on St. Thomas, St. John, Water Island, and other Territorial islands. The capacity limits of the net metering program have been met and the program closed in June 2017. Customers interconnected under net metering still receive retail credit for exported energy. Currently, a temporary net energy billing (NEB) policy was adopted by consensus between GVI, VIWAPA, VIEO, and the PSC. This policy was publicly rolled out in late 2021. NEB does not have any published system size or program cap limits.

Customers who register their systems under the NEB program are compensated for exported energy at a rate of 75% of VIWAPA's avoided fuel cost, reflected in the fuel surcharge customers.

Table 10. Renewable Energy for St. Croix and St Thomas

NAME	TYPE	CAPACITY MW (AC)
Net Metering-STX	Solar PV	5
Spanish Town Solar STX	Solar PV	4
Net Metering-STT	Solar PV	10
Donoe Solar Farm, STT	Solar PV	5
Net Energy Billing (Territory-Wide)	Solar PV	9
TOTAL CAPACITY		**24**

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Spanish Town Solar Farm St. Croix

The Spanish Town solar plant in St. Croix— in operation since 2015—received significant damage during the 2017 hurricanes. The plant remained offline for nearly 5 months while grid repairs were implemented, and production was limited to less than 45% of its energy capacity once reenergized. BMR Energy assumed restoration efforts and the PPA with VIWAPA in August 2018 and restored the plant to full capacity, ~ 3.9 MW, with improved storm resilience, in November 2018.

Donoe Solar Farm, St. Thomas

The largest solar facility in the Virgin Islands is the Donoe Solar Farm on St. Thomas, which came online in 2015 with 4.2 megawatts of generating capacity. Much of the solar farm was destroyed by Hurricane Irma in September 2017. In October of 2019, BMR USVI Renewables, LLC agreed to restore and redevelop the site with 5.05 MW. The facility became fully operational in July 2022. Power is sold to WAPA under a PPA to provide power for 25 years.

3.2.4 Electricity Prices in the Territory

Historically, most electricity generated on the islands has been fueled by imported petroleum. Fuel surcharges for diesel and residual fuel oil have typically resulted in USVI electricity rates up to three times higher than the U.S. average price for electricity.

Table 11. USVI Electricity Prices vs. Average U.S. Electricity Prices

SECTOR	USVI (Sep '23)[23]	US (May 23)[24]
Residential	40.85 ¢/kWh	16.14 ¢/kWh
Commercial	47.36 ¢/kWh	12.31 ¢/kWh

The USVI electricity grid's reliance on imported petroleum for power generation have resulted in major fluctuations in electricity rates that follow overall fuel price fluctuations. In some instances, this has resulted in electricity rates up to five times higher than the average U.S. electricity rates. These rate increases are billed to customers via a levelized energy adjustment clause (LEAC) factor which is subject to approval by the USVI Public Service Commission. The LEAC factor is essentially a surcharge on customer utility bills that allows VIWAPA to increase or decrease electricity rates based on fuel price fluctuations.[25]

3.3 RETAIL FUEL

Fuel retailers on St. Croix purchase from wholesalers (referred to as "the rack") at wholesale prices from Gulf Oil, and then sell at retail prices to end users. Retailers on St. Thomas and St. John may purchase from the rack at Ocean Point, but they may also purchase from other rack locations such as Puerto Rico. Fuel prices on St. Thomas and St. John are usually higher than St. Croix because these islands must purchase from an off-island source.

All fuel (gasoline, diesel, aviation, marine) is supplied through wholesalers bringing fuel to the islands. It is then sold to commercial retailers who then sell to all end users. End users include USVI government agencies for vehicles and generators, commercial users, hotels and hospitals, and households for personal vehicles and generators.

It is important to note that government agencies have limited fuel storage capacity. Emergency generators typically have fuel for 72 hours of operation before refueling is needed. Government fuel storage capacity for emergency vehicles is unknown. Government agencies such as the USVI Port Authority and Department of Public Works have fuel sourcing contacts with retailers to supply fuel during emergencies.

[23] VIWAPA, 2022, "Electric Rate as of March 1, 2022," accessed Sep 26, 2023, https://www.viwapa.vi/customer-service/rates/electric-rate.

[24] U.S. Energy Information Administration, 2023, "US Virgin Islands: Territory Profile and Energy Estimates," accessed Sep 26, 2023, https://www.eia.gov/state/analysis.php?sid=VQ.

[25] Corrie Clark, Richard Campbell, and D. Andrew Austin, 2018, *Potential Options for Electric Power Resiliency in the U.S. Virgin Islands*, Congressional Research Service, https://sgp.fas.org/crs/row/R45105.pdf.

Table 12. Retail Fuel Sourcing for Critical Assets

AGENCY/FACIL-ITY	CRITICAL ASSET	STORAGE CAPACITY	FUEL TYPE	FUEL SUPPLIER	SOURCE
PORT AUTHORITY					
Henry E Rohlsen Airport, and Fire Station, St Croix	Airplanes, Generators, Emergency Vehicles	Fuel Farm, 72 hours tanks for generators	Jet-A, Avgas, Diesel, gasoline	Puma	Rack-Gulf Oil at Ocean Point Terminals
Gallows Bay, St Croix	Marine Terminal generator		Diesel		
Cyril E. King Airport, and Fire Station, St Thomas	Airplanes, Generators, Emergency Vehicles	Fuel Farm, 72 hours tanks for generators	Jet-A, Avgas, Diesel, gasoline	Total Fuel	Rack – Cargo Port
Blyden Marine Terminal, St Thomas	Marine Terminal Generator	500 gallons	Diesel	Tri-Island Energy, LLC	Pier Less, Puer-to Rico
Fredricks Marine Terminal, St Thomas	Marine Terminal Generator	1,200 gallons	Diesel	Tri-Island Energy, LLC	Pier Less, Puerto Rico
Moorehead Terminal, Cruz Bay, St John	Marine Terminal Generator	155 gallons	Diesel	Enighed Contant Gas	Royal Petroleum (Shell) -Puerto Rico
BLYDEN MARINE TERMINAL, ST THOMAS					
DPW Facilities – St Croix	Generators, Vehicles	72 hours tanks for generators	Diesel	Bunkers of St. Croix	Rack-Gulf Oil at Ocean Point Terminals
DPW Facilities – St Thomas	Generators, Vehicles	72 hours tanks for generators	Diesel	Tri-Island Energy	Pier Less, Puerto Rico

3.4 Ocean Point

The Port Hamilton Refiner (formerly Limetree Bay Refinery) on St. Croix was once one of the 10 largest crude oil refineries in the world and was a substantial part of the USVI's economy providing most of the islands' petroleum products until it was shut down in early 2012. The refinery reopened briefly to produce marine fuel that meets new international low-sulfur requirements that take effect in 2020 but is currently closed indefinitely.

Located near Port Hamilton Refinery is a fuel terminal that was formerly owned by the refinery and was named Limetree Bay Terminal. It is now under separate ownership and is called Ocean Point Terminals.[26] It is a maritime terminal for storage of petroleum products. The terminal has 167 tanks capable of storing over 30 million barrels. Its Caribbean location makes it a key hub for the global crude and refined products markets close to Central and South America, Mexico, West Africa, and the U.S. Gulf Coast export markets. It also serves customers on St. Croix.

Ocean Point Terminals specifications include:

- Tank assets include 167 tanks with approximately 34 million barrels of crude oil, refined products, and LPGs storage capacity
- Tanks vary up to 284' in diameter (capacity of up to 630 thousand barrels each)

Figure 20. Limetree Bay Refinery and Terminal on St. Croix

- Customer segregated tankage with common import/export pipelines
- Fleet of six tugboats to conduct dock berthing operations
- Deepwater port with 11 docks (including single point mooring, or "SPM") for the receipt and global shipment of crude and refined products
- South-facing port with protective jetty, allowing easy access with minimal demurrage
- Protected inland port has resulted in fewer than three days of weather closures per year over last 14 years
- Extensive existing pipeline interconnectivity and jumpers allow for highly flexible product movements into and around the facility
- Aboveground piping facilitates ease of maintenance and expansion

[26] The Virgin Islands Consortium, 2022, "Limetree Bay Terminals Now Ocean Point Terminals, in Name Change Meant to Differentiate Company from Refinery," Aug 7, 2022, https://viconsortium.com/vi-business/virgin-islands-limetree-bay-terminals-now-ocean-point-terminals-in-name-change-meant-to-differentiate-company-from-refinery.

3.4.1 The Ocean Point Terminals Rack

Ocean Point Terminals leases bunker space to Gulf Oil, who stocks the tanks with refined product, various gasolines, diesel, jet fuels for wholesale pricing and “rack rate” to retailers. Retailers bring tanker trucks to the rack area at the terminal to take delivery.

The USVI Department of Licensing and Consumer Affairs (DLCA) supervises the regulation and licensing of businesses. DLCA publishes the rack rates from wholesalers as these numbers are available. Limetree Bay Terminal and Gulf Oil rack rates are usually published for the District of St. Croix. Retailers on St. Thomas and St. John purchase from different wholesalers with different rack rates from outside of the Territory. Fuel arrives at the Cargo Port and is offloaded immediately to retailers who take ferries for delivery to St. John.

3.5 ENERGY USERS BY SIZE IN THE USVI

The following outlines the categories of energy users by size in the Territory:

Large users:

- Airports
- Hospitals
- Refinery (closed and offline)
- Large resorts
- Rum distillery (currently off-grid)

Small users:

- Commercial
  - Gas stations
  - Restaurants & retail
- Government & municipal
  - Police
  - Fire
  - Library
  - Post office
  - Town hall
  - School
- Residential

4. USVI ENERGY DATA TRACKING PLAN

Image Source: USVI Government

The concept of the Energy Data Tracking Plan (EDTP) is to develop a framework for gathering, monitoring, and analyzing key energy supply, demand, and disruption data. It provides a roadmap for how to track, monitor and analyze energy information to develop a baseline during blue sky days and to provide accurate and timely energy information to VITEMA, the general public, and other organizations during and immediately following energy disruptions. The EDTP is not an existing program but a concept for improving data collection and response to emergencies.

The EDTP is intended to be updated on a regular basis as energy supply, demand, and consumption patterns and resources shift. Additionally, lessons learned from future energy disruptions should be incorporated into future iterations of the EDTP to ensure that vital energy data points are gathered, analyzed, and disseminated accurately and in a timely manner.

4.1 TRACKING ENERGY SUPPLY AND DEMAND DATA

Energy supply, demand, and distribution data must be tracked to help VIEO quantify energy supply and demand levels before, during, and after energy disruptions. Energy is supplied and distributed on the island two main ways: 1) petroleum supply chains; 2) electricity generation and distribution through the electrical grid; 3) renewable generation assets, including the solar array on St. Croix and distributed generation equipment spread across Territory; and 4) fuel retailers selling gasoline, diesel, aviation, and marine fuel directly to consumers.

In addition to tracking energy supply data, tracking demand will be critical to assessing the severity of energy disruptions and potential damages. It is important that data is tracked to understand the energy demand for USVI in general as well as the energy demand for critical infrastructure and systems such as hospitals, water desalination plants, emergency services, communications networks, and organizations that provide food and other supplies to vulnerable populations. These critical systems are described in greater detail in Section 1.5.

The following section describes the data VIEO needs to track energy supply and distribution, and how VIEO can engage with key organizations to ensure accurate and timely data is delivered to the VITEMA, the public, and other key organizations.

4.1.1 Petroleum

The USVI imports 100% of its petroleum resources, making USVI extremely vulnerable to disruptions in the complex petroleum supply chain. As a result, it is critical for VIEO to understand how the fuel supply networks operate and understand the interdependencies between each point in the supply chain in order to gather real-time information about petroleum supply network flows and reserve fuel.
A successful emergency response is highly dependent on the ability for local stakeholders to engage directly with fuel suppliers and distributors on a regular basis. VIEO will work to develop

relationships and trusted lines of communications with key contacts at each point in the supply chain. They should work with these contacts to ensure they have the proper data to establish an energy supply baseline during blue sky days and be able to anticipate specific energy supply problems that may arise during and following energy disruptions.

Table 13 identifies the key organizations at each point in the petroleum supply chain, the type of fuel provided by suppliers, and how supply information will be tracked.

Table 13. Key Organizations in the Petroleum Supply Chain and Tracking Methods*

SUPPLIER	FUEL	TRANSPORT/ TERMINAL*	RETAILER	END USER	TRACKING METHOD
VITOL	LPG	LPG Tanker-STX-Christiansted	IPOS	VIWAPA – Richmond Estate - STX	VIWAPA provides monthly report to VIEO
Glencore	#2 Fuel	Tanker-STX Christiansted	Glencore	VIWAPA-Richmond Estate-STX	VIWAPA provides monthly report to VIEO
VITOL	LPG	LPG Tanker-STT-Krum Bay	IPOS	VIWAPA-Randolph Harley-STT	VIWAPA provides monthly report to VIEO
Glencore	#2 Fuel	Tanker-STT-Krum Bay	Glencore	Tanker-STT rum Bay	VIWAPA provides monthly report to VIEO
Gulf Oil-Rack	Aviation, Diesel, Gasoline	Tanker-STX Rack Limetree Bay	Bunkers	Port Authority-Airport STX	VIPA provides monthly report
Gulf Oil-Rack	Diesel, Gasoline	Tanker-STX Rack Limetree Bay	Puma	Public Works-STX	DPW provides monthly report
Gulf Oil-Rack	Gasoline	Tanker-STX Rack Limetree Bay	Puma	General population, personal vehicles	Gulf Oil provides monthly report
Puerto Rico-Rack	Diesel, Gasoline	Barge Iso-SST Crown Bay	Tri-Island Energy	Public Works-SST	DLCA and DPW to provide monthly report
Puerto Rico-Rack	Aviation Diesel, Gasoline	Barge Iso-SST Crown Bay	Total Fuel	Port Authority-Airport SST	DLCA and DPW to provide monthly report
Puerto Rico-Rack	Gasoline	Barge Iso-SST Crown Bay	Puma, Total Gas, Race-track	General population, personal vehicles	PR provides monthly report

4. USVI ENERGY DATA TRACKING PLAN

VIEO will be responsible for coordinating with key organizations along the petroleum supply chain to track supply and reserve levels and disseminate accurate and timely data to VITEMA during and immediately following a disruption. VIEO roles and responsibilities may include:

- Establish relationships with petroleum suppliers, terminal operators, retailers, and end users identified in the table above.
- Develop lines of communication with regional stakeholders including VIWAPA and VITEMA as well as organizations that manage relevant shipping terminals and transportation corridors, such as the USVI Port Authority and the Department of Public Works.
- Coordinate a summit meeting between key organizations to:
  - Communicate and refine emergency protocols
  - Discuss past energy emergencies and identify potential issues in the supply chain during energy disruptions
  - Establish a communication protocol to ensure that each member of the petroleum supply chain is provided with timely and accurate data to mitigate effects of disruptions and aid in the recovery process
- Develop baseline for petroleum supply and end use demand that is updated on a regular basis and monitor petroleum reserves on a continuous basis to understand how long supply and reserves will meet end use demand.

4.1.2 Electrical Grid

VIWAPA owns and operates electrical distribution and central-plant generation. Electricity on USVI is generated by generation assets located on St. Thomas and St. Croix.

Most of the Territory's utility-generated electricity is produced from fossil fuels. VIWAPA's generating plants are a mix of combustion turbines and reciprocating engine generators operating on No. 2 fuel oil and LPG. These assets are outlined in Section 3.

VIEO is responsible for coordinating with VIWAPA to track key data related to the state of the electrical grid. They are responsible for disseminating accurate and timely data to VITEMA and other emergency services to enable these organizations to properly prepare for and recover from a disruption event. VIEO roles and responsibilities include:

- Establish relationships with VIWAPA staff tasked with gathering grid status information and discuss lessons learned from past energy emergencies.
- Work with VIWAPA to quantify general electricity demand as well as electrical demand from critical infrastructure and services such as hospitals and emergency services.
- Establish communication protocol to gather information regarding damage to grid facilities and equipment and disseminate information to VITEMA and other pertinent organizations.

4.1.3 Renewables

Renewables currently account for a small but increasing percentage of the Territory's energy supply. Current utility-scale renewable assets include the 4 MW PV plant at Spanish Town on St. Croix and a 5-MW plant at Donoe on St. Thomas. Both are operated by BMR through a power purchase agreement (PPA) with VIWAPA. Additional renewable capacity comes from distributed generation equipment spread across the Territory that accounts for 15 MW of net metering.

As outlined earlier, the USVI is dedicated to increasing renewable peak demand electricity generating capacity to 25% by 2020 and 30% by 2025. Additional plans for utility-scale renewables can be found in VIWAPA's Integrated Resource Plan.

Though renewables currently account for a small percentage of overall energy supply, renewables serve a crucial role during energy disruptions and can be a key resource to jump start recovery. As a result, VIEO should gather and analyze renewable energy supply data and disseminate this information to VITEMA, VIWAPA and other pertinent organizations. VIEO roles and responsibilities include:

- Establish relationships with BMR to gather energy supply data for the Spanish Town Estate Solar array before, during, and after energy disruptions. Discuss lessons learned from past energy emergencies.
- Establish relationships with VIWAPA staff tasked with monitoring data from distributed generation assets and discuss how these assets may alleviate energy demand during and immediately following disruptions.
- Monitor progress on future renewable capacity, particularly utility-scale renewable assets, including the 5MW solar array planned for St. Thomas. Ensure energy supply data is gathered from these assets once they come online.
- Establish communication protocol between BMR, VIWAPA, and VITEMA to ensure that the status and generating capacity of renewable energy assets is disseminated during and immediately following energy disruptions.

4.1.4 Retail Fuel Supply

All retail fuel is distributed to commercial retailers who sell to all end users including government agencies, commercial users, hotels, hospitals, and households. In addition to general use, this fuel is used to power critical equipment including generators and emergency vehicles. As noted in Section 3, the retail fuel distribution and consumption networks are vulnerable to disruptions: government agencies have limited fuel storage capacity; emergency generators typically have 72 hours of operation before refueling is needed; storage capacity for emergency vehicles is unknown.

VIEO must establish relationships with fuel retailers and develop a communications protocol that will allow them to gather retail fuel supply information and disseminate information to VITEMA and the general public. Table 14 outlines the aboveground (AST) and underground (UST) storage tanks supplying retail fuel to the USVI. More information about the tanks including physical addresses, contact information, and permit numbers can be found in Appendix A.

VIEO will be responsible for coordinating with fuel retailers to track fuel supply and disseminating accurate and timely data to VITEMA and the general public to enable proper preparation for and

4. USVI ENERGY DATA TRACKING PLAN

Table 14. AST and UST Storage Tanks Supplying Retail Fuel

FACILITY NAME	LOCATION	AST/UST	CAPACITY (GALLONS)
Gas Works, Inc.	St. Thomas	AST	176,545
Giant Gas Station	St. Thomas	AST	92,500
Chocolate Hole Gas Station	St. John	AST	55,000
Surtep Enterprises Inc., DBA PETRU GAS	St. Thomas	AST	61,200
Puma Budget	St. Croix	AST	30,000
Ayah Plaza Inc	St. Thomas	AST	50,300
Freedom City / Concordia / A&H	St. Croix	UST	22,000
FastWay/Amigo	St. Croix	UST	24,000
AT&T Northside	St. Croix	UST	12,000
In & Out / Remy / Capital / Farms	St. Croix	UST	16,000
Empire/ Paradise Petrol / Top Gas / Choice/ A-1 / Est. Mint	St. Croix	UST	21,000
Consumers / Get & Go	St. Croix	UST	28,000
Karim	St. Croix	UST	16,000
Fill & Chill/ Midpoint / Lower Love	St. Croix	UST	16,000
Flow & Go / Queen B / Prosperity / Covet	St. Croix	UST	16,000
Quickserve	St. Croix	UST	30,000
Puma Shuama / Shuama	St. Croix	UST	32,000
Sion Farm	St. Croix	UST	26,000
One Love West / VP West	St. Croix	UST	20,000
Gasaway / Superior / Queen Mary	St. Croix	UST	20,000
Ziggy / Smokey's	St. Croix	UST	20,000
One Love Service Center / One Love East (Princess)	St. Croix	UST	20,000
One Love Orange Grove / Lionel's	St. Croix	UST	34,000
Gasville / A&H / La Reine	St. Croix	UST	28,000
Gas for Less	St. Croix	UST	16,000
Five Corners	St. Croix	UST	20,000
Rite Way / Gas City 2 / Everybody	St. Croix	UST	20,000
DELMA/Gas City / VP Princess	St. Croix	UST	16,000
Eastend / Eastway / VP Boetzberg	St. Croix	UST	16,000
Super Tanks / VP Diamond	St. Croix	UST	23,000
Sam's Gas / VP Glynn	St. Croix	UST	24,000
Cruzan Petroleum / VP Peters Rest	St. Croix	UST	24,000

4. USVI ENERGY DATA TRACKING PLAN

FACILITY NAME	LOCATION	AST/UST	CAPACITY (GALLONS)
Welco	St. Croix	UST	16,000
Gateway	St. Croix	UST	20,000
Limetree Bay / Hovensa	St. Croix	UST	20,000
Abramson	St. Croix	UST	6,000
Target	St. Croix	UST	40,000
Gmax	St. Croix	UST	44,000
AT&T Peterborg	St. Thomas	UST	12,000
PG Barbel Plaza / DOMINO Barbel Plaza	St. Thomas	UST	28,000
First Stop / Value Foods / DOMINO Est. Thomas	St. Thomas	UST	24,000
First Stop East / DOMINO Est Frydenhoj	St. Thomas	UST	24,000
PG Smith Bay / DOMINO Est Smith Bay	St. Thomas	UST	20,000
TOTAL Bonjour, Esso Tutu, 4 Winds, Esso Energy Mart, On the Run	St. Thomas	UST	22,000
TOTAL One Stop Red Hook / Eddie's Mart / Esso One Stop	St. Thomas	UST	20,000
TOTAL Times Center Rodriguez / Esso Rodriguez	St. Thomas	UST	20,000
Jarrah Mini Mart / One Stop SS/ Esso One Stop Sugar Estate	St. Thomas	UST	20,000
Arch_Blue Fig/ Mt. Olive Hometown / Texaco Hometown	St. Thomas	UST	20,000
PUMA Pollyberg / Texaco Pollyberg	St. Thomas	UST	12,000
PUMA Smith Bay / Texaco Smith Bay	St. Thomas	UST	22,000
PUMA Tutu / Texaco Tutu	St. Thomas	UST	30,000
PUMA Veterans Drive / Texaco Veterans Drive	St. Thomas	UST	30,000
PUMA Yacht Haven Grande	St. Thomas	UST	70,000
TOTALSmart Mart Altoona, Esso One Stop	St. Thomas	UST	20,000
TOTAL Gottieb Quickway	St. Thomas	UST	30,000
PUMA Airport / Texaco Airport	St. Thomas	UST	20,000
PUMA Bovoni / Texaco Bovoni	St. Thomas	UST	16,000
PUMA Northside / Texaco Northside	St. Thomas	UST	10,000
Racetrack	St. Thomas	UST	20,000
American Yacht Harbor / PUMA AYH	St. Thomas	UST	40,000
AT&T Kronprindsens Gade	St. Thomas	UST	8,000
Judicial Branch of the Virgin Islands (VI Supreme Court)	St. Thomas	UST	6,000
E&C	St. John	UST	32,000

recovery from a disruptive event. VIEO roles and responsibilities may include:

- Establish relationships with fuel retailers, discuss lessons learned from past energy emergencies and develop communication protocol to track fuel supply and deliveries as well as damage to key facilities during disruption and recovery.
- Develop communication protocol to alert VITEMA and the general public to fuel levels at gas stations during disruption and recovery. VIEO may work with local radio stations to identify opportunities to broadcast fuel supply levels of various gas stations during and immediately following disruptions.
- Work with government agencies and other key organizations to quantify retail fuel demand for critical services (e.g., emergency service vehicles) to ensure critical fuel need is met during and immediately following disruption events.

4.2 IDENTIFYING POTENTIAL ENERGY DISRUPTIONS

In addition to tracking energy supply and demand to aid in recovery, VIEO should track data and develop indicators that can help them identify potential energy disruptions. The following section describes types of energy disruptions as well as the data that VIEO should track to identify those energy disruptions.

4.2.1 Types of Energy Disruptions

There are two major categories of energy disruptions: 1) external supply disruptions; and 2) internal/ distribution disruptions.

External Supply Disruptions

External supply disruptions are those caused by disruptions in the petroleum supply chain, or those that occur before the fuel is distributed to USVI for end use, including, but not limited to:

- Crude oil shortages caused by natural disasters, geopolitical factors, etc.
- Disruptions in shipping lines caused by inclement weather, labor disputes, etc.
- Petroleum shortages caused by disruptions at refineries
- Damage to terminals caused by natural disasters, poor facility maintenance, terrorism, etc.
- Disruptions in on-island fuel transport and delivery (ex: trucking) caused by natural disasters, labor disputes, economic issues, etc.

Internal Supply Disruptions

Internal/distribution disruptions are those caused on-island by disruptions in generating assets or distribution lines that prevent the energy from being distributed to the end user. These disruptions prevent a sufficient energy supply from being delivered to the end user. Internal/distribution disruptions include, but are not limited to:

- Damage to electricity generation equipment (steam turbines, combustion turbines, and renewable energy assets) caused by natural disasters or poor equipment maintenance.
- Damage to electricity distribution networks such as equipment malfunctions or downed power lines caused by natural disasters, aging equipment, falling trees, etc.
- Damage to local fuel retailers (e.g., gas stations) caused by natural disasters, equipment failures, etc.

4.2.2 Identifying and Tracking Energy Disruptions

The relationships and communications protocols established in Section 2.4 will allow the VIEO to identify potential energy disruptions across energy supply chains. In addition to these data, the VIEO should track data related to external threats including weather-related disruptions or geopolitical events such as terrorist attacks. Table 15 outlines indictors and actions to identify different types of energy disruptions.

4.3 POST-EVENT AFTER ACTION REPORTING

The VIEO should log key data related to energy disruptions and recovery efforts and incorporate data into a post-event after action report. Tracking and analyzing these data will allow VIEO to identify lessons learned from energy disruptions and recovery efforts and incorporate these lessons learned into future iterations of the EDTP and other emergency planning documents. The following section outlines a framework for logging, tracking, and analyzing energy disruptions.

4.3.1 Logging and Tracking

Energy supply disruptions should be tracked and logged and should be referenced as energy assurances strategies are updated. Key information related to how the disruption occurred and any corrective actions taken should be recorded. The table below provides the type of information that should be logged during disruption and recovery.

Table 15. Disruption Types, Indicators and Example Actions

DISRUPTION TYPE	INDICATORS	ACTIONS
Supply and demand disruptions	• Forecast for demand do not match supply • Reserves too low to meet demand	• Identify energy levels at which energy supply chain or government action is required • Identify demand reduction measures Maintain accurate log of storage inventories
Energy infrastructure failures	• Electrical generation or distribution outages (tree falling, etc.) • Equipment failure at substations • Equipment failures affecting energy transport (shipping, trucking, etc.)	• Work with VIWAPA to get updates regarding disruptions related to scheduled maintenance or unanticipated equipment failures
Price	• Embargos increase energy prices • Labor strikes increase energy prices Other price sensitivities	• Work with VIWAPA and the USVI PSC to identify ways to help low-income residents reduce sensitivity to price fluctuations
Weather-related disruptions	• Forecast of major heat wave • Forecast of major storms that could damage energy infrastructure or shipping routes	• Forecast energy needs for different weather scenarios • Identify demand abnormalities due to different weather scenarios
Other disasters	• Geological disasters such as earthquakes or tsunamis Terrorist attacks • Solar flares • Geopolitical upheavals affecting crude oil generation	• Review and monitor media events • Work with VITEMA and VIWAPA to anticipate potential disruptions

Table 16. Example Post-Disruption Log Information

DISRUPTION DATA	• Type of disruption • Time and date of start and end of disruption • Location of disruption • Number of customers affected Impact on affected customers • Duration of disruption
RECOVERY INFORMATION	• Corrective actions taken (supply, consumption, and demand) and by whom start and end time and date of corrective actions • Resources required to fully recover ($, outside assistance, etc.) • Recovery duration • Regions affected in recovery • Basic effectiveness of each corrective actions

4.3.2 Post-Event Analysis

Once the USVI has fully recovered from an energy disruption, the VIEO should analyze the event to identify ways to improve response to future disruptions. Post-event analysis should include the following steps:

1. Develop a chronology of the disruption and recovery. Chronology should include:
   a. Root cause of disruption
   b. Start, duration, and resources required to identify the disruption and assess its severity
   c. Start, duration, and resources required for each corrective response and recovery action.
2. Develop a post-event analysis of the overall effectiveness of event response and recovery using the chronology developed in step one. Post-event analysis should answer questions including, but not limited to:
   a. How quickly was the disruption identified? How accurately was the severity determined? Did the data provide a timely warning of the disruption?
   b. How did data contribute to disruption identification, response, and recovery? Were the data adequate and accurate? What data should be collected to ensure a better response to future disruptions of this type?
   c. How did the disruption affect the community?
   d. What corrective actions were taken during the disruptions? How effective were they at preventing the spread of the disruption?
   e. What corrective actions were taken after the disruption? How effective were they at delivering comprehensive and timely recovery?
   f. What was the actual recovery time vs. the estimated recovery time?
   g. How can the USVI better prepare for future disruptions of this type?
   h. How can the USVI emergency protocols and processes be updated to ensure a better response to future disruptions of this type?
3. Incorporate lessons learned into USVI emergency response and recovery protocols and processes.

4.4 VIEO ROLES AND RESPONSIBILITIES

At a high level, VIEO's role is to: 1) gather, analyze, and disseminate key information related to the USVI's energy supply and demand during and immediately following energy disruptions, and 2) track data and indicators that will help identify potential energy disruptions, and develop a post-event after action report to identify lessons learned from emergency response and recovery efforts to incorporate into future emergency planning efforts.

Table 17 provides a high-level summary of VIEO's roles and responsibilities before, during, and after energy disruptions. More information about each of these roles and responsibilities can be found in the previous sections.

4.4.1 Data Needs and Sources

As outlined above, it is critical that VIEO has access to accurate data in the event of an emergency. As such, VIEO must establish lines of communication with key sources of critical data and establish a procedure for collecting this information on a regular basis. Table 18 identifies the data needed, sources of that data, and how often they should be collected.

Table 17. VIEO's EDTP Roles and Responsibilities

VIEO'S EDTP ROLES AND RESPONSIBILITIES		
1. TRACK AND DISSEMINATE KEY ENERGY DATA		
BEFORE DISRUPTION	**DISRUPTION**	**RECOVERY**
• Establish working relationships and communication protocols with key contacts at each point of energy supply chain • Track fuel levels and reserves on an ongoing basis • Analyze demand data to understand electrical and retail fuel demand and consumption patterns for all of USVI as well as critical systems	• Engage with contacts to verify supply/reserve levels and delivery timeframes • Engage with WAPA and fuel retailers to identify scope and severity of disruption (e.g., how many customers are affected and where) • Disseminate information to VITEMA and other emergency organizations	• Monitor and track supply/reserve fuel levels • Verify fuel deliveries • Monitor and track recovery efforts in energy distribution networks (e.g., scheduled repairs and results) • Monitor and track energy demand recovery data (e.g., how many customers have resumed power and when) • Disseminate information to VITEMA and other emergency organizations
2. IDENTIFY POTENTIAL ENERGY DISRUPTIONS AND DEVELOP POST-EVENT AFTER ACTION REPORT		
BEFORE DISRUPTION	**DISRUPTION**	**RECOVERY**
• Track internal energy disruption indicators including infrastructure failures, grid overloads, etc. • Track weather and other disaster-related indicators	• Track key energy disruption data	• Track data related to recover efforts • Analyze disruption and recovery data and develop post-event after action report • Work with VITEMA and other organizations to incorporate lessons learned into future emergency planning efforts

4. USVI ENERGY DATA TRACKING PLAN

Table 18. Data Needs

	DATA NEEDED	SOURCE	FREQUENCY
ENERGY SUPPLY	Locations of all terminals and transportation networks	Port Authority, IPOS, VI DPW	One time
	Petroleum supply	VIWAPA	Weekly
	Petroleum reserves	VIWAPA	Weekly
	Petroleum burn rate	VIWAPA	Weekly
	Post-event status of petroleum deliveries	VIWAPA	Real time
	Locations and generation capacity of all renewable generation assets	VIWAPA, BMR and others as developed	Annual
	Total electricity generated from renewable sources	VIWAPA, BMR and others as developed	Weekly
	Forecasts for electricity generated from renewable sources	VIWAPA, BMR and others as developed	Weekly
	Retail fuel locations	Local retailers	Annually
	Retail fuel supply and deliveries	Local retailers	Real time
	Post-event status of fuel deliveries	Local retailers	Real time
ENERGY DEMAND	All-island electricity consumption	VIWAPA	Monthly
	Energy consumption of critical systems and services	VIWAPA, Energy managers at critical services organizations	Monthly
	Retail fuel consumption by type (gas stations, marine, jet fuel, etc.)	Local retailers	Monthly
	Retail fuel consumption of critical systems and services	Critical systems operators	Monthly
DISRUPTION DATA	Supply chain disruptions	Fuel suppliers	Real time
	Damage and operational status of fuel terminals	VI Port Authority	Real time
	Damage and operational status of transportation corridors	VI Port Authority and DPW	Real time
	Damage and operational status of electrical generation and distribution systems	VIWAPA	Real time
	Damage and operational status of local fuel retailers	Local retailers	Real time
	Weather forecasts	NOAA's National Weather Service	Ongoing
	Electrical outage information	VIWAPA	Real time
	Other disruption information (geological disruptions, terrorist attacks, etc.)	Various	Real time

5. Risk Assessment – Energy Infrastructure

Risk Assessment Summary

An electrical power system shall be defined as an interconnected or autonomous set of transmission lines, distribution lines, substations, central power generation stations, other sources of power, distributed energy resources, or enabling technologies and services, such as industry-standard billing, accounting information technology, cybersecurity enhancements, microgrids and fuel transfer delivery systems, that are necessary for the provision of reliable, resilient, stable, and cost-effective electrical service. The Virgin Islands unstable electrical system exposed by Hurricanes Irma and María is still felt every day by the Territory's residents. As the current condition of the electrical power system is critical, the system will remain extremely weak and susceptible to collapse from any future major event, in which vulnerable communities will suffer the most, unless action is taken to address systemic issues. Every community in the Territory deserves to enjoy a strong, reliable, and resilient electrical power system that ensures the tranquility of the people and a better quality of life for residents.

Risk Assessment Methodology

Hurricane winds, earthquakes and flooding are the disasters which pose the greatest threat to the electrical infrastructure of the territory. The 2019 Hazard Mitigation Plan (THMP) cites data from the Atlantic Oceanographic and Meteorological Laboratory that calculates a 42% annual chance of a hurricane or tropical storm striking the US Virgin Islands. During Hurricanes Irma and Maria, high winds toppled overhead utility lines, while heavy rains and flooding damaged electrical substations and the generators at the power plant resulting in customers territory-wide losing power, some going without electricity for several months. Over 90% of all aerial power lines were damaged during the storms, and about 7500 poles were damaged on St. Croix. The 4-megawatt utility-scale solar installation on St. Croix at Estate Spanish Town Solar Project experienced damage although it was not a complete loss like the facility on St. Thomas. All the generators at Richmond experienced water intrusion to varying degrees, which caused countless electrical faults and prevented the units from being immediately returned to service without inspections, cleaning, and the replacement of several motors and MCCs. This wreaked havoc on both the population and businesses in the territory. In the aftermath of the disasters, the recovery efforts focused heavily on the transmission and distribution components. First CAT B FEMA funding facilitated the replacement of the overhead utility lines to restore the power. After those efforts in the immediate aftermath of the storm, FEMA awarded CAT F mitigation funding to facilitate the installation of resilient composite polls and the undergrounding of utility lines to improve the electric grid's resistance to windstorm damage. A sophisticated analysis was performed that considered the number of customers served, the terrain and the main backbone of each feeder to determine which areas would receive composite poles and which areas would be buried. These efforts will significantly improve the transmission and distribution network's resiliency to damaging wind events.

5. Risk Assessment – Energy Infrastructure

Electrical power systems are vulnerable to the high winds, coastal flooding, and extreme precipitation that hurricanes bring. Due to its unique location, the Territory is at risk of experiencing a variety of hazards including tropical winds, storm surge, flash flooding, sea level rise, coastal erosion, extreme heat, drought, earthquakes, wildfires, tsunamis, and pandemics. On average, a hurricane passes by the islands every three years and makes a severe impact on the islands every eight years.

Before Hurricanes Maria and Irma, the USVI was most significantly impacted by Hurricane Marilyn in 1995, Hurricane Hugo in 1989, and smaller hurricanes and tropical storms in between, too. Over the last century, hurricanes and other tropical storms that pass within two degrees of the USVI are highly concentrated in September and October. The risk of impacts tied to natural disasters and climate change is captured in the credit rating for WAPA, for example, as one of the metrics tied to environmental, social, and governmental (ESG) issues as reported in the Fitch Ratings. WAPA projects incorporating hardening, mitigation, and redundancies are attempts to address the extreme weather event risks. WAPA's financial situation over the last several years, with negative operating balances, cash flow management challenges, and vendor payment delays, continues to contribute to future vulnerabilities if left unaddressed.

The territory can create more resilient systems that work well and are developed in a sustainable manner that will serve residents well for many years to come, making this plan a critical document for the Territory's residents. Given the time and bandwidth constraints, Virgin Islands Energy Office risk assessment uses information from a variety of existing resources and conversation with VITEMA and other stakeholders. The Virgin Islands Energy Office will update their risk assessment in the coming year to be more comprehensive, incorporating new information, delving deeper into the secondary and tertiary impacts, and expanding the threats and hazards. Another aspect of this future work will involve ongoing efforts to socialize and validate the risk assessment with public and private energy stakeholders, as well regional partners.

USVI's risk assessment methodology utilizes information and analysis from the Energy Sector Profile (located in Section 3), the DOE's Energy Sector Risk Profile, USVI Hazard Mitigation Plan, conversations with stakeholders including the VITEMA and VI Water and Power Authority, and the energy expertise of staff from the Virgin Islands Energy Office.

Hazard/Facilities	Power Plant	Solar Farm	Electrical Substations	Power Lines
Rain-driven Flood				
Coastal Flooding				
Hurricane				
Earthquake				
Tsunami				
Drought				
Landslide				
Wildfire				
Hazardous Materials				
Cyberattack				
Infectious Diseases				
Transportation				
Sargassum				

Legend		
High Impact		Requires urgent preventative actions.
Medium Impact		Analyze the most economically viable measures to strengthen facilities and actions that should be prioritized.
Low Risk/ Impact		Minimal Impact but requires a review of facilities/infrastructure.

5. Risk Assessment – Energy Infrastructure

Power System Interdependencies

The electric power system in the Territory supplies energy essential to many critical services, such as communication systems, hospitals, industry, schools, and water supplies. Specific critical loads must be considered relevant unmet needs for the entire Territory when looking at the existing electrical systems. These include essential logistics assets needed before and during the disaster recovery process to ensure the materials supply chain and the continuity of production for crucial products. Considering the lessons learned from Hurricanes Irma and María, the power supply for these critical loads must be reliable and resilient, requiring work on many different components to make sure that all parts function as well as possible when linked together, anticipating where weak points may be to shore them up in advance while anticipating what may be needed to fix problems during future disasters.

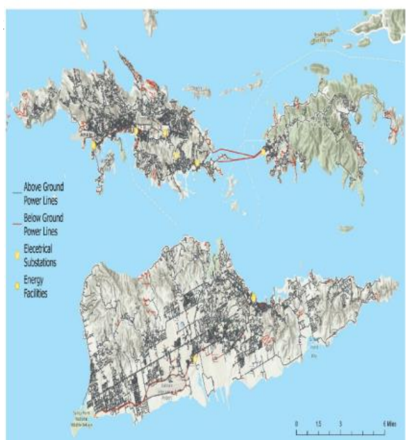
A fault in the electric power service can endanger the lives of many individuals, such as patients in a hospital without a reliable backup power system, and negatively affect the operation of commerce and industry. These interdependencies were widely documented in the aftermath of Hurricanes Irma and María, which only compounded already ongoing difficulties within the system and revealed significant concerns on the current system's limitations and its long-term impact on the population. When the electric power system suffers from an outage, connected critical services are hindered or cease to work until the situation is resolved. Frequent outages can cause a chain reaction resulting in the collapse of other essential services.
A dependency is a unidirectional relationship between two assets, where the operations of one asset affect the operations of another. Upstream dependencies refer to assets that directly influence the operations of a given asset, while downstream dependencies are those impacted by the operations of the given asset. For example, fuel importation facilities in the U.S. Virgin Islands (USVI) serve as upstream dependencies for power plants, as timely fuel deliveries are necessary for power generation. On the other hand, hospitals are downstream dependencies, requiring a stable electricity supply to provide healthcare services. Interdependency is a bidirectional relationship, where both assets rely on each other's operations. For instance, desalination plants in the USVI require electricity to produce potable water, which is also critical for cooling and other functions at power plants. These interdependent relationships are crucial for maintaining essential services across the islands. The disruption risk of critical desalination processes can be triggered by a variety of threats. For example, in August of 2022, Governor Albert Bryan Jr. announced that the White House had approved his request for federal support in protecting the V.I. Water and Power Authority's water plant on St. Croix from becoming overrun by the large influx of Sargassum seaweed that threatened to disrupt normal water production on St. Croix.

Interdependencies between infrastructure systems enable critical functions, such as electricity distribution and water management. However, these linkages also amplify the risks of disruptions. In the USVI, the interdependencies between the energy sector and other critical sectors, expose the islands to indirect disruptions. The USVI's reliance on imported fuel, which typically arrives through a limited number of ports that are challenging to navigate, creates unique economic and physical vulnerabilities. In 2024 critical fuel delivery disruptions have occurred due to adverse weather conditions, delayed fuel payments, and delivery vessel unavailability due to mechanical issues. The aforementioned events resulted in rotating power outages across the territory, and the threat of future instances continues to loom.

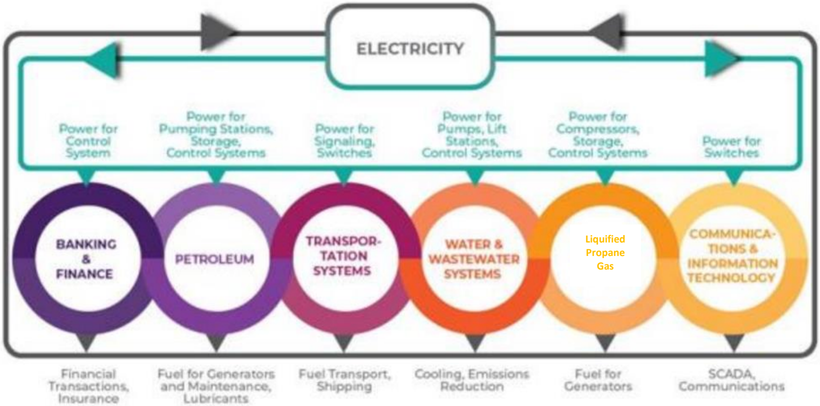
Damage to energy infrastructure in the USVI can lead to widespread service disruptions, affecting public services, government operations, and emergency services for uncertain periods of time. These outages may create cascading impacts on critical sectors, including healthcare, communications, and water supply, and could also undermine the resilience of local supply chains. For example, In May of 2024, the island of St. John was subject to consecutive days of power outages due to a damaged Subsea Transmission line. Under normal conditions, there are two lines running from St. Thomas to St. John, however, due to unresolved transmission line repairs a single point of failure exists and places the entire island of St. John at a risk that was realized and lasted for nearly a week.

The USVI's key economic tourism sector is especially sensitive to energy disruptions. For example, extended power outages during peak tourism seasons could significantly impact visitor experience, straining an economy heavily reliant on this industry. While government agencies and some essential services, like hospitals, often have backup generators, prolonged power interruptions could still severely impact overall operations and the islands' long-term resilience. The energy sector's interdependencies with other critical infrastructure in the U.S. Virgin Islands underline the importance of robust planning and resilience-building to mitigate the risks posed by these complex relationships. The Energy Sector includes power plants fueled by fossil fuels, solar farms, electrical substations, and power lines spread across the region. The two primary power plants on St. Croix and St. Thomas are situated near the coast, making them vulnerable to flooding caused by rainfall, coastal flooding, and tsunamis. Furthermore, these power plants are built on infilled land, which puts them at higher risk of damage during earthquakes. Distribution and management of power from power plants heavily rely on electrical substations, which are vulnerable to natural disasters like earthquakes, tsunamis, landslides, and wildfires. Furthermore the energy sector's heavy dependence on computer systems makes it susceptible to cyberattacks.

Figure 4.11: WAPA Transmission and Distribution System



5. Risk Assessment – Energy Infrastructure



Energy Sector Interdependencies Impact:

Source: 2024 Hazard Mitigation Plan

Legend	
	Severe service disruption across major parts of the system or to critical facilities that significantly affect system functioning.
	Moderate service disruption across portions of the system or critical facilities that would have some effect on system functioning.
	Limited-service disruption to the system or critical facilities would have a limited effect on system functioning.

Impact of failure of the energy sector on other systems/lifelines

Safety and Security	Food, Hydration Shelter	Health and Medical	Communication	Transportation	Hazardous Materials	Economy	Education	Housing	Natural Resources	Cultural Resources	Solid Waste	Water & Waste-water

Figure 5 Hazard Consequence Impact for Energy Lifelines by Island

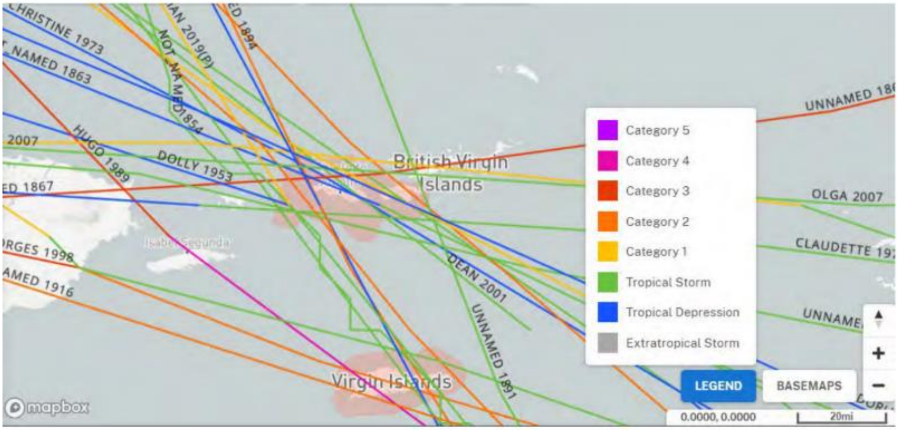
Hazard	Consequence Classification St. Croix	Consequence Classification St. John	Consequence Classification St. Thomas
Drought	Low Impact	Low Impact	Low Impact
Earthquake	High Impact	High Impact	High Impact
Flooding (Designated Special Flood Hazard Area)	High Impact	Low Impact	High Impact
Four Feet of Sea Level Rise	Low Impact	Low Impact	Low Impact
Storm Surge from a Category 5 Storm	High Impact	Low Impact	Low Impact
Hurricane Winds	Low Impact	Low Impact	Low Impact
Rain-Induced Landslide	Low Impact	Low Impact	Low Impact
Tsunami	Low Impact	Low Impact	Low Impact
Wildfire	Low Impact	Low Impact	Moderate Impact
Pandemic/Disease Outbreak	Low Impact	Low Impact	Low Impact
Source: USVI CDBG-MIT Action Plan			

5. Risk Assessment – Energy Infrastructure

Hurricane winds have historically been a major source of damage in the US Virgin Islands, spawning two disaster declarations in 2017 and accounting for nine of the 22 deadliest, most expensive, and most intense hurricanes to strike outlying US territories and Hawaii in the past century (2019 Hazard Mitigation Plan). Since October 1984, Hurricanes Klaus, Hugo, Marilyn, Lenny, Omar, Earl, Irma, and Maria have had significant impacts to the islands Given its location and hurricane history, the US Virgin Islands are categorized in Wind Zone 4, where requirements for strength design wind speed are the highest at 145 mph (FEMA 2009, FEMA 2015, USVI 2019).

Since the 1850s, the US Virgin Islands have been impacted by 24 hurricanes or tropical storms that passed through the territory, the most recent of which was Hurricane Dorian in 2019. The following image shows the path and strength of storms impacting the US Virgin Islands.

Figure 39. Hurricane Paths Impacting the US Virgin Islands (1850-2019)



Source: National Hurricane Center

Figure 4 Chronology of Significant Natural Disasters in the US Virgin Islands, 1989 to March 2013

September 17, 1989	Hurricane Hugo struck the USVI and damaged 60% of the electric distribution system in St. Croix. WAPA restored the system and received disaster funding from FEMA of approximately $55 million (accounting for overpayment).
September 15, 1995	Hurricane Marilyn struck the USVI and damaged the electric distribution system. Estimated cost of repairs was $45 million, and WAPA funded restoration and rehabilitation through various means.
September 15, 2004	Tropical Storm Jeanne damaged WAPA facilities. Estimated repair costs were approximately $1 million.
October 16, 2008	Hurricane Omar struck the USVI and caused an estimated $3 million worth of damage to the electric distribution system.

Other factors for consideration in assessing energy systems in the USVI include reliability, performance, and economic pressures. WAPA's generation capacity is comprised of older infrastructure much of which is past its original useful life and as result has led to vulnerabilities and interruptions of service. WAPA's financial constraints have also led their generation to suffer from a lack of appropriate maintenance which has resulted in a lack of reliability. . WAPA's current generation portfolio on the island of St. Croix consists of three operational gas turbines that are owned outright and 18 Aggreko units that are leased at a very high monthly cost. It is important to note that the forced outage rate (FOR), which is the percentage of scheduled operating time that a unit is out of service due to unexpected failures, is very high on the WAPA-owned units, particularly when compared to that of the newer Aggreko units. This significantly impacts WAPA's ability to provide reliable power consistently. While WAPA has backup generators, they were not designed to run for extended periods to offset outages.

6 USVI PLAN FOR ENERGY RESILIENCE

The Territory reached a tipping point after the hurricanes of 2017. The current state of the energy supply chain as laid out in Section 3 of this document shows that the Territory is making sweeping and quick changes to its energy supply particularly the electrical grid. This is exemplified by both the grid hardening measures to the transmission and distribution systems and the improvements to the power plants at both generation stations (retiring old systems and replacing them with more efficient and fuel flexible systems, etc.). These improvements were necessary not only to get back online from the 2017 hurricanes, but to be more resilient for the next storm.

To complement grid hardening and further energy resilience, USVI should develop a long-term transition plan that moves the Territory to a more resilient energy system that consists of more renewable energy systems, is less dependent on fossil fuels, and is built around distributed energy resources. VIEO will additionally embark on a public education campaign to promote the TESP as well as energy efficiency and resilience throughout the Territory. The National Institute of Building Sciences 2019 report, Natural Hazard Mitigation Saves, concluded that "Based on the mitigation measures the project team examined for the Interim Report, mitigation remains a solid investment."[27] One cost-benefit analysis showed that for every $1 spent on mitigation activities, a utility saved $8 or $9 in recovery costs from future events and disasters, with an even higher potential depending on the adopting and implementing mitigation strategy.[28]

6.1 ENHANCING THE RESILIENCE OF ENERGY SYSTEMS

Since the hurricanes of 2017, ongoing recommendations and efforts have been made to fortify the existing transmission and distribution grid by burying power lines where possible and using composite poles that are better fit to stand up to storms, replacing pole-mounted transformers with pad-mounted units, and improving the communication of the SCADA and AMI systems to allow for improved grid operations.

Table 19 provides a snapshot of the ongoing grid hardening measures.

[27] Multi-Hazard Mitigation Council, 2019, Natural Hazard Mitigation Saves: 2019 Report, National Institute of Building Sciences, https://www.nibs.org/files/pdfs/NIBS_MMC_MitigationSaves_2019.pdf.

[28] ICF International Inc., 2021, "Finding and building resilience in the power grid," Jan 25, 2021, https://www.icf.com/insights/disaster-management/resilience-power-grid-interview.

Table 19. Summary of Ongoing Grid Hardening Measures

RESILIENCE / GRID HARDENING MEASURES	ST. CROIX	ST. THOMAS	ST. JOHN	WATER ISLAND
*Composite Poles	34% of poles replaced. Scheduled completion March 2024, 5,368 poles.	32% of poles replaced. Scheduled completion January 2024, 3089 poles.	54% of poles replaced. Scheduled completion January 2024, 3021 poles.	**100% of poles replaced. 200 poles.**
Underground Circuits	All PW 126 St. Croix projects paused pending archeologist approvals.	Submarine cable from Harley to East End Station. Engineering and Design RFP at WAPA level to make changes recommended.	Work will begin in non-historic and non-CZM zone on April 1, 2021. CZM Coastal Consistency Permit Approved.	**n/a**
Substation Repair and Hardening	Gregory E. Willocks Substation	Completed: East End Substation 34.5 kV Air insulated switchgear with GIS & Construction of Concrete building and control room with emergency generator. 20% complete: 13.8 kV Air Insulated Switchgear with GIS.	Replacement of Damaged Power Transformer E-T2 – Completed	**n/a**
Improve Grid intelligence by AMI and improved SCADA systems	AMI restoration and improvements started	AMI restoration and improvements started	AMI restoration and improvements started	AMI restoration and improvements started
Critical Infrastructure and Key Resources	Recommendation: Include in Tier 1 a list of access points (roads, bridges) to major critical infrastructure that, in order to restore power to the CIKR, would need to be cleared from debris to access. In doing so, any potential hazards can be cleared first on very specifics roads or access points to critical infrastructure through a rapid needs assessment.			

6.2 GENERATION TRANSFORMATION VIWAPA developed an integrated resource plan (IRP) with the overall objective of identifying the best mix of generation resources that can achieve safe, adequate, and reliable power at the lowest reasonable cost and environmentally acceptable manner. The IRP was a cost-driven exercise that was also guided by the need for system reliability, fuel flexibility, and the Territory's desire of having 25% of the installed capacity from renewable energy resources by 2020 and increasing to 50% by 2044.

The IRP modeled economics associated with capital costs, maintenance, fuel, and funding sources for more than 20 scenarios at St. Thomas and St. Croix. The plan considered the current generating units at the generating stations on both districts and provides options for replacement of outdated units with more flexible and efficient fossil generators that can operate on LPG or diesel. It also considered renewable sources like wind, solar, and waste-to-energy in addition to battery energy storage system (BESS). VIWAPA reviewed the plan and has expanded on the initial recommendations. The IRP recommendations and final measures are laid out in the next sections.

6.3 2019 VIWAPA INTEGRATED RESOURCE PLAN

The 2019 VIWAPA IRP looked at the existing generating stations on St. Thomas and St. Croix as the backdrop for improvements. It evaluated the economics of meeting future load requirements with a diverse set of generating options including reciprocating internal combustion engines (RICE units), simple cycle combustion turbines (CTs) and combined cycle (CC), and the following renewable energy, RE, systems; solar, wind, and waste-to-energy. BESS options were also considered.

The study made the following conclusions and recommendations:

- Significant savings are realized if VIWAPA moves away from its existing units to new RE generation and efficient RICE generation
- The sooner the RE units are available to put into service the better from an economic standpoint
- It is economical to retire most existing units on STT and STX, but this must be coordinated to ensure sufficient system reliability
- It is economical to add significant amounts of RE, even beyond the target of 50% (for both systems combined)

The following tables show the most economical options from the IRP for each island.

Table 20. Summary of the Most Economic STT Expansion Plan (STT P0)

STT P0		
UNITS SELECTED	**UNITS RETIRED**	**CANDIDATES NOT SELECTED**
Bovoni Solar, 1/2021	STT 14	Port Authority PV
Donoe Solar PPA, 1/2021	STT 15	Bovoni Wind PPA*
8 MW RICE Unit, 1/2021	STT 25	STJ Rooftop Solar
3 x 7 MW RICE Units, 1/2021	STT 26	STT Rooftop Solar
7 MW RICE, 4/2022	STT 27	STJ Cruz Bay Solar
STJ Cruz Bay BESS, 4/2022		CTs and CCs

*Note that if VIWAPA ownership of the Bovoni wind resource is assumed, the project would be selected in the optimization.

Table 21. Summary of the Most Economic STX Expansion Plan (STT P0)

STX P0		
UNITS SELECTED	**UNITS RETIRED**	**CANDIDATES NOT SELECTED**
Estate Pearl PV, 18 MW, 1/2021	STT 19	Rooftop Solar Program
HERA PV, 10 MW, 1/2021	Aggreko lease	BESS, Willock
Longford Wind 5x3.3 MW, 7/2021	STT 11	CTs and CCs
3 x 8 MW RICE, 7/2022		
7 MW RICE, 4/2022		
Richmond BESS, 7/2022		

Table 22. Summary of the Most Economic STX Expansion Plan (STT P1)

STX P1		
UNITS SELECTED	**UNITS RETIRED**	**CANDIDATES NOT SELECTED**
Estate Pearl PV, 18 MW, 1/2021	STT 19	Rooftop Solar Program
HERA PV, 10 MW, 1/2021	Aggreko lease	BESS, Willock
Longford Wind 5x3.3 MW, 7/2021	STT 11	CTs and CCs
3 x 8 MW RICE, 7/2022		
3 x 7 MW RICE, 7/2022		
Richmond BESS, 7/2022		

6.4 VIWAPA STRATEGIC TRANSFORMATION PLAN

In 2020 VIWAPA released their VIWAPA Strategic Transformation Plan. The Strategic Transformation Plan, STP, represents a more holistic approach to the Territory's electric systems. Where the IRP specifically addressed the most economical way to achieve generation reliability with a balanced mix of fossil and RE generation, the STP considers generation, as well as the resilience of the distribution grid, and the financial stabilization of the Territory. It provides a three-themed approach to reliable, clean, and affordable energy for USVI: 1) Financial and System Stabilization, 2) System Resilience, and
3) Generation Sector Transformation.

1) Financial and System Stabilization

- Restoration of Financial health through debt restructuring
- Secure Federal Funding
- Rate Design
- Short term integration of new generating units

2) System Resilience

- Installation of composite poles
- Undergrounding of circuits
- Substation Hardening and pad-mounted transformers
- Improve Grid intelligence by AMI and improved SCADA systems

See Table 19 for more details on grid hardening measures implemented as part of this theme.

3) Generation Sector Transformation

This theme builds on the recommendations of the IRP as shown earlier in tables 20-24. The highlighted rows are additional generation that is sought in STP. The key additions include further BESS projects on St. Thomas, St. Croix, St. John, and Water Island and Wind project at Bovoni.

Table 23. STT and STJ Strategic Transformation Plan, 2020

STT, STJ		
LOCATION	SELECTED RESOURCE	UNITS RETIRED*
Bovoni	15 MW Solar & Wind	STT 14
Donoe	5 MW Solar PPA	STT 15
Harley Station	8 MW RICE	STT 25
Harley Station	3 x 7 MW RICE	STT 26
Harley Station	7 MW RICE	STT 27
Bovoni	15 MW BESS	
STJ Cruz Bay	2 MW BESS	
STJ Coral Bay	2 MW BESS	
Water Island	1 MW BESS	

Table 24. STX Strategic Transformation Plan, 2020

STX		
LOCATION	SELECTED RESOURCE	UNITS RETIRED*
Estate Pearle	18 MW Solar	STT 19
HERA	10 MW Solar	Aggreko lease
Longford	5 x 3.3 MW Wind	STT 11
Richmond Station	3 x 8 MW RICE	
Richmond Station	7 MW RICE	
Richmond Substation	10 MW BESS	
Willocks Substation	10 MW BESS	

*Although not specifically stated in the Strategic Transformation Plan (STP), retiring of these units is consistent with the recommendations of the IRP. The STP has identified a five-year timeline for these changes. The various milestone dates for the particular improvements should be updated in this TESP as they are completed.

6.5 DEMAND SIDE MANAGEMENT TO BUILD RESILIENCE

VIWAPA and the VIEO promote awareness of energy and water efficiency and conservation on the part of end users through outreach, websites, and marketing campaigns. However, more can be done to achieve targeted and traceable energy reductions through demand side management programs that focus on residential, commercial, and industrial energy efficiency and demand reduction.

6.5.1 Energy Efficiency

Investor owned and municipal utilities in many states have some kind of energy efficiency portfolio that provides rebates or incentives to its customers for installing energy efficient technology such as: LED lights, appliances, fans, air conditioners and other equipment. These programs saved approximately 5% of total electrical sales or about 200B kWh in 2015.

Energy efficiency has a lower levelized cost than any other resource, as shown by Figure 21. The graph shows that energy savings from energy efficiency programs are typically achieved at 1/3 the cost of new generation resources.

Defining efficiency as a resource and integrating it into the utility decision making process should be given serious consideration. Efficiency programs can also reduce the need to install, upgrade or replace transmission and distribution equipment.

Although there is no utility-scale energy efficiency portfolio that attempts move efficiency into all sectors, the VIEO is currently running two energy efficiency rebate programs.

1. One is open to residential and small business customers. The program is funded by the DOE and provides 40% rebates to eligible energy efficiency appliance investment.
2. The VIEO is also conducting an Energy Efficiency Benchmarking Pilot Program – This Pilot program is DOI funded and will ensure USVI has the capacity to maximize the impact of limited public funds by providing up-to-date energy efficiency analysis and auditing. This grant funding will allow the VIEO to conduct detailed energy assessments on a variety of GVI & commercial building envelopes throughout the Territory.

6.5.2 Demand Response

Demand response (DR) refers to the various strategies used by utilities to reduce and better manage loads on the grid usually during times of grid distress such as a storm. These strategies include the use of interruptible rates that when they are invoked require customers to reduce their load by a predetermined amount. In return the customer is paid for their participation. Programs like these have been highly successful for utilities and studies from ACEEE found that potential DR savings ranged from 2-27% of the utility's peak demand, with 10% peak demand savings being the average.

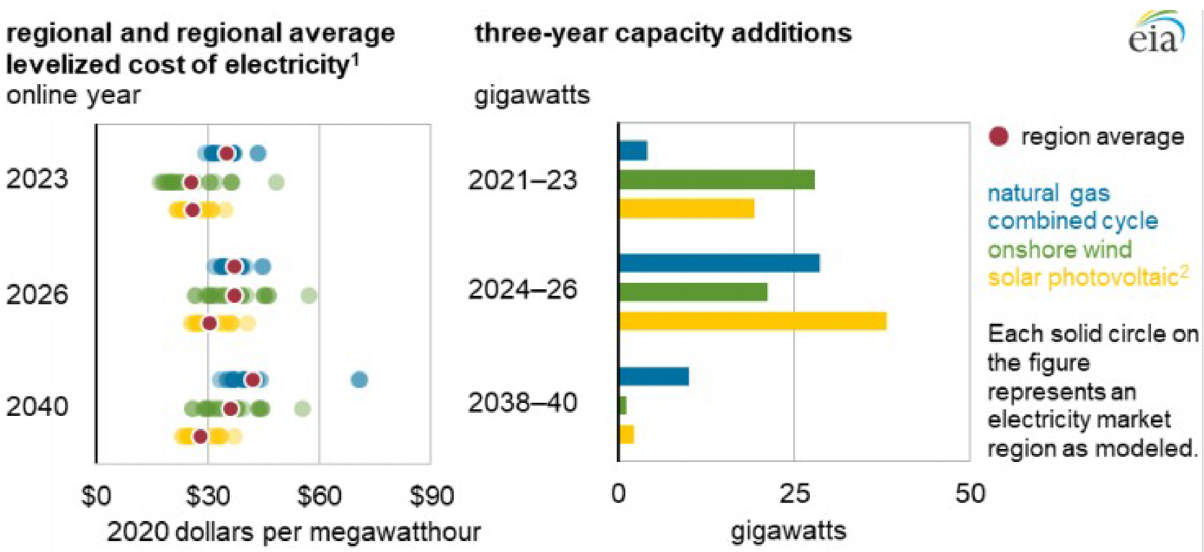


Figure 21. Levelized Cost of Electricity Resources.

Source: U.S. Energy Information Administration, Annual Energy Outlook 2021

DR will help VIWAPA make the shift to a grid that has more distributed resources. As VIWAPA's grids both islands become more diverse DR can be used to manage and isolate entire sections of each network based on need. A robust and sophisticated DR program should be developed to complement and meet the generation and grid hardening measures laid out in the STP.

6.6 HURRICANE RECOVERY AND RESILIENCE TASK FORCE

In 2018, a Hurricane Recovery and Resilience Task Force was formed to develop a comprehensive report on the 2017 hurricanes' impact, as well as produce recommendations for effective recovery and resilience. The report addressed key resources of energy, water, transportation, solid waste and wastewater, and communications. It also addressed housing and buildings, health, vulnerable populations, education, and the economy.

Specifically, the report was to answer three questions for each of several sectors:

1. What happened during the hurricanes and why?
2. How will climate change affect the sector in the future?
3. What will the Territory do to respond?

Although it only addressed the impacts of one of the potential threats, it exposed many, if not all of the Territory's vulnerabilities. The Hurricane Recovery and Resilience Task Force Report is a key reference for this TESP.

6.7 PUBLIC AWARENESS MEASURES

VIEO has partnered with the University of the Virgin Islands' Caribbean Green Technology Center in order to create an Energy Plan for the Territory that is based on community input and principles as well as research and analysis. As an academic institution, the University of the Virgin Islands (UVI) is well positioned to conduct research, collect relevant data, perform analyses, engage stakeholders, and facilitate community outreach.

VIEO will work with WAPA to develop outreach programs to educate communities about how power companies respond during an extreme weather event, as well as before and after, and where that response could be limited by various factors.

Creating programs to educate property owners about the need for regular vegetation maintenance, so communities can be better prepared for future events will be crucial. Trees and power poles and lines are often located close together on frontage roads, running along private property, jockeying for space. Power companies can trim and remove trees on private property that meet certain criteria. Property owners also have responsibility for maintenance. Vegetation management crews sometimes face community backlash when they are out working, but a single tree could cause a lengthy outage during a storm.

6.8 RENEWABLE ENERGY INITIATIVES

Net energy billing (NEB) is a solar credit program in which residents with grid-tied distributed generation systems can be credited for the excess energy they generate and send into the grid. It is a non-optional program for homes with systems installed after the end of the original Net Energy Metering program. NEB is meant to be just a temporary program, used to test rates, fees, and the overall process. A subsequent program should be finalized afterward.

6.9 MICROGRIDS AND DISTRICT ENERGY SYSTEMS

The Territory can increase energy resilience and promote energy assurance by developing microgrids that use distributed generation assets that can disconnect from the main grid and operate independently in the event of a grid failure. Microgrids enable end users connected to the microgrid to maintain power during energy disruption events.

VIWAPA has funding from FEMA to install microgrids on St. Thomas, St. John, and St. Croix. Table 25 shows the location and equipment for each system.

During an energy emergency, these resources could be activated to provide secure power to the microgrid.

Table 25. Location and equipment for each microgrid

Location	Technologies	Capacity (MW-DC)	Capacity (MW-AC)	BESS (MWh)
Adventureland, St. Croix	PV+BESS	21	18	20
Bovoni, St. Thomas	BESS coupled to wind IPP	-	-	30
St. John	PV, BESS, and backup generators	4.7	4	8

6.10 ALTERNATIVE FUEL VEHICLE AND TRANSPORTATION

Potential programs to promote alternatives to fuel vehicles include:

Electric Vehicles

The VIEO has launched the Government Operations Fleet Energy Efficiency Transition (GO FLEET) initiative, a plan to transition the entire government fleet to electric vehicles. This transition is well under way, and not only will it contribute to mitigation efforts for the USVI but will also reduce logistical hurdles of government operational vehicles reliance on gas fueling during times of emergency and recovery. Vehicles will not have to rely on gas supply during an energy emergency and can simply plug in and charge through electricity. VIEO has been seeking MOU's with reputable electric vehicle and battery industry leaders to enable the transition. The GVI fleet currently does contain select amounts of hybrid gas-electric vehicles, as the rest of the fleet is being transitioned to being fully electric. The GVI fleet should be 25% converted to EV's by 2025.

Bikeshare Programs

The authors of a 2015 report[29] from the Institute for Transportation and Development Policy and the University of California, Davis, estimated the potential savings in energy use, carbon dioxide emissions, and costs to travelers resulting from significant numbers of people switching from cars to bikes. "It would take a very large expansion of bike sharing systems around the world to have a significant effect [on outcomes such as emissions reductions]," they wrote. Nevertheless, they added, "Given that bike share systems have catalyzed dramatic increases in private bike use in many cities, especially when paired with bicycle infrastructure and other policies that support cycling, these systems can have strong indirect impacts on total cycling levels and benefits."

The GVI could create a public awareness program to promote the use of bicycling throughout the Territory in lieu of cars where applicable. Additionally, enlisting a public-private partnership to create a bikeshare program making it easier for residents.

Car-Sharing Services

The GVI could create a public-private partnership to create a car share program (Zip car, Enterprise car share) making it easier for residents to use a car only when needed versus relying on personally owned vehicles. Over one-third of American drivers (37%) admit they own a car that is not driven often. Studies prove the average car sits idle, parked 95% of the time.[30] Car-sharing enables lower traffic congestion, as well as lowers air pollution while contributing to lowering emissions across the Territory. Additionally, less cars on the roads improve the longevity of roads themselves and overall dependency on refined oil and gas.

[29] Jacob Mason, Lew Fulton, and Zane McDonald, 2015, *A Global High Shift Cycling Scenario*, Institute for Transportation & Development Policy and the University of California, Davis. https://itdpdotorg.wpengine.com/wp-content/uploads/2015/11/A-Global-High-Shift-Cycling-Scenario_Nov-2015.pdf.

[30] Donald Shoup, 2011, *The High Cost of Free Parking*, New York, NY: Routledge.

6.11 FUEL SUPPLY DISRUPTION MITIGATION STRATEGIES

This document has outlined the supply chain for fuel coming into the Territory for all major users and fuel types. The current dependency on fossil fuel dictates that increasing on- island fuel storage capacity is the best way to improve long term, 14 days, fuel disruption.

6.11.1 LPG

LPG capacity for electricity at both plants is fixed at 19-days at Estate Richmond and approximately 18 days at Randolph Harley. Tankers make regular deliveries, weekly, to both plants. Disruptions would occur from:

- Storms occurring in the region preventing ships form arriving
- Damage to the terminal that would prevent offloading of fuel
- Payment delays; LPG deliveries are cash on delivery

LPG Mitigation Strategy

- Prepare for hazards by keeping LPG bullet bunkers topped off ahead of threats
- Ensure timely payment to suppliers
- Increase the number of suppliers; Currently all suppliers are getting their fuel from the same place
- Purchasing of tanker truck or some sort of mobile fuel

6.11.2 Diesel Fuel

Emergency generators for critical facilities typically only have fuel for two days that is stored in the generators tank. The key suppliers of diesel fuel during emergencies are outlined in Section 4. There are multiple fuel disruption possibilities.

- Emergency generators can run out of fuel
- Deliveries from suppliers can be disrupted, including disruptions impacting all suppliers

Mitigation Strategy

- Increase the fuel storage capacity at each emergency generator. Invest in on-site storage tanks capable of holding a minimum 14-day supply.
- Invest in a centralized storage bunker at the EOC or other central location.
- Government agencies could invest in fuel tanker trucks dedicated for delivering emergency reserve fuel.

6.12 FRAMEWORK SUPPORTING PUBLIC-PRIVATE PARTNERSHIPS

There are currently two established Public-Private Partnerships (PPP) that are part of the USVI electric grid. The solar farms on St Croix and St Thomas were built in 2015 by NRG company and operated through power purchase agreements (PPA) with VIWAPA. Though both arrays were damaged during the 2017 hurricanes, the St. Croix array has currently been fully repaired.

In 2018, NRG sold the St. Croix Spanish Town solar farm to BMR Energy, a Virgin Investments company. BMR also assumed the existing PPA from NRG. BMR repaired the system and installed more resilient features through a new grounding system and storm preparedness operating procedures. The Spanish Town solar farm has been up and running since late 2018. BMR Energy has committed to a similar rebuild and PPA with the more heavily damaged Donoe Solar farm on St. Thomas. These PPA's for distributed resources can serve as models for building storm hardened systems that benefit private companies and the general public.

The USVI continues to identify ways to improve the resilience of its energy, and interdependent infrastructure, such as water, transportation, and communications systems, as summarized in Table 26.

Table 26. Mitigations to VI High-Priority Hazards/Threats

HAZARD OR THREAT	MITIGATION
Hurricane	USVI entities are working together to address hurricane vulnerabilities within the energy sector by hardening distribution poles, undergrounding critical feeders where the geology allows, relocating equipment that is susceptible to storm surge or moisture inundation, to name just a few.
Equipment Failure	VIWAPA is addressing potential equipment failure through vegetation management, asset management and retirement, and training and capacity building.
Earthquake/Tsunami	The USVI continues to improve infrastructure to harden against earthquakes and tsunamis, as well as exercise emergency alarm systems to provide warning to evacuate or relocate in specific areas.
Human Attack/Cyberattack	Training, protective fencing, and safety protocols are being improved within VIWAPA operations and around assets to mitigate the impacts of a human-cause event. Cybersecurity awareness and architectures are being explored as options to include in VIWAPA annual training.
Hazmat/ Chemical Release	VIWAPA continues to monitor LPG storage facilities, Limetree Bay Terminals, and exercise emergency response with VITEMA and other entities.
Pandemics/Endemics	USVI continues to learn from the COVID-19 pandemic to understand how energy infrastructure can become more resilient to disruptions in operations, supply chains, fuel price instability, and economic hardships.
Geopolitical Upheaval	The USVI continues to explore potential opportunities to diversify fuel sources away from vulnerable fuel supply chains and possible disruptions.

7 CONCLUSION

The purpose of this TESP is to describe the energy emergencies and vulnerabilities facing the USVI and how the VIEO and other organizations respond to and mitigate the effects of energy disruptions caused by those emergencies and vulnerabilities. The TESP outlines:

a. The parties responsible for preparedness, response, recovery, mitigation, and resilience strategies,
b. An updated energy profile of the USVI, including a detailed description of energy infrastructure and energy supply networks,
c. An Energy Data Tracking Plan that provides a roadmap for how the VIEO can collect, monitor, analyze and disseminate key energy supply, demand, and disruption data, and
d. An overview of planned and ongoing resilience measures designed to protect the Territory from future energy disruptions.

Recommendations to Promote Energy Resilience

The USVI has taken major steps to increase energy reliability across the Territory, as outlined in Section 5. Many of these steps were created through lessons learned from response to and recovery from the hurricanes of 2017. Over the course of developing this TESP many themes and vulnerabilities were identified in addition to those already planned in the USVI.

The following are some common themes that were identified as critical steps to achieve energy assurance in the Territory.

- The Territory is planning to decrease its dependence on fossil fuels. The reliance on imported fossil fuels makes the Territory vulnerable to a range of disruptions that can occur across the energy supply chain. Major disruptions to fossil fuel supply chains would not only threaten the electric grid, but could impede the ability to provide clean, safe drinking water to residents as the desalination plants rely on these imported resources.
- The Territory should take immediate steps to improve the resilience of the electrical grid and decrease its dependence on fossil fuels for electrical generation through the following:
  - Harden the transmission and distribution system
  - Diversify the generating capacity and immediately incorporate renewables such as solar, wind and the use of battery storage and energy efficiency.
  - Restructure VIWAPA's debt and pursue a new rate structure. The debt and inflated cost of electricity is in part driven by the Territory's dependence on fossil fuels to produce electricity.
  - Incorporate the use microgrids and the use of distributed generation using renewable energy systems such as wind and solar and battery storage systems.
- The Territory is working to right-size emergency generators for key government agencies and critical systems. Currently, government agencies emergency generators typically have fuel for 72 hours of operation before refueling is needed.

The USVI continues to work toward enhancing resilience and securing energy and interdependent infrastructure against all hazards while addressing challenges related to grid flexibility, integration, reliability, and affordability. This plan is an updated plan, which will continue to be updated to reflect progress being made in the Territory.