



# Energy Transition Support to U.S. Territories

Phil Voss and Dan Olis  
National Renewable Energy Laboratory  
Federal Partners Meeting  
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# NREL at a Glance



3,702

## Workforce, including

205 postdoctoral researchers

179 graduate students

94 undergraduate students



## World-class

facilities, renowned  
technology experts

More than  
1,000

## Partnerships

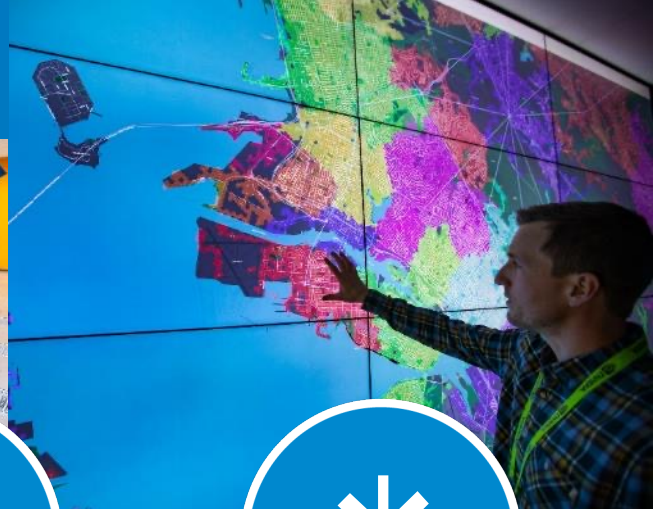
with industry,  
academia, and  
government



## Four Campuses

operate as a  
living laboratory

# NREL Science Drives Innovation



## Renewable Energy

- Solar
- Wind
- Water
- Geothermal



## Energy Efficiency

- Buildings
- Advanced Materials and Manufacturing
- State, Local, and Tribal Governments



## Sustainable Transportation

- Bioenergy
- Vehicle Technologies
- Hydrogen and Fuel Cells



## Energy Systems Integration

- Grid Integration
- Energy Storage
- Hybrid Systems
- Security and Resilience



# Supporting Communities to Achieve Their Goals



## STAKEHOLDER ENGAGEMENT AND DECISION SUPPORT

Map and assess actionable pathways for achieving energy goals, with continuous community input



## CUSTOMIZED MODELING AND ANALYSIS

Apply customized tools to provide analysis on critical policy and technology decisions



## SIMULATION, EMULATION, AND VALIDATION

De-risk complex deployments through realistic simulations and emulations on the ARIES platform



## LOCAL CAPACITY BUILDING AND TRAINING

Support training and institutional capacity on equity, policies, smart buildings, transportation, etc.



## PEER-TO-PEER LEARNING WITH OTHER COMMUNITIES

Work through coalitions to leverage learnings from other deployments and share best practices

# Technical Support for Islands

*Affordable and secure energy supplies are fundamental to a sustainable economic future*

- **Efficient buildings**
  - Energy efficiency measures, policy-driven incentive programs
  - Development, adoption, and enforcement of building energy codes
- **Renewable energy integration** – high-penetration renewable energy (RE) grid integration with energy storage
- **Energy resilience** – Distributed energy resources, microgrid support, grid analysis, techno-economic modeling of energy systems
- **Transportation**
  - Fleet management – Fleet policy, use standards, fueling infrastructure
  - Sustainable transport – Electric vehicle adoption policy, mass transit, multimodal transit policy, congestion pricing
- **Clean energy and land use policies** – Solar/wind zoning, clean energy ordinances, territory-specific energy plans, energy security plans
- **Clean energy standards and requirements** – Subnational/state Renewable Portfolio Standard (RPS) goals, utility franchise agreement policies
- **Technology-specific policies** – e.g., Interconnection, net metering, photovoltaic (PV) + storage
- **Clean energy finance policies** – e.g., PACE, green infrastructure bonds, subnational finance institutions
- **Government agency energy use** – reducing government operations costs, leading by example

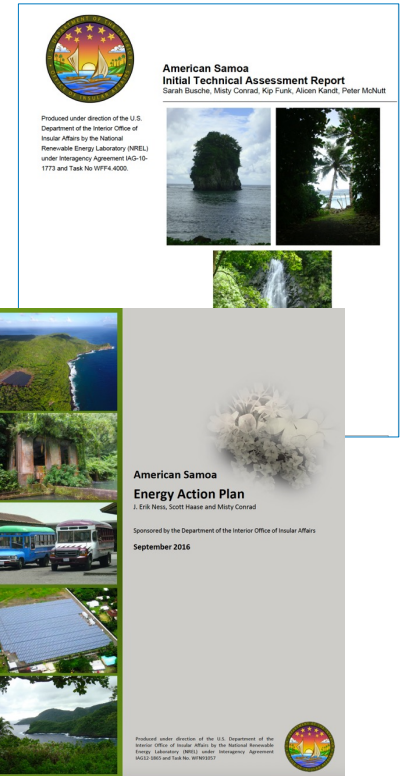
# NREL Support for OIA's Mission

**NREL works with the territories, Freely Associated States, and other island communities to address technical, policy, social and economic hurdles to greater adoption of sustainable transportation, energy efficiency, and renewable energy**

**2010 – Governor's Executive Orders created energy committees in American Samoa, Commonwealth of the Northern Mariana Islands, and Guam.**

## **NREL assistance included:**

- Helped set up energy committees and provided subject matter expertise
- Led stakeholder workshops to develop strategic energy plans and implementation strategies
- Advised utilities on grid improvements and how to accommodate increasing levels of renewable energy
- Provided trusted and neutral techno-economic perspective on various project proposals and resource plans



# OIA/NREL Support to Territories

Interagency  
Agreement executed  
Sept. 2022

Technical support to the Office of Insular Affairs (OIA), and the territories...in support of their continued efforts to deploy clean energy systems, improve energy security and resilience, reduce energy costs, and diversify away from dependence on petroleum-based fuels

- **Update energy baseline data; document progress, challenges, and lessons**
- **Assess needs and develop long-term technical assistance program**
  - Based on territory priorities
  - Short-term and comprehensive support
- **Assist with Territory Energy Security Plan (ESP)**
  - Planning/analysis/assistance with ESPs and other plans
  - ESPs unlock considerable Infrastructure Investment and Jobs Act (and potentially other) funds
- **Other programmatic and technical assistance to OIA**



*Goal: Assist with energy issues until energy is no longer an impediment to development*

**NREL's OIA  
U.S.  
Territory  
Support  
Team**



**Scott Haase**

Senior Advisor, Partnership Lead



**Phil Voss**

Project Lead, Guam Lead



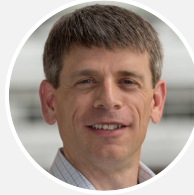
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American Samoa Lead



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Commonwealth of the  
Northern Marianas  
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**Dan Olis**

U.S. Virgin Islands (USVI)  
Lead



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Energy Security Lead



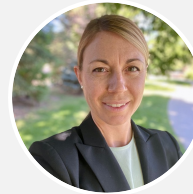
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Project Manager



**Jared Temanson**

Energy Security,  
Energy Justice



**Chrissy Scarpitti**

Energy Security,  
Energy Justice,  
Resilience



**Laura Leddy**

Energy Security,  
Resilience



# General Technical Assistance

## OIA Program Support:

- Ongoing coordination with multiple agency partners
- Supported development of Territory Climate and Infrastructure Workshop agenda
  - Participated in workshop; led breakout sessions; site visit to utility-scale PV/Battery Energy Storage System (BESS) facility
- Reviewed “Energizing Insular Communities” grant applications to assist OIA in project selection
- Participated in Pacific Power Association annual conference, provided two presentations: “Cybersecurity for Grid Operators” and “A Secure and Resilient Grid”

## General Territory TA support:

- Travelled to each territory to meet with stakeholders and Governor’s office, gather information, and build connections
- Completed draft Energy Baseline Reports for each territory
- Assisted USVI, CNMI, and American Samoa in drafting Territory Energy Security Plans (TESP)
  - Also, Energy Justice section for Guam’s TESP
  - Facilitated meetings on energy security planning (individual; jointly with Pacific territories)
- Greenhouse gas accounting to assist applications for Environmental Protection Agency (EPA) climate pollution reduction grants (all)

# Selected Technical Assistance by Territory

## American Samoa:

- Airport subject matter experts (SMEs) reviewing conceptual designs for new airport and port facilities
- Supporting renewable energy integration (20MW PV; potential 40MW wind)
  - Review of grid interconnection studies, proposed battery energy storage approach

## CNMI:

- Developing trainings for energy auditors (for technicians), and grid-integration of high-penetration solar PV (for decision-makers)
- Convening Energy Task Force and working groups to establish stakeholder priorities
- Held technology-specific briefings – geothermal power, heat pumps, energy efficiency retrofits

## Guam:

- Providing SMEs to review proposals on Guam Power Authority's (GPA) RFP for utility-scale PV/BESS
- Facilitated bi-weekly meetings to coordinate project needs and priorities

## USVI:

- SME input to Energy Office on strategies for EPA Solar for All grant application
- Hosted Virgin Islands Water and Power Authority staff at NREL (joint-funded with FEMA); currently scoping additional TA

# Guam 100: Transition to 100% RE Study

Guam legislation requires net electricity sales from 50% RE by 2035 and 100% RE by 2045

Achieving 100% RE goal requires detailed technical analysis to succeed

- **Guam100 will be a state-of-the-art planning and modeling framework to serve as a foundation for next ~20 years**
  - Goal: identify affordable, technically-sound, resilient, equitable, reliable, secure pathways to 100% renewable energy
  - Comprehensive analysis considering future load growth, resilience, equity, and costs
  - RE resource assessment, electricity demand profiles, detailed power system modeling and scenarios
- **Stakeholder advisory group will help inform process and needs**
- **Process and results allow informed decision making**
  - Results will be published



# Guam 100 Can Help Answer Key Questions



- What are the pathways, costs, and benefits to achieving Guam's 100% renewable energy target by 2045?
- Does reaching 100% mean big changes locally?
- How might electric vehicles and expanded air-conditioning change future electricity demand?
- How can Guam assure that the new power system is reliable during extreme weather events?
- What are the roles of energy efficiency, demand management, and Virtual Power Plants?
- What are the impacts on jobs and the local economy?
- What needs to be done to support an equitable energy transition?
- And what investments and actions are needed in the near term to enable Guam's long-term objectives?
- How can the community shape these changes to prioritize equity and energy justice?





## 1 Responsive Stakeholder Engagement and Energy Justice

- Stakeholder engagement inclusive of procedural justice
- Energy justice and climate risk assessment

## 2 Data Gathering and Generation

- Resource potential and demand projections (solar, wind, hydro)
- Demand projections and adoption of distributed energy model (considering load, electric vehicles, energy efficiency, distributed photovoltaics, and storage)

## 3 Scenario Generation and Capacity Evaluation

- Detailed scenario generation
- Distributed PV and storage grid capacity expansion
- Production cost and resource adequacy

## 4 Impacts Modeling and Analysis

- Bulk system analysis for enhanced resilience
- Distribution system analysis
- Economic impacts

## 5 Reports, Visualization, and Outreach

- Scenarios for grid resilience and 100% renewable electricity
- Reports and outreach
- Implementation road map

# Activities and Process for “100 Study”

# Summary

- Goal: direct technical assistance to help address local challenges
  - Help OIA meet goal to address energy issues in territories
  - Work plan being developed for FY24
    - How do discrete efforts support a strategy or big picture?
    - What work efforts could apply across territories (and beyond)?
- Broad collaboration can help mutual goals
  - Unprecedented funding, leveraging expertise can help
- Island connections and relationship building takes time
  - Stakeholder development is critical to success

# FEMA-funded Technical Assistance in the USVI

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# Federal Emergency Management Agency (FEMA) Interagency Reimbursable Work Agreement (IRWA)

- Department of Energy (DOE), NREL, Sandia National Laboratories, and Lawrence Berkeley National Laboratory are supporting FEMA and USVI stakeholders
- 2018 to present; agreement managed by DOE Grid Deployment Office
- Objectives:
  - Enhance institutional capacity to support successful integration of distributed energy generation on the VI Water and Power Authority (VIWAPA) power system
  - Enhance power system resilience
  - Advise on development and provide review of Requests for Proposals and proposals that support resilient recovery of the USVI power system
- TA primarily to VIWAPA; other recipients include the VI Energy Office & VI Housing Finance Authority



# NREL VIWAPA TA Example

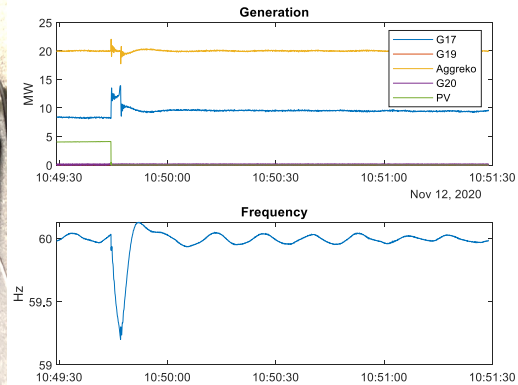
**Objective:** Validate that VIWAPA conceptual design of St. Croix microgrid won't destabilize power system

**Result:** Design concept is technically valid

## Process:

1. Work with WAPA engineers to commission and validate utility instrumentation on training and development; add NREL-developed instrumentation to augment
2. Develop testing plan with WAPA plant operations teams
3. Instigate dynamic events, collect and validate data
4. Validate, tune WAPA power system models with data
5. Expand models to include FEMA-funded PV and BESS
6. Test STX power system dynamic stability against probable destabilizing events; deliver report
7. Return tuned power system model (PSS/E) to VIWAPA

Event	Event description	Date	Time (AST)	Units operating	System Load (MW)	Event load (MW)	Event load fraction (%)
1	Drop Aggreko unit 1	11/11/2020	1:00 PM	CTG 17 propane, Aggreko reciprocating propane	34.41	1.20	3.38
2	Drop Aggreko unit 4	11/11/2020	1:08 PM	CTG 17 propane, Aggreko reciprocating propane	34.84	1.19	3.41
3	Drop Aggreko unit 1	11/11/2020	1:25 PM	CTG 17 propane, Aggreko reciprocating propane	34.20	1.25	3.64
4	Drop Aggreko unit 4	11/11/2020	1:33 PM	CTG 17 propane, Aggreko reciprocating propane	34.02	1.27	3.73
5	Drop 4.2MW PV	11/12/2020	10:46 AM	CTG 17 propane, Aggreko reciprocating propane	32.50	4.04	12.43
6	Drop Fdr 3A	11/12/2020	11:41 AM	CTG 17 propane, Aggreko reciprocating propane	32.49	1.06	3.27
7	Drop Fdr 3A	11/12/2020	11:58 AM	CTG 17 propane, Aggreko reciprocating propane	33.50	1.12	3.35
8	Drop RO plant	11/12/2020	12:08 AM	CTG 17 propane, Aggreko reciprocating propane	33.95	1.26	3.71
9	Drop Aggreko unit 4	11/13/2020	1:53 PM	CTG 19 propane, Aggreko reciprocating propane	34.03	1.20	3.53
10	Drop Aggreko unit 2	11/13/2020	2:00 PM	CTG 19 propane, Aggreko reciprocating propane	34.38	1.29	3.74
11	Drop Aggreko unit 1	11/13/2020	2:11 PM	CTG 19 propane, Aggreko reciprocating propane	33.84	1.19	3.52
12	Drop Aggreko unit 4	11/13/2020	2:30 PM	CTG 19 propane, Aggreko reciprocating propane	34.07	1.21	3.56
13	Drop Aggreko unit 2	11/13/2020	2:40 PM	CTG 19 propane, Aggreko reciprocating propane	34.18	1.22	3.56
14	Drop Aggreko unit 1	11/13/2020	2:47 PM	CTG 19 propane, Aggreko reciprocating propane	34.14	1.18	3.47
15	Drop 4.2 MW PV	11/13/2020	3:01 PM	CTG 19 propane, Aggreko reciprocating propane	34.02	2.60	7.64



Completed Tasks	Planning & Analysis	Capacity Building	Review & Advise ment
Collect high speed dynamic data on power system on St. Croix	•	•	
Validate FEMA-funded St. Croix microgrid concept design for dynamic stability	•		
Estimate capacity and generation output of RE developments	•		
High penetration inverter-based resource workshop for VIWAPA		•	
Revise utility customer interconnection procedures and requirements	•	•	
Review contracts for wind and PV power purchase agreements			•
Support VIWAPA 2020 integrated resource plan (IRP)			•
Assist VIWAPA in responding to FEMA RFIs			•

## Current Tasks

Planning &  
Analysis

Capacity  
Building

Review &  
Advisement

Collect high speed dynamic data on power system on St. Thomas

•

•

Inform, provide data, & review results of microgrid interconnection studies being performed by VIWAPA contractors

•

Analyze, review, and comment on VIHFA CDBG-MIT amended action plan for VIWAPA to acquire propane infrastructure

•

Review HUD-funded battery use-cases and vendor controls product

•

•

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# DOE Energy Development in Island Nations

## ~2010 thru 2014

- Supported VIWAPA solar PV power purchase agreements for first utility-scale solar plants
- Investment-grade wind resource assessment
- Wind power development studies
- Scenario modeling and roadmap development
- Undersea power cables analysis
- Transportation study
- Workshops, convening stakeholders, communications support
- Utility customer interconnection procedures and processes



# Thank You!

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**Partner with NREL:**

<https://www.nrel.gov/workingwithus/>

<https://www.nrel.gov/state-local-tribal/decision-support.html>



# Examples of Assistance to Asia-Pacific Islands

NREL has provided extensive assistance to islands in the Asia-Pacific region, including:

- **U.S. territories and states:** American Samoa, Northern Mariana Islands (CNMI), Guam, Hawaii, Palmyra Atoll
- **Freely Associated States:** Federated States of Micronesia (FSM), Republic of the Marshall Islands (RMI), Palau
- **Other countries:** Ecuador, Fiji, Indonesia, Japan, Kiribati, Philippines, Samoa, Tonga

Some examples of support include:

- PV system inspection; performance assessment; operations and maintenance (O&M) training; and system optimization (Pohnpei)
- Supported development of **Tonga Energy Efficiency Master Plan** (Tonga)
- Developing recommendations for **grid protection with high-penetration PV/battery storage** (Palau)
- **Energy efficiency audits** and energy auditor trainings: Guam, RMI, Japan and 14 other countries
- Supporting Energy Administration on **tariff analysis**, PPAs and energy planning (Palau)
- **PV-battery-diesel hybrid analysis** (Palmyra Atoll)
- Developing **best practices for** large-scale (Indonesia) and small-scale (Galapagos Islands) **wind system installations**
- **Disaster resilience** training for energy infrastructure planning (in Japan, for ASEAN)
- **Mini-grid** project implementation design standards (Philippines)
- **Environmental impacts** assessment and **gender equity** study (Indonesia)
- **Integrating solar systems** into the grid (Samoa)

# Examples of NREL Assistance in the Caribbean

In addition to USVI, NREL's broad portfolio of work in the Caribbean includes:

- **Wind and solar resource assessments** (Port-au-Prince Waste to Energy feasibility study, Haiti)
- **Mobilizing public and private investments** for energy efficiency (Dominican Republic)
- Feasibility study for **waste to energy** development (Aruba)
- Country-level **transportation systems analysis** (Jamaica)
- **Techno-economic modeling** of energy systems for reconstruction (Barbuda)
- **Capacity building** for the national utilities regulatory commission (St. Lucia)
- Support for **rebuilding following 2017 hurricanes** (Puerto Rico)
- Techno-economics and dynamic stability analyses, advanced wind power plant controls TA (Aruba)