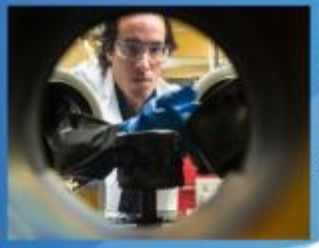
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

40
1977 – 2017


Tonga Energy Efficiency Master Plan

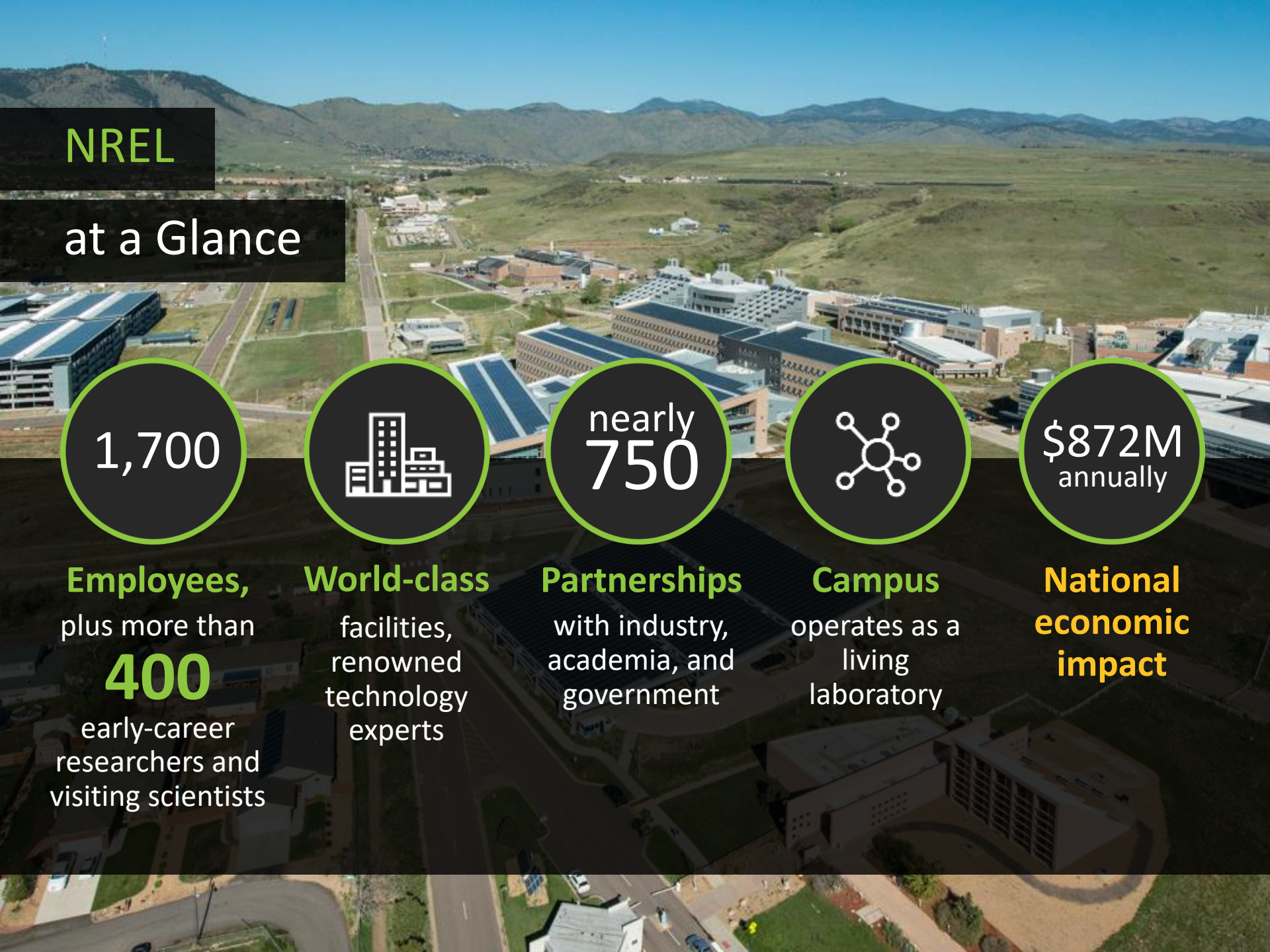
Bethany Speer, Caley Johnson, Eliza Hotchkiss

October 2017

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Agenda

- Introduction to the National Renewable Energy Laboratory (NREL)
- Purpose of Master Plan
- Process of Creating Master Plan
- Components of Master Plan
- Metrics of “Efficiency”
- Scope of Master Plan
- Data Collection
- Tools and Training
- Timeframe of Key Deliverables



NREL at a Glance

1,700

Employees,
plus more than
400
early-career researchers and visiting scientists

World-class
facilities, renowned technology experts

nearly 750

Partnerships
with industry, academia, and government

Campus
operates as a living laboratory

$872M annually

National economic impact

NREL's Science Drives Innovation

Renewable Power

- Solar
- Wind
- Water
- Geothermal

Sustainable Transportation

- Bioenergy
- Vehicle Technologies
- Hydrogen

Energy Efficiency

- Buildings
- Advanced Manufacturing
- Government Energy Management

Energy Systems Integration

- Integrated Deployment
- High-Performance Computing
- Data & Visualizations

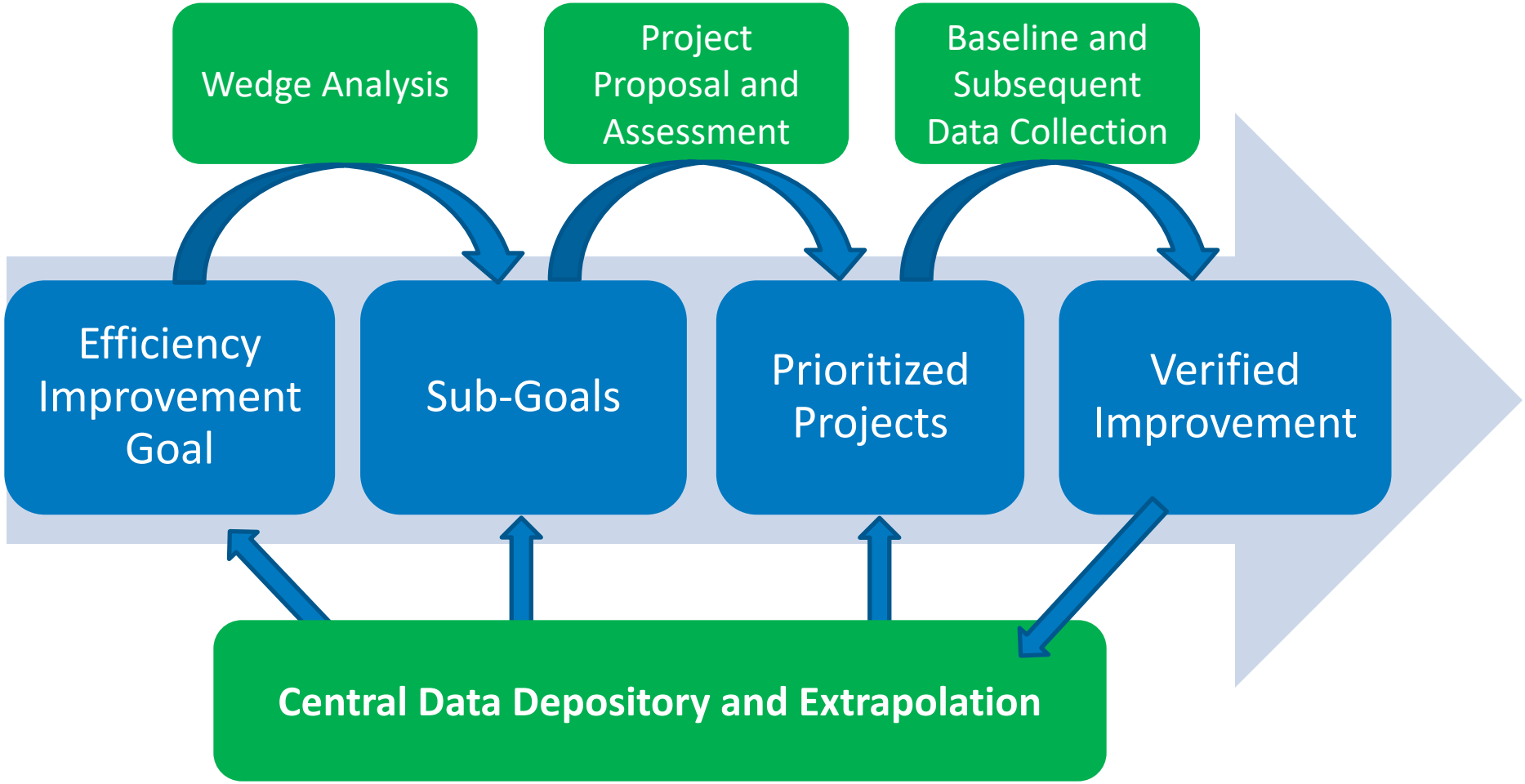
Purpose of Energy Efficiency Master Plan

- Tonga is actively trying to balance the national requirements of meeting the nation's energy needs while reducing Tonga's GHG emissions (including via reductions in energy intensity) in order to tackle climate change impacts. Accordingly, the government is working to identify the best social, environmental and economic technology options, while ensuring sustainable development is achieved.

- The main objective of this Climate Technology Centre and Network (CTCN) assistance is to support the development of a Tonga Energy Efficiency Master Plan (TEEMP) with achievable energy efficiency (EE) and greenhouse (GHG) targets to ensure the transition to an energy efficient future for Tonga.

- The assistance will support: 1) the development of a survey, data collection, and a baseline/benchmarking study; 2) the development of EE and GHG targets (including energy intensity targets); 3) a needs assessment of potential EE activities for the energy sector; and 4) initial capacity development and training for Energy Department staff and identification of a longer-term capacity building plan.

Energy Efficiency Master Planning Process



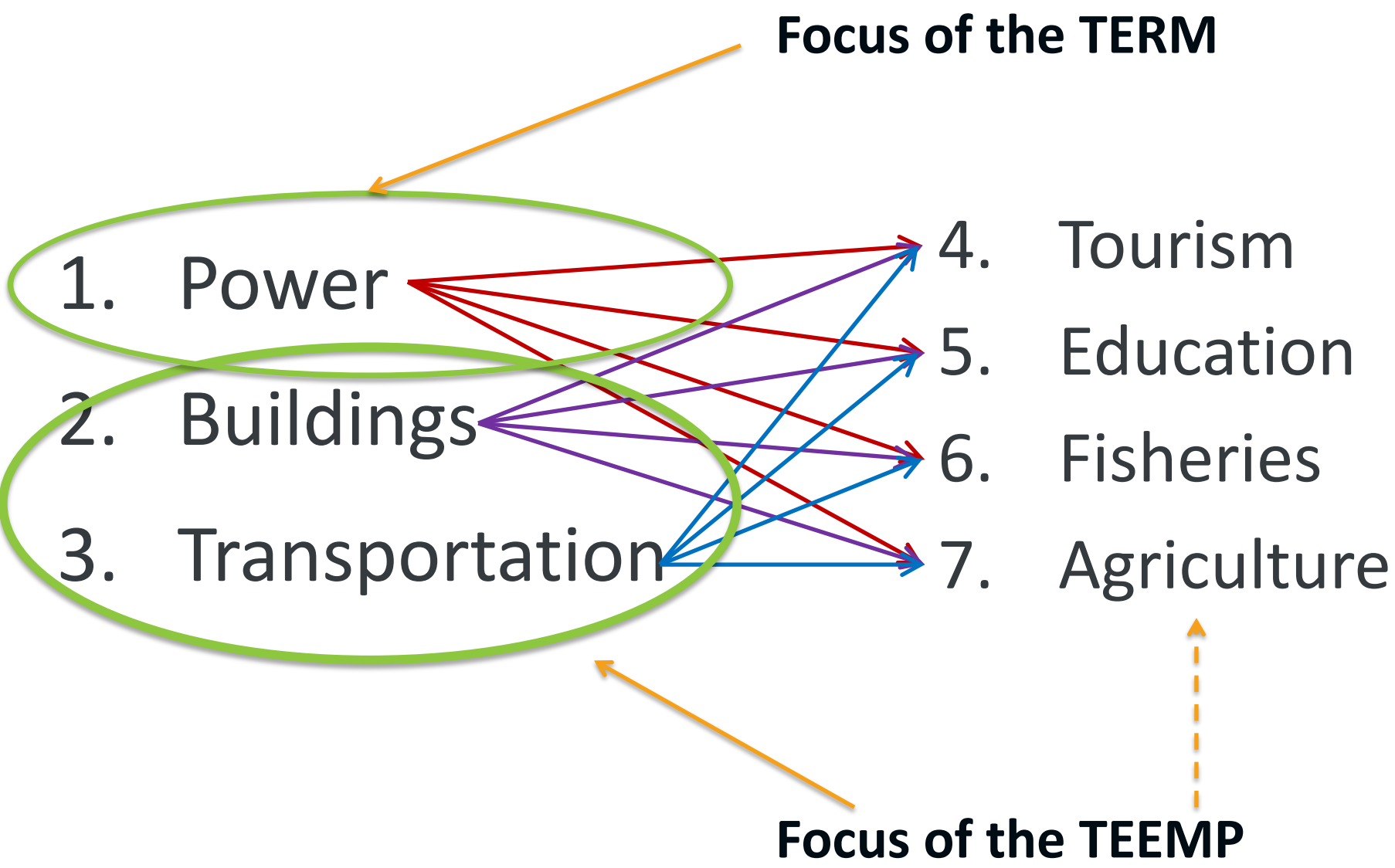
Energy Efficiency Master Planning Process, *continued*

- Typical methodology includes:
  - Data collection and understanding the current context
  - Determining what is culturally and climate appropriate (i.e., what will work in Tonga) through stakeholder engagement
  - Identifying strategies: technical solutions and policies (e.g., setting minimum energy performance standards for appliances for imports)
  - Analyzing the impact that strategies will have
  - Drafting a strategy for review by Tonga
  - Incorporating comments and finalizing the strategy
  - Follow-up training on implementation
  - Implementation of the strategy

Components of Master Plan

- Energy use by sector, projected to 2050 (BAU)
- Documentation of data sources and recommendations for how to best store/update them
- Proposed energy efficiency goal
- Wedge analysis of ways to improve energy efficiency
- Proposed projects to achieve goal, ranked according to magnitude, cost, readiness, and popularity
- Proposed system of tracking project success

Components of Master Plan, *continued*



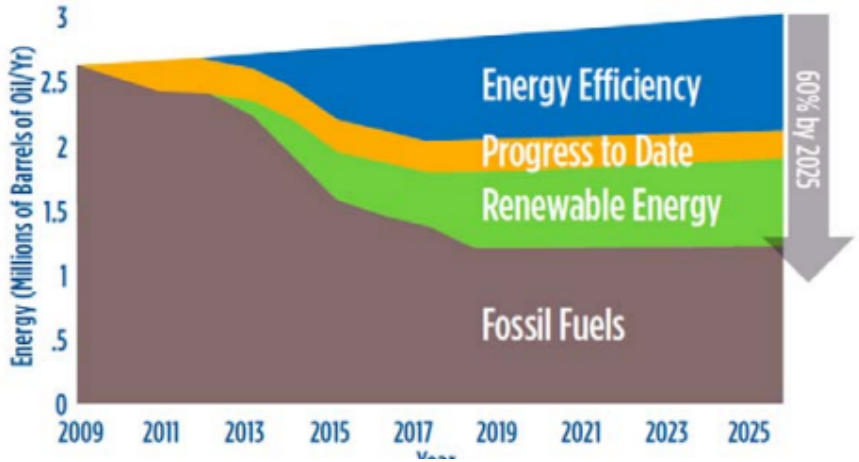
Metrics of Efficiency in Master Plan

- Overall: Fuel consumption per person (or GDP)
- Power Generation
  - Heat rate
- Buildings
  - kWh per square foot
  - Water consumption per square foot
- Transportation
  - Average kilometers per Liter petroleum?
  - Passenger-km-travelled per Liter petroleum?
  - Kg freight or passengers transported per liter petroleum?
  - Gross domestic product per Liter petroleum?
  - Liters of petroleum to cover all transport needs
  - Liters of petroleum per person

Power and Buildings Planning Process

- Building codes that incorporate resilience and energy efficiency
- Energy efficiency standards for appliances
- Policies and campaigns for reduction in energy in the highest consuming sectors (e.g., hotels/resorts, public sector)
- Integrated resource management and planning (e.g., transportation policies and energy considerations)
- Renewable energy technologies for resilience and reducing dependence on fossil fuels

Electricity Sector	Efficiency Sector	Transportation Sector	Fuels Sector
40% Renewable Energy (RE) by 2030	*30% Greater Energy Efficiency by 2030*	*Displace 70% Petroleum by 2030*	*Meet In-State Demand for Renewable Fuels*
Strategies: • Align regulatory and policy framework with clean energy goals • Increase process certainty in developing new RE • Deploy RE and grid infrastructure • Explore next gen technologies and new applications	**Strategies:** • Align regulatory and policy framework • Retrofit residential and commercial buildings • Strengthen new constructions policies / building codes • Identify non-building related energy efficiency measures	**Strategies:** • Accelerate electric and hydrogen vehicle infrastructure and deployment • Increase renewable fuel use in the transportation sector • Improve vehicle fleet efficiency • Reduce vehicle miles traveled	**Strategies:** • Support development of local agricultural industry • Invest in key infrastructure at scale • Evaluate and develop renewable fuel processing infrastructure • Match potential fuel supply with in-state demand



Transportation Planning Process

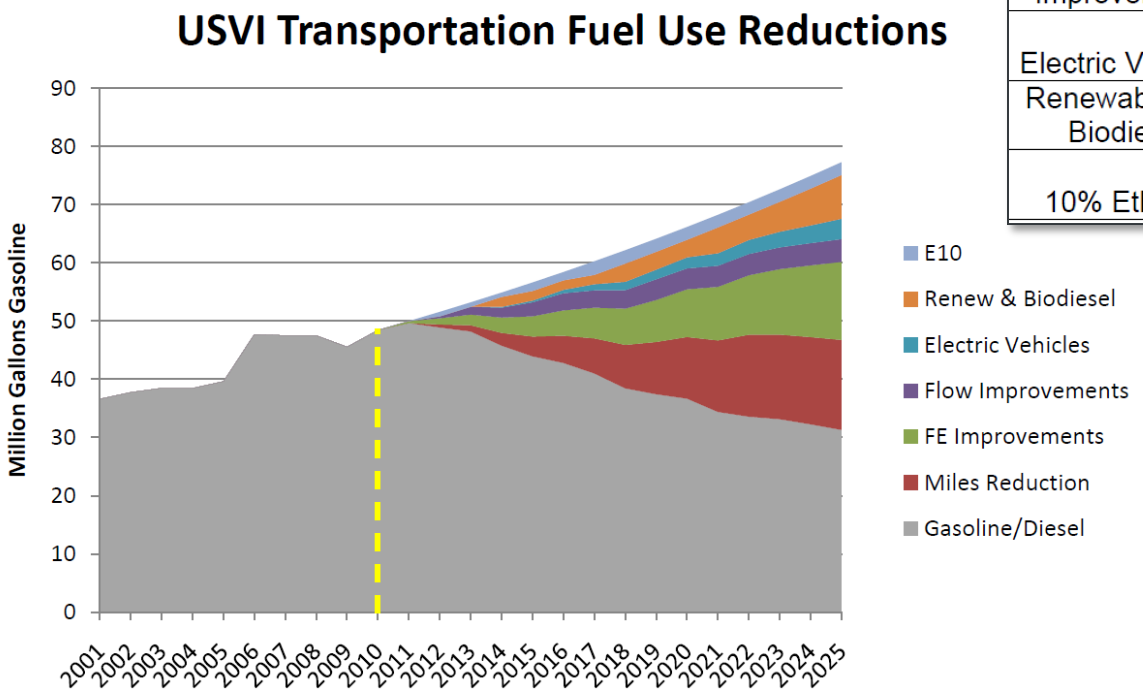
Step 1: Determine baseline data such as number of vehicles, average VMT, fuel economy, means of commuting, projected petroleum use

Step 2: Set achievable petroleum reduction goal

Step 3: Wedge analysis breaks the goal down into sub-goals

Overall US Virgin Islands goal: 60% below business-as-usual by 2025

Wedge	2025 Goal
Miles Reduction	Motorized vehicles travel 20% less
Fuel Economy Improvements	New LDV labels average 4mpg below CAFE goal for given year
Traffic Flow Improvements	20% of VMT will be converted to highway drive cycle
Electric Vehicles	15% of the vehicles in the USVI will be electrically powered
Renewable and Biodiesel	55% of all diesel sold to road vehicles is renewable or biodiesel
10% Ethanol	75% of all gasoline sold to road vehicles is E10



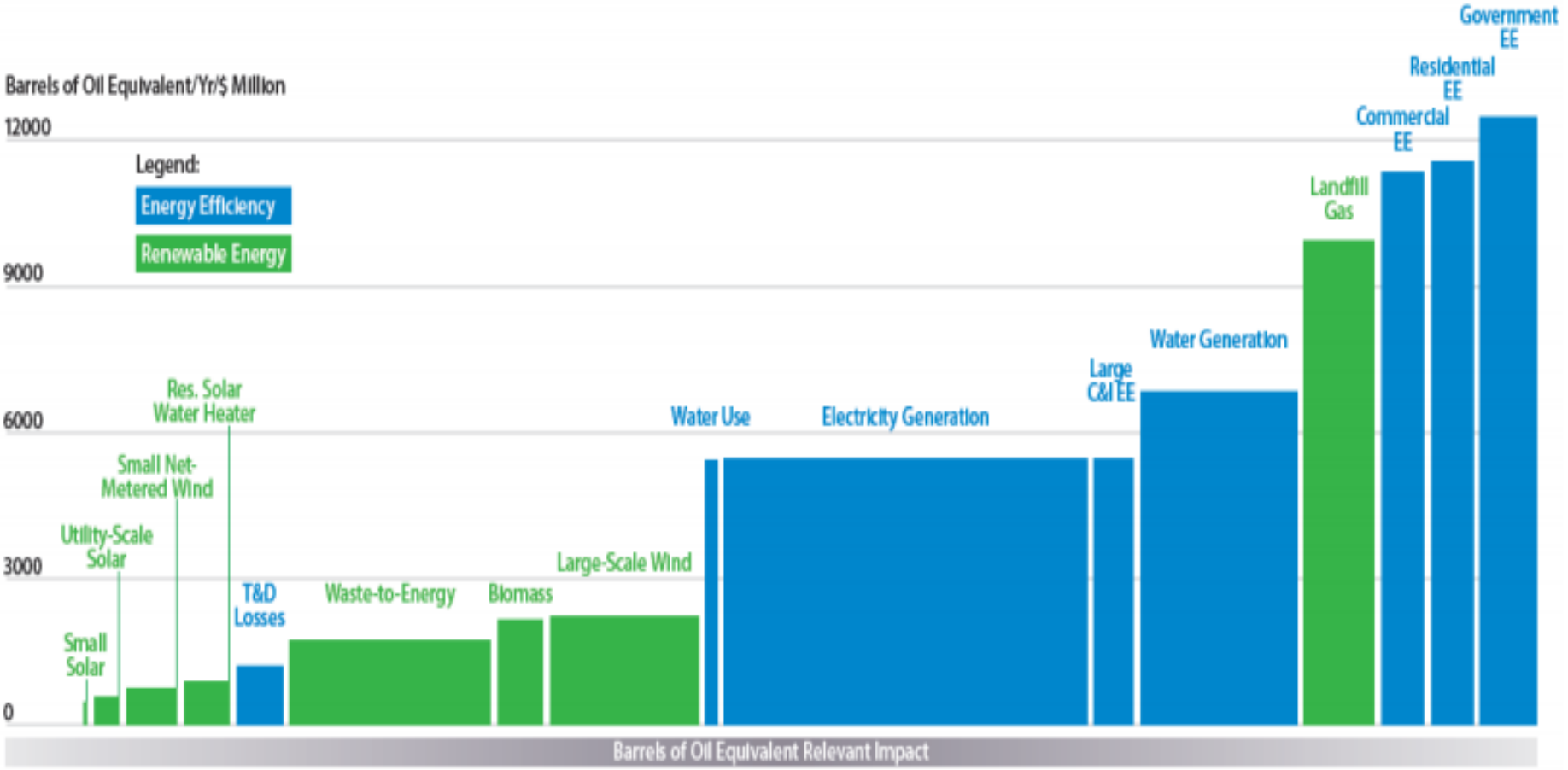
Entire process is done with input and direction from local experts

Step 4: Project proposal, assessment, and ranking

Examples from U.S. Virgin Islands

Project	Rank	Wedge	Cost	Petroleum Reduction	Time frame	Popularity
Geotrackers to coordinate VITRAN buses, dollar rides, and passengers	1	Miles Reduction	Low	High	Short	High
New government vehicle purchase specifications	2	Fuel Economy	Low	High	Short	Medium
Purchase-price adjustments to encourage more efficient vehicles	3	Fuel Economy	Low	High	Medium	Medium
Road maintenance and repair system	4	Traffic Flow	Low	High	Medium	High
Ride sharing website	5	Miles Reduction	Low	Medium	Short	High
Telework	6	Miles Reduction	Low	Medium	Short	Medium
Expand bus routes	7	Miles Reduction	Low	Medium	Medium	High
Education campaign for alternative transportation	8	Miles Reduction	Low	Medium	Medium	Medium
Education campaign for fuel economy	9	Fuel Economy	Low	Low	Medium	Medium
Waste grease biodiesel in school project	10	Renewable/Biodiesel	Low	Low	Medium	High
Intra-island ferries and water taxis	11	Miles Reduction	Medium	High	Medium	High
USVI Renewable Fuel Standard	12	E10 and Biodiesel	Medium	High	Medium	Low
Strategic parking to facilitate carpool, bus, and ferries	13	Miles Reduction	Medium	Medium	Short	High
Traffic signal timing and synchonization	14	Traffic Flow	Medium	Medium	Short	High
Pull-offs for buses/taxis	15	Traffic Flow	Medium	Medium	Short	High
Government vehicle tracking and monitoring	16	Miles Reduction	Medium	Medium	Medium	High
Maintenance facility for hybrids and EVs	17	Fuel Economy	Medium	Medium	Medium	High
Right hand turn lanes	18	Traffic Flow	Medium	Medium	Medium	High
New sidewalks and paths	19	Miles Reduction	Medium	Low	Medium	High
Pedestrian overpasses at schools	20	Traffic Flow	Medium	Low	Medium	High
Trial fleets of EVs	21	Electric Vehicles	High	Medium	Medium	High

Ranking of Power Generation and Buildings Projects



Estimated cost effectiveness and impact of the various energy efficiency and renewable energy strategies considered for an island roadmap

Note: The height of each bar represents an estimate of the island-specific cost effectiveness of a given investment. The width represents energy savings assumed in the analysis.

Scope of Master Plan

- Transportation
  - Include land, domestic marine, and domestic flights
  - Include international flights or marine, or portions thereof?
- Buildings
  - Insulation and air conditioners
  - Appliances and import policies
  - Specific buildings over a certain size or within a certain sector (e.g., whichever uses the most energy)

Buildings Data Collection

This week we will collect data related to:

- existing policies and incentives
- success of those policies and incentives
- Codes and standards
- Energy consumption (kWh/floor area per month) and best practices
- Water consumption (litres/floor area per month) and best practices
- Utility practices (e.g., how is energy generated? How is energy managed, billed and distributed?)
- Reviewing energy and water practices and management within different sectors (e.g., residential, commercial, hospitality, industrial, public sector, etc.)

The goal is to identify what is working well and where there might be room for opportunities.

Transportation Data Collection

- **Gasoline, diesel, and jet fuel use by year**.
- **Vehicle registrations**. Ideally with vehicle weight, model, age, and odometer readings
- **Traffic counts on various roads**.
- **Household transportation survey data**. Ideally this would include a breakdown of trips taken by single-occupancy vehicle, carpool, bus, boat, bike, and walking.
- **Public transit data**. In particular, how many buses and boats are in operation, how many passengers are carried, what are their schedules, and how many miles do they travel per year?
- **Tonga Government fleet data**. Many times the government fleet can lead by example
- **Airport records of domestic flights**.
- **Port records of domestic ship trips**.
- **Fishing boat operations**
- **Potential for sustainable biofuels**

Tools and training to be delivered to Tonga

- Transportation wedge analysis tool
- Future Automotive Systems Technology Simulator (FASTSim) drive cycle analysis tool
- Buildings wedge analysis tool
- HOMER tool
- RETScreen

Draft Timeframe of Key Deliverables and Milestones (Based on data availability, etc.)

- December: Development of the final baseline and benchmarking study
- December: Summary document of least cost EE options with supporting enabling environment
- February: Remote presentation of draft reduction targets
- February: EE Master Plan 80% complete
- March: EE Master Plan 100% complete
- Before or by March : EE programs and projects under the TEEMP identified
- Before or by March: Tool for tracking TEEMP implementation developed
- By March: MEIDECC staff attend training (e.g., in NZ)
- March: EE Master Plan implementation training delivered by NREL in Tonga
- By March: Summary document of capacity building needs in the MEIDECC to successfully implement the TEEMP

Thank you!

We appreciate the partnership with Tonga and are looking forward to working with you all.

www.nrel.gov

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Supplemental Slides

www.nrel.gov

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Tonga Energy Road Map

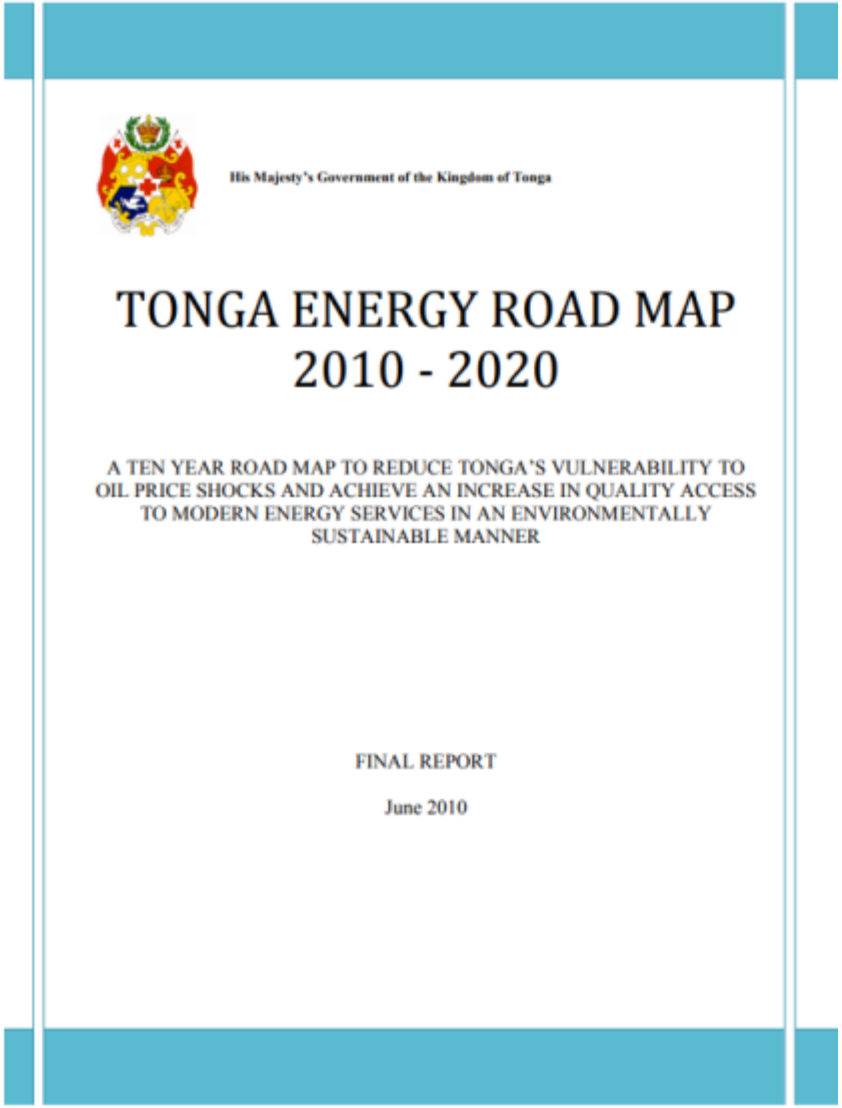
Electrification Rate: 96%
- Urban areas is 100%, rural areas is 83%

Electricity production: 50 million kWh
(2014 est)

Electricity installed generation capacity: 17,000 kW; 100% from fossil fuels

Emissions associated with energy consumption: 200,000Mt CO_2e

Data Source: www.cia.gov/library/publications/the-world-factbook/geos/tn.html



Energy Efficiency and Resilience Concepts

- Energy efficiency and resilience are important for island nations for a number of reasons:
  - "As climate change accelerates, small island nations will suffer a disproportionate share of the global consequences already occurring. Island nations are highly reliant on imported diesel and petroleum, which are not only major contributors to greenhouse gas emissions but are also some of the most expensive fuels in the world. Furthermore, island nations are at higher risk of being impacted by rising sea levels and extreme weather patterns, exacerbating negative effects on our ecosystems and agriculture."

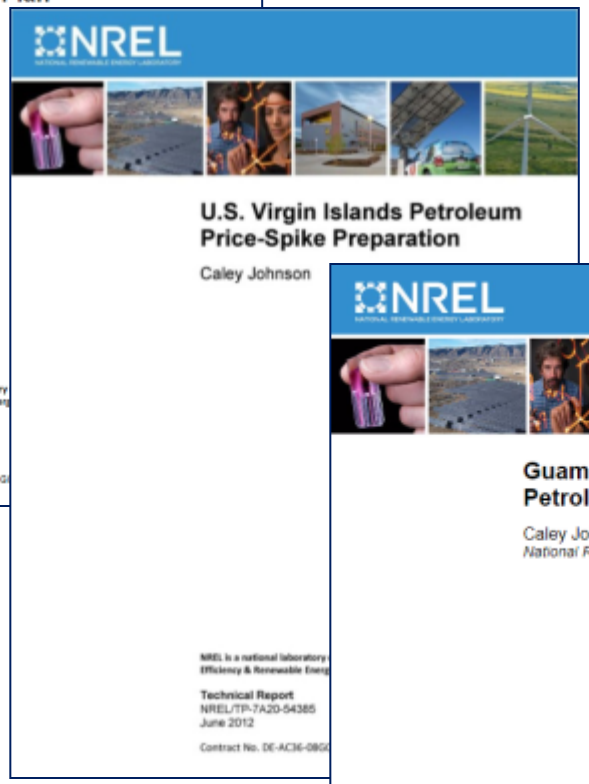
    - Clinton Climate Initiative

Regional/Island Transportation Plans Assisted by NREL


NREL

U.S. Virgin Islands Transportation Petroleum Reduction Plan

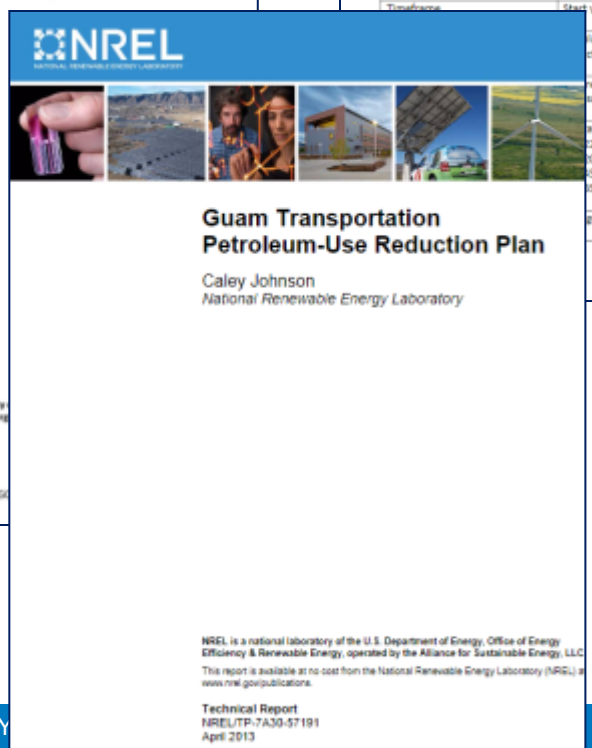
Caley Johnson


NREL

U.S. Virgin Islands Petroleum Price-Spike Preparation

Caley Johnson

Technical Report
NREL/TP-7A20-54385
June 2012


NREL

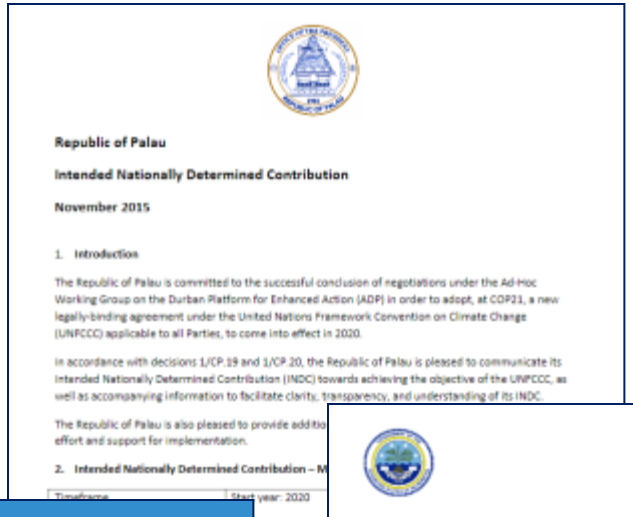
Guam Transportation Petroleum-Use Reduction Plan

Caley Johnson
National Renewable Energy Laboratory

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by the Alliance for Sustainable Energy, LLC

This report is available at no cost from the National Renewable Energy Laboratory (NREL) at www.nrel.gov/publications.

Technical Report
NREL/TP-7A30-57191
April 2013


Republic of Palau

Intended Nationally Determined Contribution

November 2015

1. **Introduction**

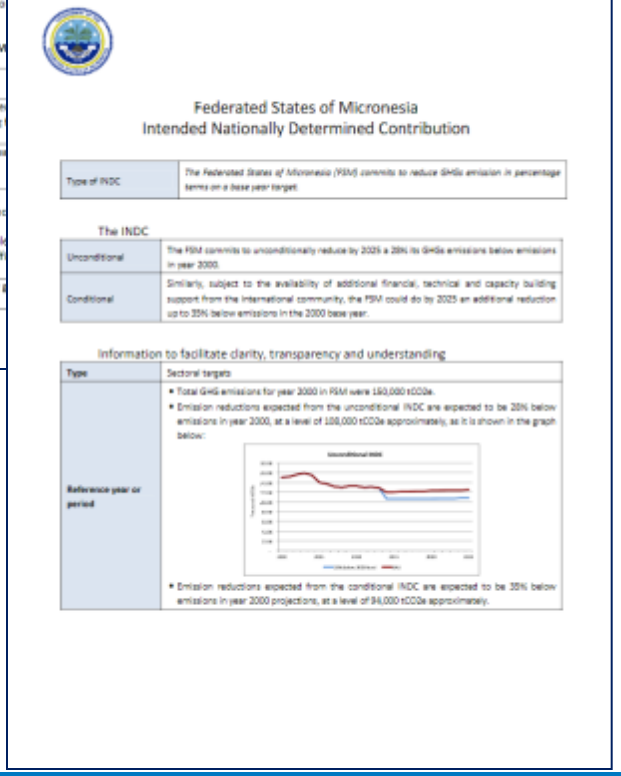
The Republic of Palau is committed to the successful conclusion of negotiations under the Ad-Hoc Working Group on the Durban Platform for Enhanced Action (ADP) in order to adopt, at COP21, a new legally-binding agreement under the United Nations Framework Convention on Climate Change (UNFCCC) applicable to all Parties, to come into effect in 2020.

In accordance with decisions 1/CP.19 and 1/CP.20, the Republic of Palau is pleased to communicate its Intended Nationally Determined Contribution (INDC) towards achieving the objective of the UNFCCC, as well as accompanying information to facilitate clarity, transparency, and understanding of its INDC.

The Republic of Palau is also pleased to provide additio
effort and support for implementation.

2. **Intended Nationally Determined Contribution – M**

Timeframe	Start year: 2020


Federated States of Micronesia
Intended Nationally Determined Contribution

Type of INDC	*The Federated States of Micronesia (FSM) commits to reduce GHGs emission in percentage terms on a base year target*

The INDC

Unconditional	The FSM commits to unconditionally reduce by 2025 a 28% its GHGs emissions below emissions in year 2000.
Conditional	Similarly, subject to the availability of additional financial, technical and capacity building support from the international community, the FSM could do by 2025 an additional reduction up to 35% below emissions in the 2000 base year.

Information to facilitate clarity, transparency and understanding

Type	Sectoral targets
Reference year or period	• Total GHG emissions for year 2000 in FSM were 160,000 tCO2e. • Emission reductions expected from the unconditional INDC are expected to be 28% below emissions in year 2000, at a level of 108,000 tCO2e approximately, as it is shown in the graph below: • Emission reductions expected from the conditional INDC are expected to be 35% below emissions in year 2000 projections, at a level of 94,000 tCO2e approximately.