

# TONGA'S RENEWABLE ENERGY & NETWORK PROJECTS

## TPL Projects

2019 & BEYOND





# Presentation Outline

## Topics to be Covered

TPL Background

Stock take of TERM Projects

GCF TREP Projects

Nuku'alofa Network Upgrade Project (NNUP)

Related Efforts & Strategic Summary

Ultimate Goal for Renewable Energy Technology



# TPL Vision, Mission & Values

## OUR VISION

**"Powering the sustainable development for our Kingdom"**

## OUR MISSION

Providing safe, reliable, affordable and sustainable electricity services for Tonga, with at least 50% of electricity requirements through renewable sources by 2020 whilst remaining financially stable.



Quality Customer Service ✓

Excellent practice & embracing technology ✓

Transparency & Accountability ✓

✓ Creativity & Innovation

✓ Honesty & Integrity

✓ Run the business as if its your own

✓ Success as a unified team, success as a dedicated individual

# OUR VALUE CHAIN

OUR STRUCTURE AND  
PROCESS





# OUR PEOPLE

Number of Staff

**CEO** 1  
CEO Office



Senior Management



 **3**  
Study Leave

**TOTAL**  
Number of Staff = **254**



# OUR TECHNOLOGY

## SOFTWARE



- ▶ Technology 1
- ▶ Orion
- ▶ SINCAL
- ▶ Openway Riva
- ▶ Cimplicity

## PURPOSE



- ▶ Enterprise Resource Planning
- ▶ Billing and CIS
- ▶ Load Flow Analysis
- ▶ Smart Metering
- ▶ SCADA



# OUR STRATEGIC OBJECTIVES

## 50% RENEWABLE 2020

Achieving 50% diesel fuel savings from Renewable Energy generation by 2020 in order to achieve the government TERM target and realistic tariff reductions.

## ADOPTING NEW TECHNOLOGIES

Adopting technologies to manage the complexities arising from a digitized and decentralized renewable future

## IMPROVING THE NETWORK

Improving the network by replacing ageing assets to improve safety, efficiency and reliability of supply

## SAFETY ENVIRONMENT

Promote a hazard free safety environment to minimize any danger to both the public and staff.

## IMPROVING BUSINESS PROCESS

Improving our business processes to enhance customer/employee satisfaction while supporting a healthy and competent team.

## MANAGEMENT OF FUNDS

Manage all external funding and internal financing sources successfully in order to increase shareholder value.

# Stocktake Highlights



## Generation

## Distribution

## Retail

## ERP/IT



Maama Mai 1.3MW  
Matatoa 2MW  
Mata 'o e La'a 1MW  
La'a Lahi 420KW - Vava'u  
Hulo 'o e La'a 200KW - 'Eua  
Ha Masani Solar Farm 500KW - Ha'apai



TVNUP/NNUP



OIREP



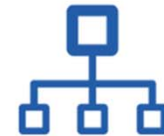
Online Payment



PEEP



Common Billing



New IT Network Infrastructure



Nakolo Windfarm 11KW  
Ha'apai Windfarm 11KW



Smart Metering Project



New ERP System



Grid Code



His Majesty Statement to UNGA (UN General Assembly)



*“ Tonga believes it can achieve its 50% by 2020 Renewable Energy Target through more and stronger private public partnership arrangements ”*

# BUSINESS ENVIRONMENT ANALYSIS

EVENT



HOW CAN WE

get there?

STRATEGIC DECISION MAKING

Updated Strategic Objectives and Priority Initiatives





# Where do we want to be?



17.5 MW OF RE



10MW/20MWh Energy Storage added to Tongatapu system



Climate Resilient Networks



50% or more of electricity generation from RE



**Achievable-** through significant donor and private sector investment and a dedicated implementation team

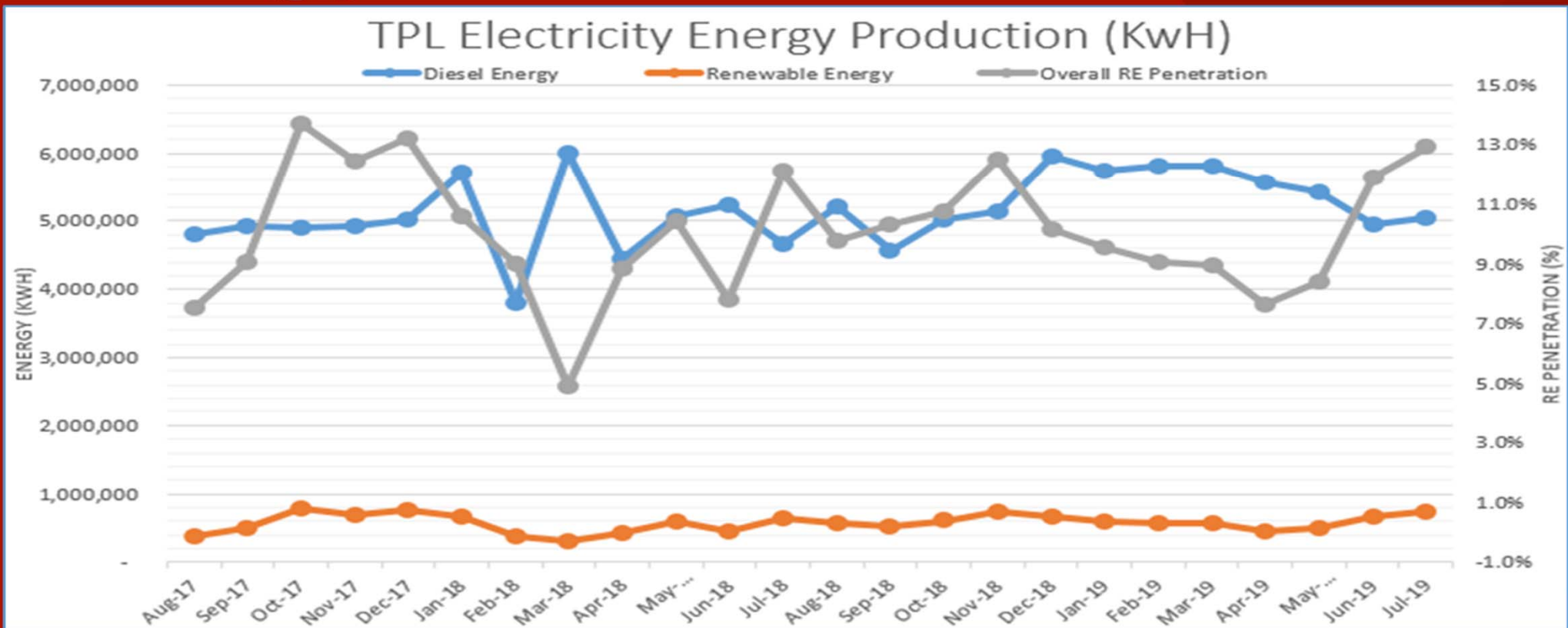


**Relative:** Socio-economic benefits through tariff stability & affordability due to less impact of oil price shocks.

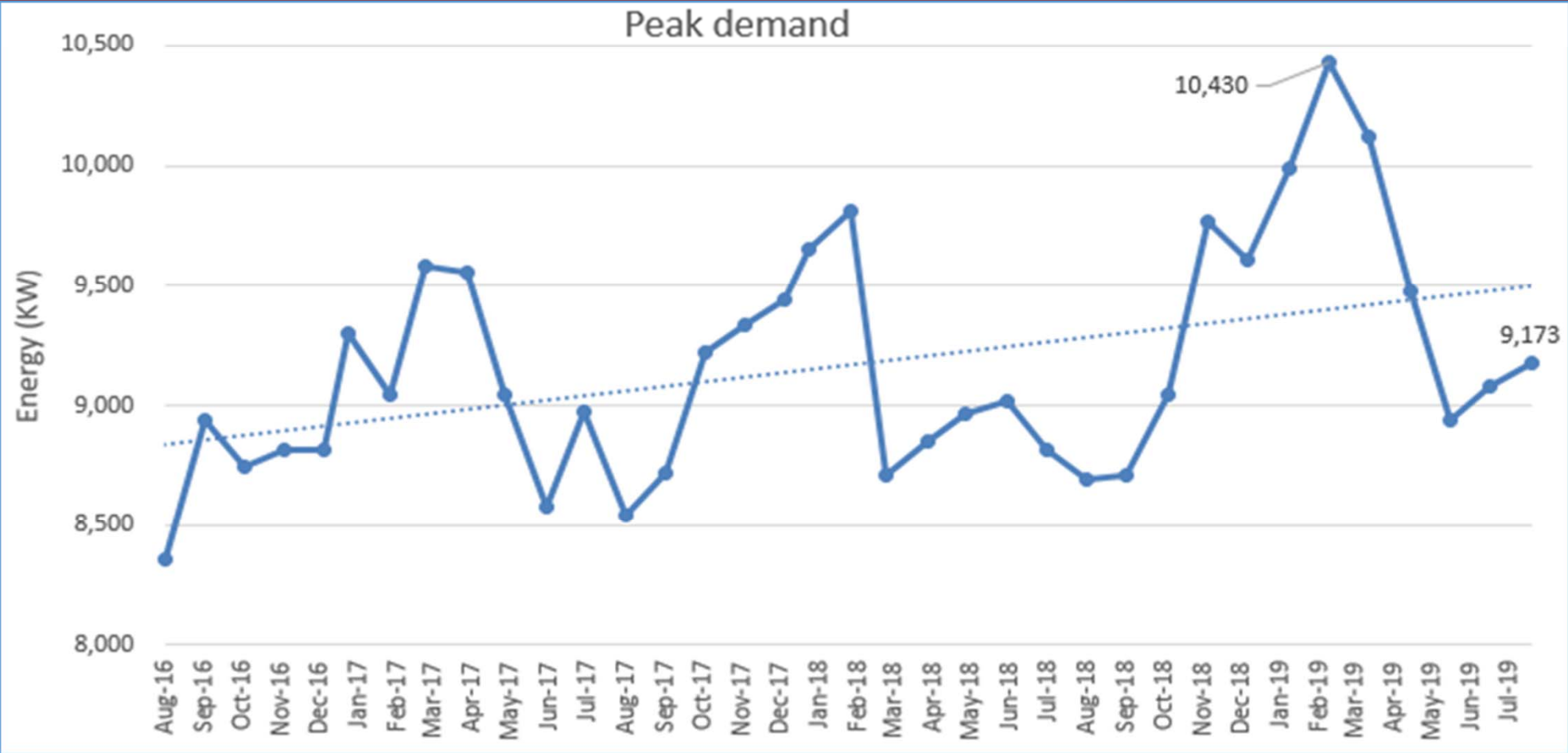


**Time Bound** - before the end of 2020

# Tonga's Renewable Energy Penetration

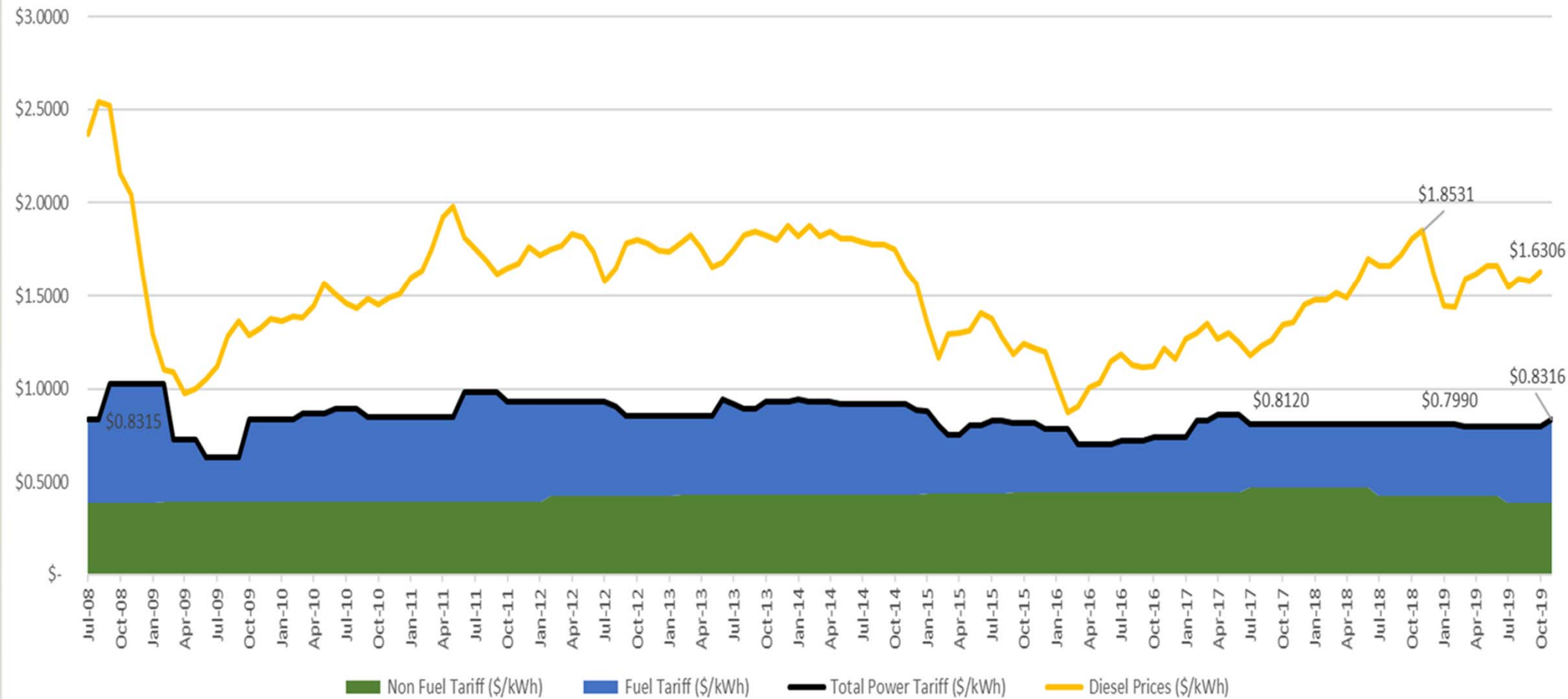


# Peak Demands





## TPL DIESEL PRICES, FUEL AND NON FUEL POWER TARIFF & TOTAL POWER TARIFF July 2008 to October 2019



# Tonga 50% RE Target by 2020

Phases to achieving 50%



## Tonga's 50% Renewable Energy Target by 2020

### Phase 1 (2014-2019)

**Outer Island Renewable Energy Project [OIREP] (RE plants on 9 outer islands + power distribution network upgrades) funded by**

- ADB Loan: \$2.50M
- ADB Grant: 11.44 M
- Government of Australia Grant: \$6.72 million
- European Union: \$3.57 million
- Second Danish Cooperation Fund for Renewable Energy and Energy Efficiency for Rural Areas: \$0.75M
- Global Environment Facility Grant: \$2.64 M
- Government of Tonga: \$1.57 million

**Total: \$29.19 M**

### Phase 2 (2017-2019)

- 1 Solar IPP: ~ \$5.0 M
- 2 Wind Farms to be funded by JICA and Government of China : \$10-15M
- **Total: \$15~20 M**

### Phase 3 (2018-2020)

**Tonga renewable energy project (TREP):**

- Green Climate Fund Grant: \$29.90M
- ADB Grant: \$12.20M
- Government of Australia Grant \$2.50M
- Tonga Power Limited: \$3.00 million
- Government of Tonga: \$5.60 million

**Total: \$53.20 M**

- ✓ 4MW Solar PV farms and 3.8MW wind farm to be developed by IPPs
- ✓ Potential contribution from Government of NZ for wind IPP (to be confirmed)
- ✓ Potential Biomass Plant \_Funding sought

## Tonga's Energy Efficiency Target (Reduction of Power Grid Losses to 9%) by 2020

### Completed

**1. Cyclone Ian Recovery Project to rehabilitate TPL's power grid on Haápai (completed in 2015).**

- ADB Grant: \$ 2.0 M
- Tonga Power Limited: \$0.5M

**2. Tongatapu – Tonga Village Network Upgrade Project (completed in 2015).**

- Government of New Zealand Grant: \$ 35 M

**Total: \$37.5 M**

### Ongoing

**1. 'Eua – part of OIREP (to be completed in 2018).**

**2. Vava'u – part of OIREP (to be completed in 2019).**

**2. Tongatapu – Smart Metering Project (completed in 2018).**

- Government of New Zealand Grant: \$ 0.6 M
- TPL: \$3.0M

**Total: \$3.6 M**

### Planned (Beyond 2020)

**1. Nukuálofa Network Upgrade Project**

- ADB Grant: \$ 6.8 M
- Government of New Zealand: \$8.0M

**2. Battery Energy Storage System - part of TREP**

**3. Energy Efficiency Programs for residential and commercial customers**

- Tonga Power Limited: \$0.5M/yr
- Total: \$14.8 M (excluding TPL's annual contribution)**

# TONGA RENEWABLE ENERGY ROADMAP (TREP)

TPL GRID



GREEN CLIMATE FUND

## COMPONENTS

## RE CAPACITY

## BESS CAPACITY



Ha'utu Solar PV plant

2MW



Fualu Solar PV plant

2MW



Liukava/Kolovai PV plant

2MW



'Eua & Vava'u Islands PV plant

650KW

1.4MWh



JICA Wind Farm

1.3MW



Niutoua Wind PPA

3.8MW



Government of China

2.25MW



BESS #1

5.1MW/2.5MWh



BESS #2

5.0MW/17.4MWh



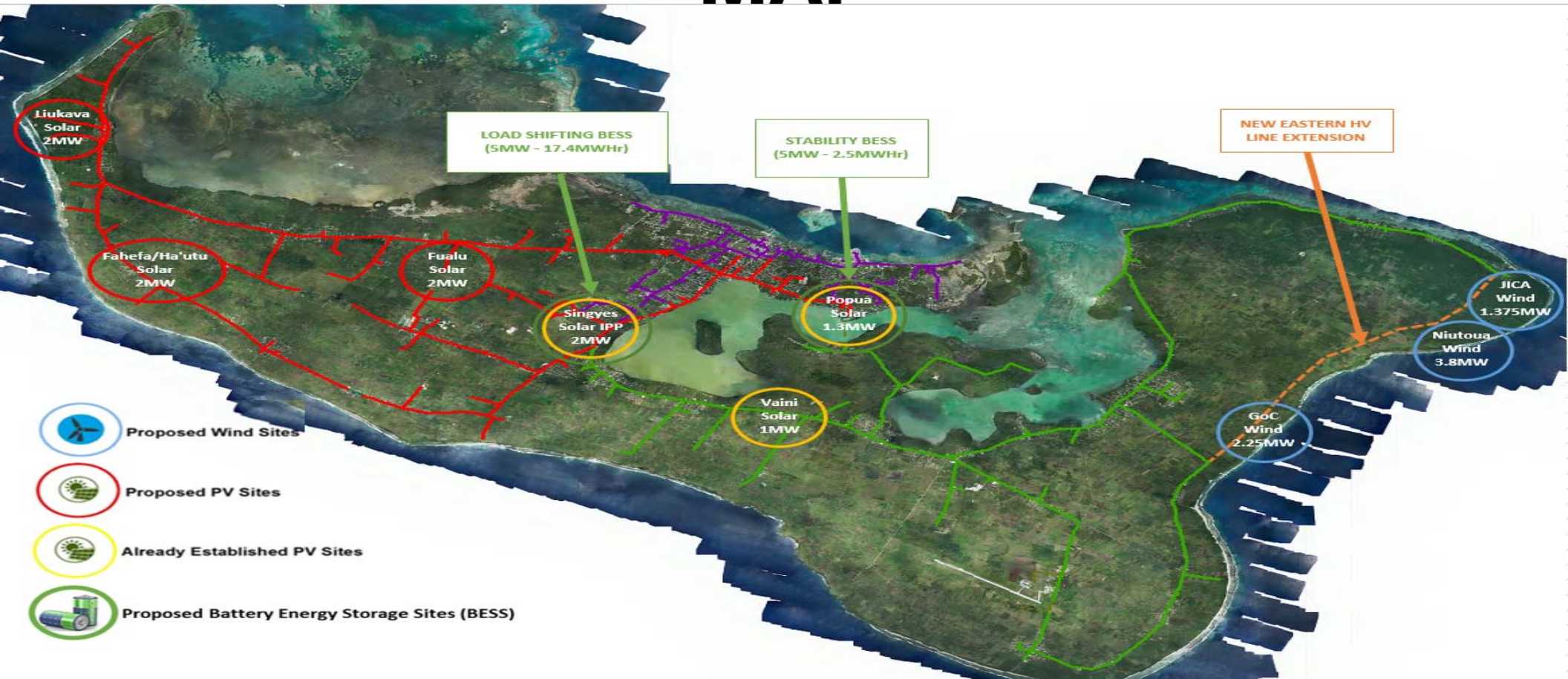
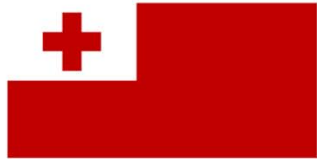
'Eua & Vava'u Solar Energy Storage

1.3MW/1.4MWh





# RENEWABLE ENERGY ROAD MAP



# TONGA RENEWABLE ENERGY ROADMAP (TREP)

## Non TPL - GRID

Solar/Battery Hybrid + New Mini-grid



GREEN CLIMATE FUND

COMPONENTS	RE CAPACITY	BESS CAPACITY
 O'ua	58KW	109KWH
 Tungua	84KW	160KWH
 Kotu	69KW	130KWH
 Mo'unga'one	35KW	66KWH
 Niuafou'ou	0.25MW	0.404MWH

# Anticipated Impact of Each Phase to Renewable Energy Penetration

Phase	TPL Grid				Non TPL Grid	TOTAL	%
	Tongatapu	'Eua	Vava'u	Ha'apai	Outer Islands		
<b>Grand Total Consumption (kwh)</b>	<b>54,215,438</b>	<b>1,791,133</b>	<b>6,148,000</b>	<b>1,533,085</b>	<b>2,292,344</b>	<b>66,000,000</b>	<b>100%</b>
Conventional (kwh)	23,549,038	978,333	5,000,000	699,435	252,297	30,479,103	46%
<b>Phase 1</b>							
OIREP RE + BESS (kwh)	-	301,800	-	837,650	747,596	1,887,046	3%
Existing RE + BESS (kwh)	4,000,000	-	710,000	16,000	550,946	5,276,946	8%
<b>Phase 2</b>							
Ongoing and Upcoming RE + BESS (kwh)	10,840,000	-	-	-	15,885	10,855,885	16%
<b>Phase 3</b>							
TREP RE + BESS including IPPs (kwh)	15,826,400	511,000	438,000	-	725,620	17,501,020	27%
<b>Total</b>							
Total RE + BESS (kwh)	30,666,400	812,800	1,148,000	853,650	2,040,047	35,520,897	-
RE Penetration (%) per Island	57%	45%	19%	55%	89%	54%	-



# RENEWABLE ENERGY ROAD MAP



Plant	Capacity (AC)	Installed	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025 Future
Existing	6 x Caterpillar (CAT-1750kVA-50Hz-CP_C)	9.6	2004											Phase out
	2 x MAK 2.88 6CM32	5.6	2014											Maintain
	Solar PV (Maama Mai)	1.3	2014											25 year (Refurb 2039)
	Solar PV (Vaini)	1	2015											25 year (Refurb 2040)
	Solar PV (Villa)	2	2017											25 year (Refurb 2042)
	Solar PV (distributed rooftop)	0.5	2015-											Ongoing
Under construction	Wind (JICA - Niutoua)	1.37											20 year (refurb 2038)	
Proposed	BESS (TREP)	2019	TREP Subproject 3										25 year (replace cells 2031)	
Proposed - dependent on BESS	Solar PV (TREP - Matafonua)	2	2019	TREP Subproject 1										25 year (refurb 2046)
	Solar PV (TREP - Fahefa)	2	2019	TREP Subproject 1										25 year (refurb 2046)
	Wind (TREP - Niutoua)	3.8	2020	TREP Subproject 2										20 year (refurb 2040)
	Wind (GoC)	2	2020											20 year (refurb 2040)
	Solar PV (Future)	2	2020											25 year (refurb 2047)
	Solar PV (Future)	2	2020											25 year (refurb 2047)
	Wind (2020->2030)	5.3	2021											
	Solar PV (2020->2030)	See ->	See ->											4 4 4 4 4 +2MW/year for growth
Totals	Cumulative Wind													1.3 1.3 7.1 12.4 12.4 12.4 12.4 12.4
	Cumulative Solar PV			1.3	2.8	2.8	4.8	4.8	8.8	12.8	16.8	20.8	24.8	28.8

Past, present (as at 2018) and proposed generation for Tongatapu

# Related Efforts



## Network Enabling

- ▶ 4th Feeder
- ▶ Easter/Western Ring
- ▶ Differential Protection
- ▶ Synchronous Condenser or Diesel UPS (3-4Mvar)



## 6MW Solar IPP

- ▶ Land Acquisition
- ▶ Permitting



## Grid Code

- ▶ Combined Control Centre Communication System for distributed Renewable Energy
- ▶ Renewable Energy Forecasting
- ▶ Weekly Generation Dispatch





# 50% RENEWABLE by 2020

Achieving 50% diesel fuel savings from Renewable Energy generation by 2020 in order to achieve the government TERM target and realistic tariff reductions.

## YEAR 1

-  6MW IPP
-  CHINA WIND
-  WIND IPP 3.8MW (JUNE 2020 - DEC 2020)
-  300 KW VAVA'U
-  300KW 'EUA

## YEAR 2

-  WIND IPP 3.8MW (JUNE 2020 - DEC 2020)
-  300 KW VAVA'U
-  300KW 'EUA

## YEAR 3 and beyond

-  BIOMASS
-  HEAT & RECOVERY
-  COCONUT
-  TIDAL
-  WAVE
-  GEOTHERMAL
-  SDG's (Customer Owned)














# ADOPTING NEW TECHNOLOGIES

Adopting technologies to manage the complexities arising from a digitized and decentralized renewable future

## YEAR 1

-  BESS #1
-  BESS #2
-  BESS VAVA'U
-  BESS 'EUA
-  COMBINED CONTROL CENTRE
-  SYNCHRONOUS CONDENSER (3-4Mvar)

## YEAR 2

-  BESS VAVA'U
-  BESS 'EUA
-  REPORTING, DATA ANALYTICS & BUSINESS INTELLIGENCE (In House)

## YEAR 3 and beyond

-  More Reclosers & Sectionalizers
-  EV as a for BESS



# NUKU'ALOFA NETWORK UPGRADE PROJECT

*Project Scope-Benefits-Funding Requirements*







TONGA POWER LIMITED

## TOPICS TO DISCUSS

- Project Scope
- Project Benefits
- Funding Requirements
- Project Timeline





Create an environment for sustainable economic growth through improved electricity accessibility, reliability & safety.











Upgrade Low and High Voltage within urban areas of Tongatapu



Increase network efficiency and reliability



New Connections with homes and businesses not previously connected to the grid.



New underground service line to all premises providing free new connection



Upgraded to AS/NZ Standards

# PROJECT BENEFITS

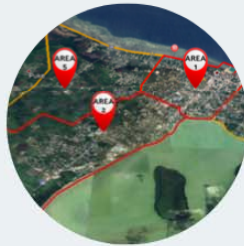


INCREASED RESILIENCE TO CLIMATIC EVENTS

INCREASED SAFETY



INCREASED ACCESS TO ELECTRICITY

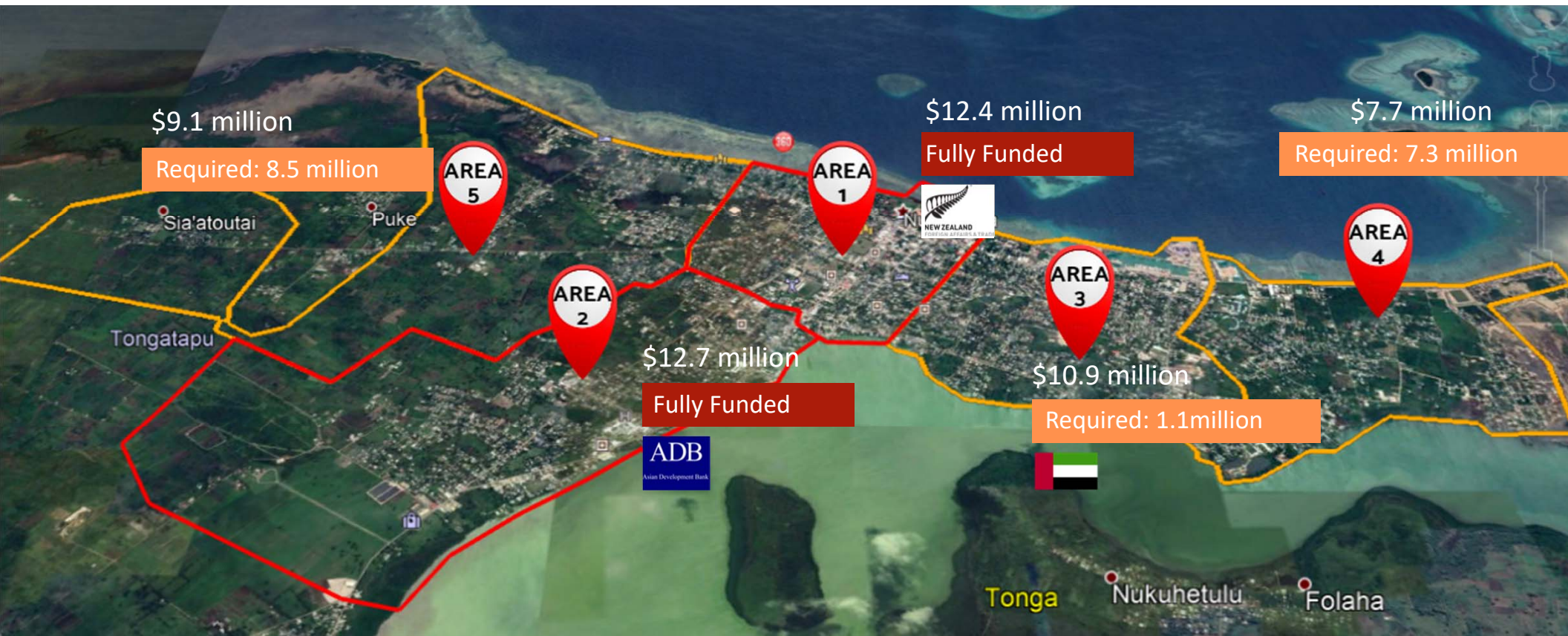


REDUCED LINE LOSSES



REDUCTION IN TARIFF





○ 56 Villages

○ 6,815 Customers

○ 5 Areas

○ 5 Years



# Nuku'alofa Network Upgrade Project

## BENEFITS

## PROJECT SCOPE

## FUNDING REQUIREMENT



**\$13.1m** (11m + 2.1m savings from TVNUP relocated to NNUP)



**\$9.3m** through Cyclone Gita Project



**\$5.2m** as announced at NNUP Ground Breaking and confirmed in email to CEO but still awaiting formal documentation.



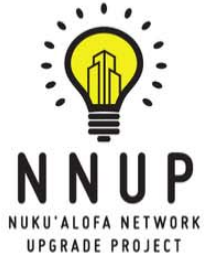
**\$3.3m** as announced at NNUP Ground Breaking but confirmed from Ministry of Finance, fund has been redirected to another GoT project



**\$5m**

**TOTAL = \$35.9m**

**PROJECT REQUIREMENT = \$16.9m**



# TIMELINE

**EXPECTED  
COMMENCEMENT DATE &  
TARGET COMPLETION DATE**





■	AREA 1 OCTOBER 2018/ <b>SEPTEMBER 2020</b>	08
■	AREA 2 JULY 2018/ <b>JUNE 2020</b>	
■	AREA 3 JULY 2020/ <b>JUNE 2022</b>	
■	AREA 4 OCTOBER 2020/ <b>SEPTEMBER 2022</b>	
■	AREA 5 JULY 2022/ <b>NOVEMBER 2023</b>	■




# IMPROVING THE NETWORK

Improving the network by replacing ageing assets to improve safety, efficiency and reliability of supply


## YEAR 1

-  OVERHAUL/OVERDUE
-  REFURB CAT 2
-  UPDATE AMP'S
-  NNUP AREA 1 & 2

## YEAR 2

-  REFURB CAT 3
-  NNUP AREA 3

## YEAR 3 and beyond



-  REFURB CAT 4,5,6
-  RE O&M
-  Proactive Maintenance
-  HV Upgrades for Outside Nuku'alofa (Underground)
-  Vehicle/Plant Improvement Plan
-  Streetlights







# IMPROVING OUR BUSINESS PROCESS

Improving our business processes to enhance customer/employee satisfaction while supporting a healthy and competent team.





## YEAR 1

-  HR-ERP SYSTEM
-  WEBSITE UPGRADE
-  TPL SMARTPHONE APP
-  POLICY TRAINING
-  BILL PAYMENT OPTIONS POLICY
-  SOCIAL MEDIA PLATFORM
-  TRAINING REGISTER
-  FORMAL SUCCESSION PLAN
-  GENERATION & DISTRIBUTION MASTER PLAN

## YEAR 2

-  ENERGY EFFICIENCY CAMPAIGN
-  RENEWABLE ENERGY GENERATION FORECAST
-  GRID INTEGRATION STUDIES
-  WEEKLY GENERATION DISPATCH

## YEAR 3 and beyond

-  E-FILLING
-  EMAIL MARKETING
-  RESERVE MANAGEMENT TOOL
-  BUSINESS INTELLIGENCE SYSTEM INTEGRATION





# MANAGEMENT OF FUNDS

Manage all external funding and internal financing sources successfully in order to increase shareholder value

## YEAR 1



ERP INTEGRATED BUDGETS



FUNDING FOR NNUP & OIEEP PROJECTS



TARIFF SUBSIDIES-GRP/DIVIDENDS

## YEAR 2



NEW PROFIT FORMULA (service fees)



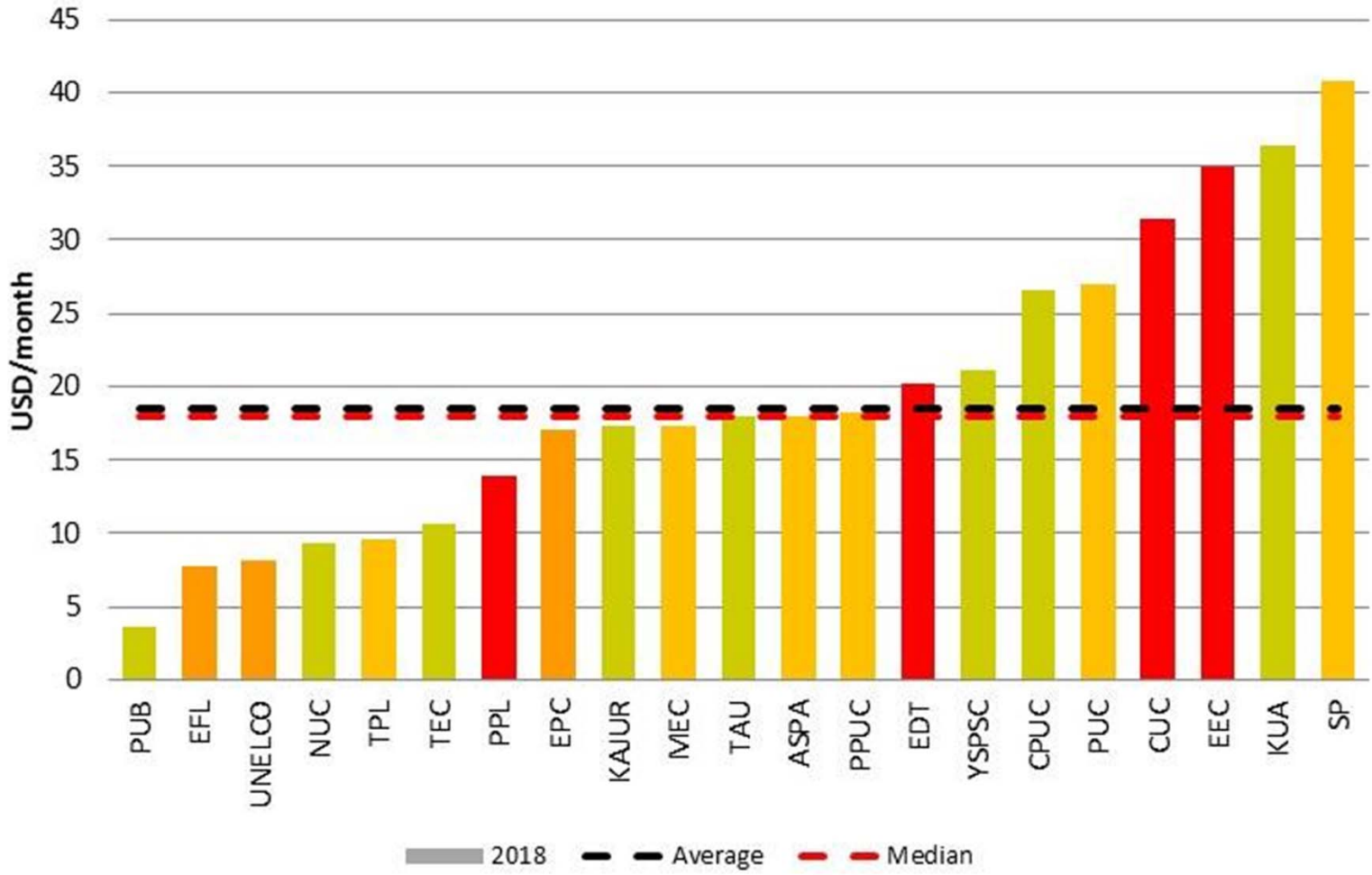
PPP Policy



INTEGRATE OFF-GRID POWER

## YEAR 3 and beyond

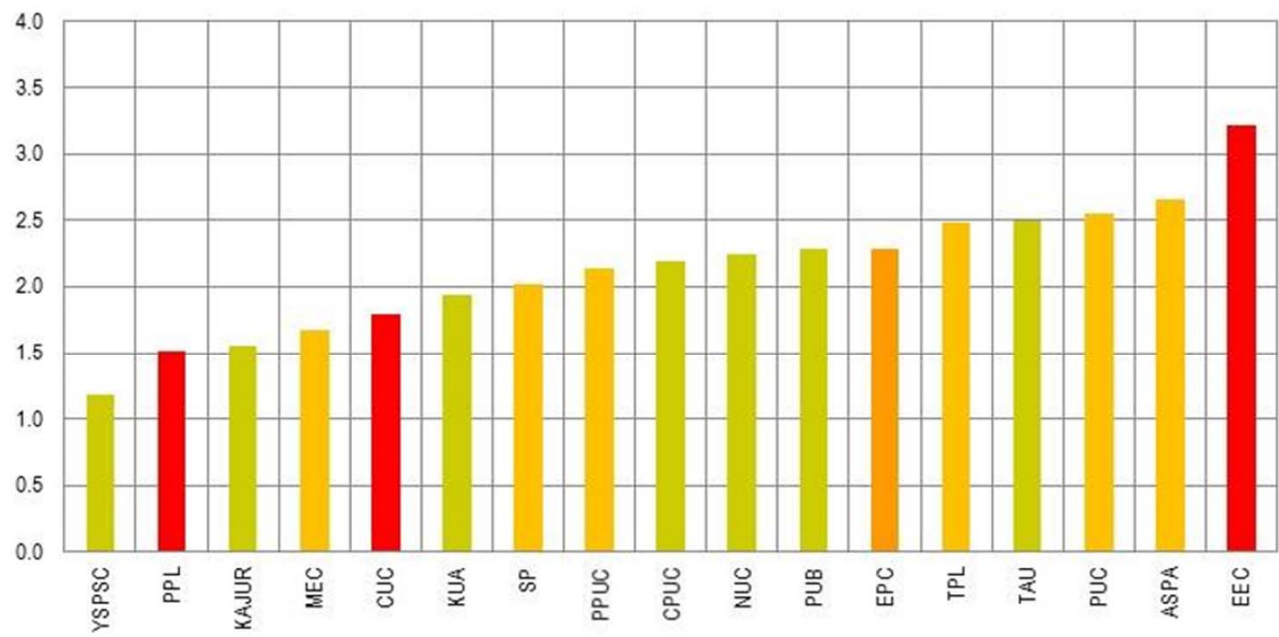
Tariff Analysis Domestic Consumer Cost (USD per month) 2018 for 50kWh Consumption



# Overall Composite Indicator

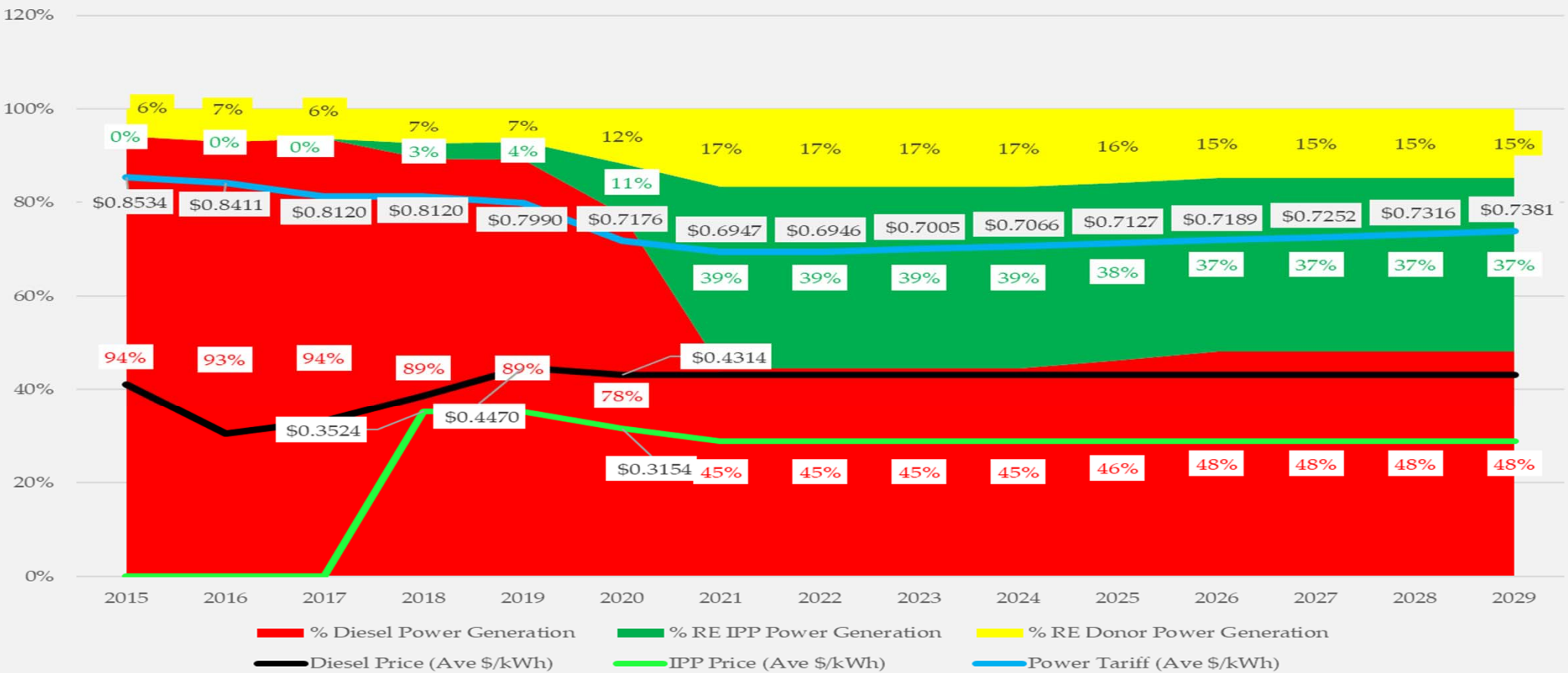
The overall composite indicator is a simple indicator that equally weights generation efficiency, capacity utilisation, system losses and overall labour productivity, as derived from quantitative scores on a scale up to 4.0. Overall, this is considered to be a valid assessment of technical performance.

Components of Composite Indicator (Maximum score 4.0)	
▪	<b>Generation efficiency:</b> specific fuel consumption (25%)
▪	<b>Efficient utilisation of assets:</b> capacity factor (25%)
▪	<b>System losses:</b> network delivery losses (25%)
▪	<b>Overall labour productivity:</b> customers per full time utility employee (25%)
Final score weighted in terms of comparative data reliability	



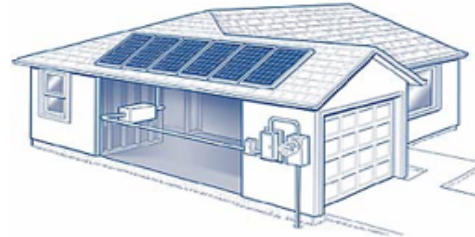
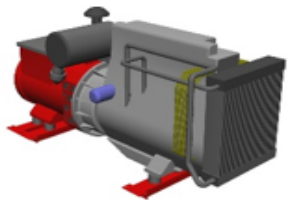
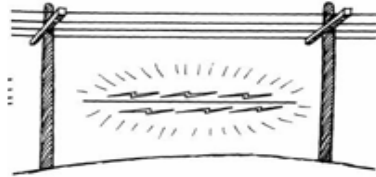
# Ultimate Goal for Renewable Energy Technology

Forecast Impact of Donor RE, IPP RE  
& Diesel Power Generation on  
Electricity Prices  
2015 - 2029





# ► Hybrid System Plan to reach 50% Renewable Penetration by 2020



**SAFE,  
RELIABLE,  
SUSTAINABLE,  
AFFORDABLE  
Electricity for  
the people of  
Tonga**



**MALO 'AUPITO**

