TONGA RENEWABLE ENERGY ROADMAP

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Tonga Power Limited

OVERVIEW

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- Tonga’s Renewable Energy Penetration
- Where do we want to be
- How do we get there
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- Hybrid System Plan to reach 50% by 2020
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T.P.L CORE PURPOSE

Safe, Reliable, Sustainable and Affordable Power Service to the People of Tonga

TPL MISSION:

To deliver the nation's core purpose via our strategies and Business Plan

- To be financially sustainable

'every public enterprises and subsidiary to operate as a successful business and, to this end, to be as profitable and efficient as comparable businesses that are not state owned'

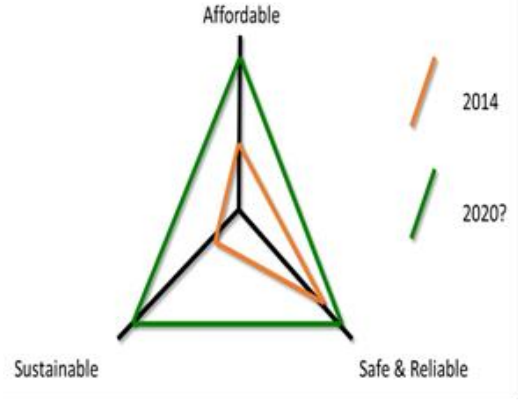
TONGA CORE PURPOSE:

Reduce Tonga's vulnerability to oil price shocks, and achieve an increase in quality access to modern energy services in an affordable and environmentally sustainable manner

50% RENEWABLE BY 2020 & 70% RENEWABLE BY 2030

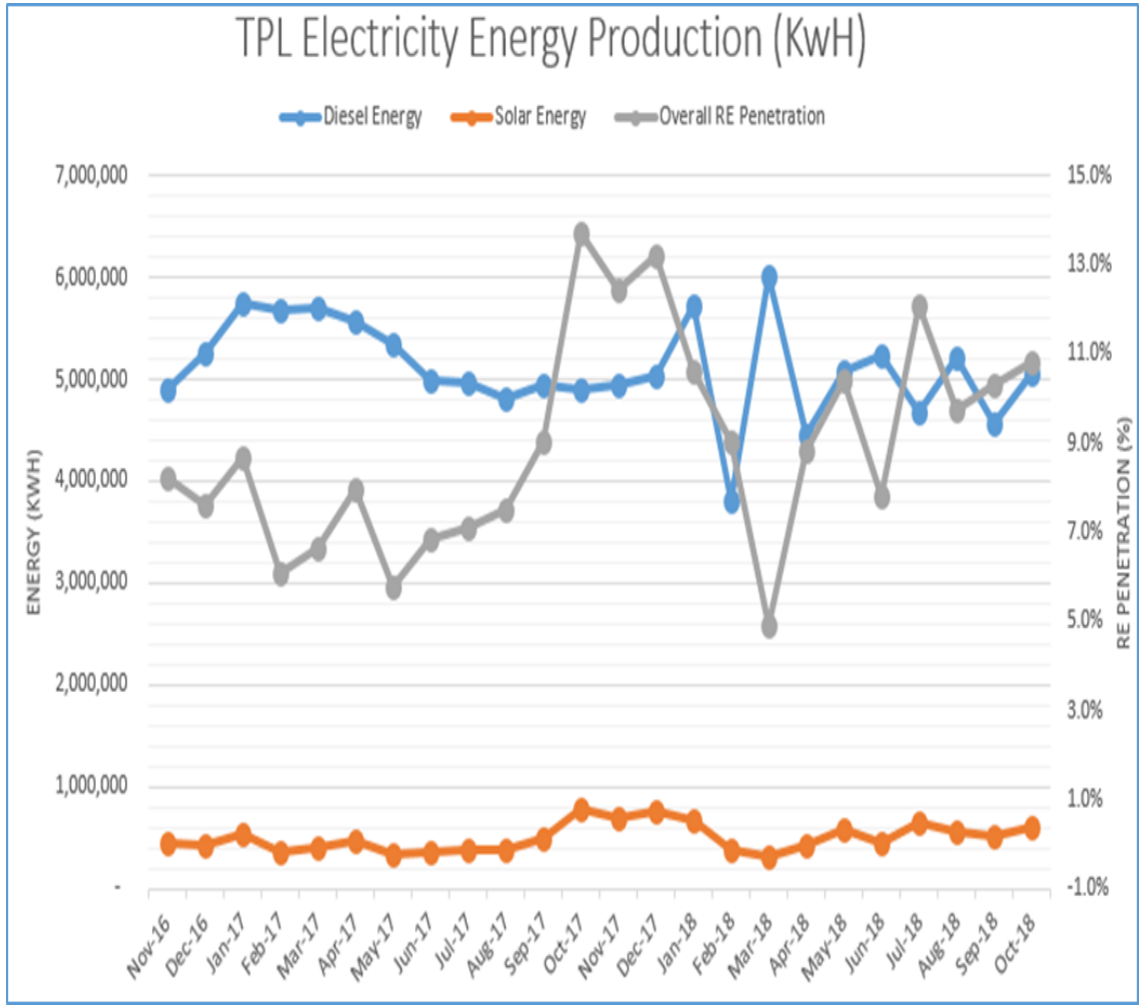
Key Energy Outcomes:

- National security of supply of energy
- Economic development- competitive energy pricing
- Standard of Living- energy price, quality, services
- Low carbon energy system



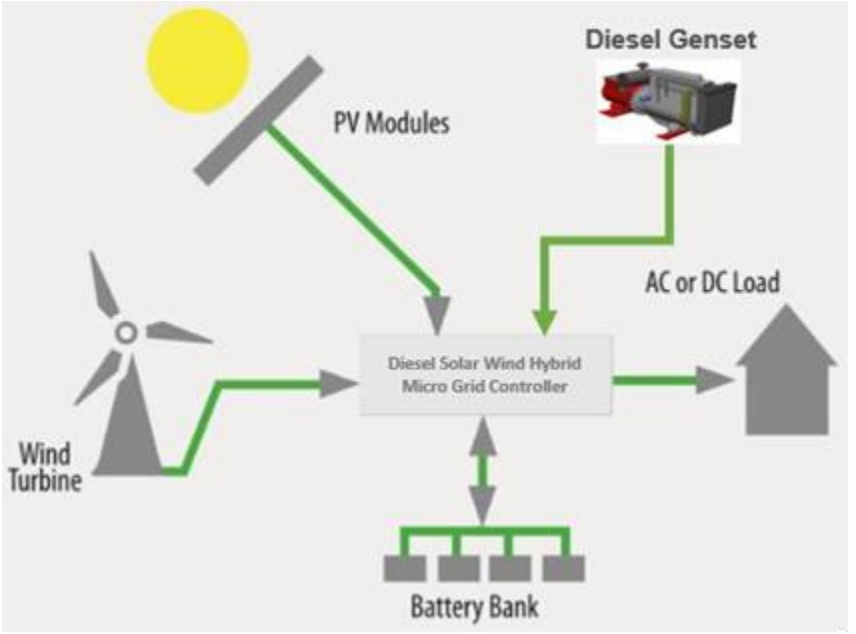
Tonga's Renewable Energy Penetration

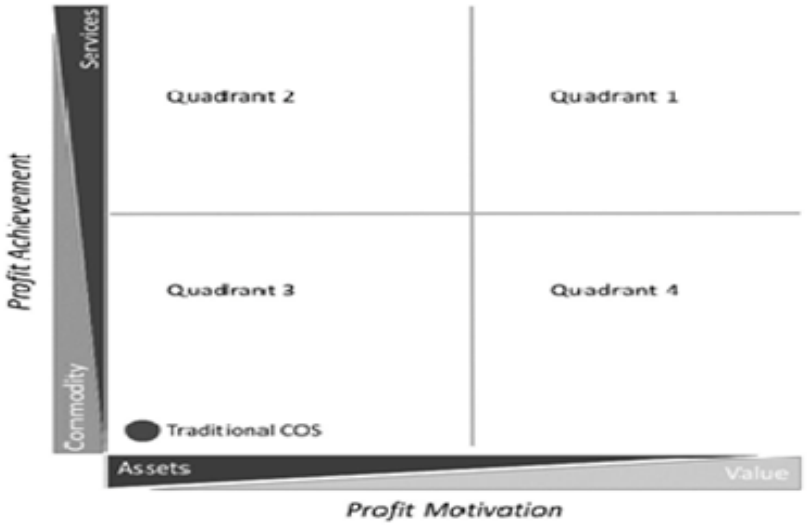
- Consistently between 7% and 11%
- Best month achieved is 14% - 16%
- Diesel Generation RE absorption limit reached (4.3MW)
- 17.7 MW of Diesel Capacity Installed
- 6.2 MW of RE Installed On-grid (Solar PV, Wind, IPP)
- 1.8 MW/1.6 MWh Total BESS Installed



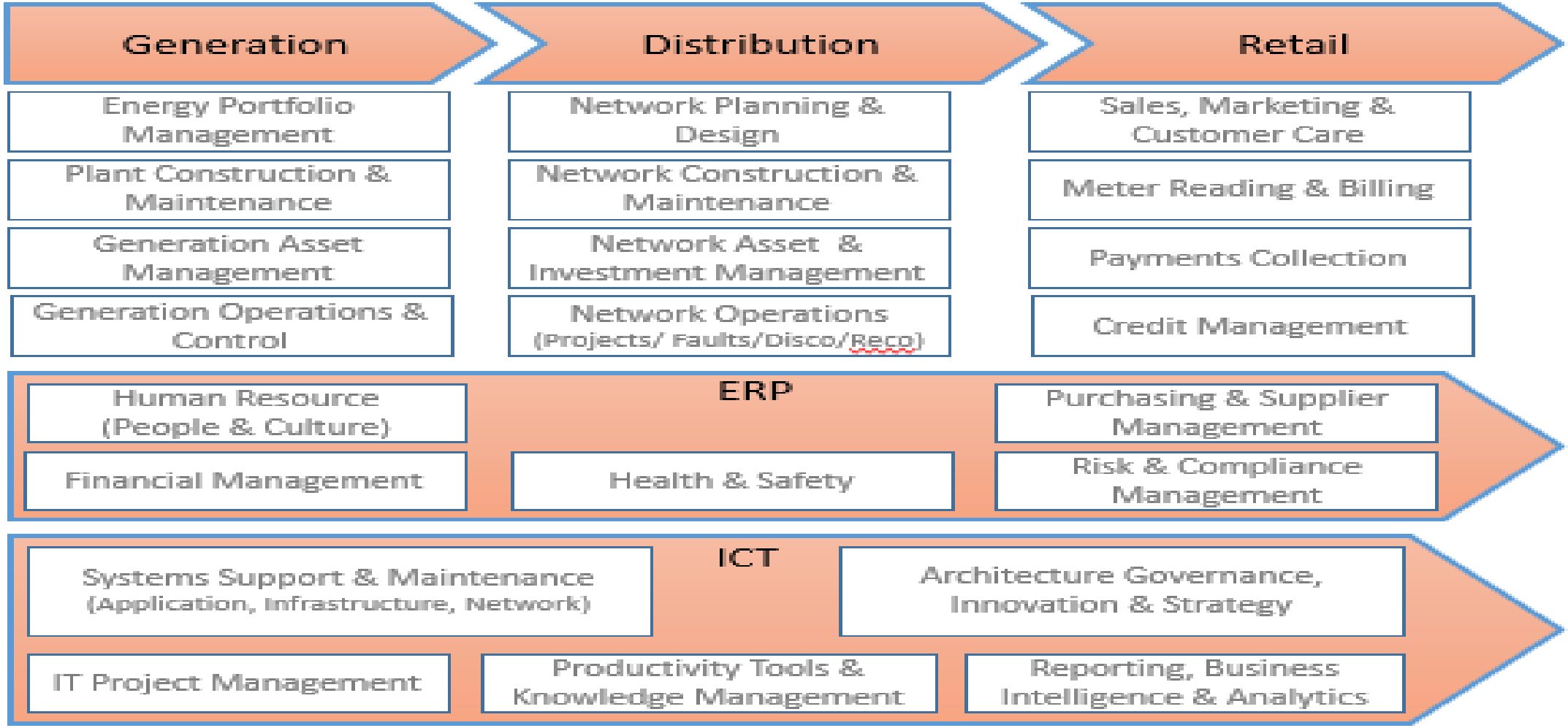
Where We want to be?

- **Specifically** – 17.5 MW of RE and 10 MW/20 MWh Energy storage added to the Tongatapu system
- **Measure** – 50% or more of electricity generation from RE
- **Achievable** – Through significant donor, private sector investment and a dedicated implementation team
- **Relative** – Socio-economic benefits through tariff stability due to less impact of oil price shock
- **Time Bound** – before the end of 2020

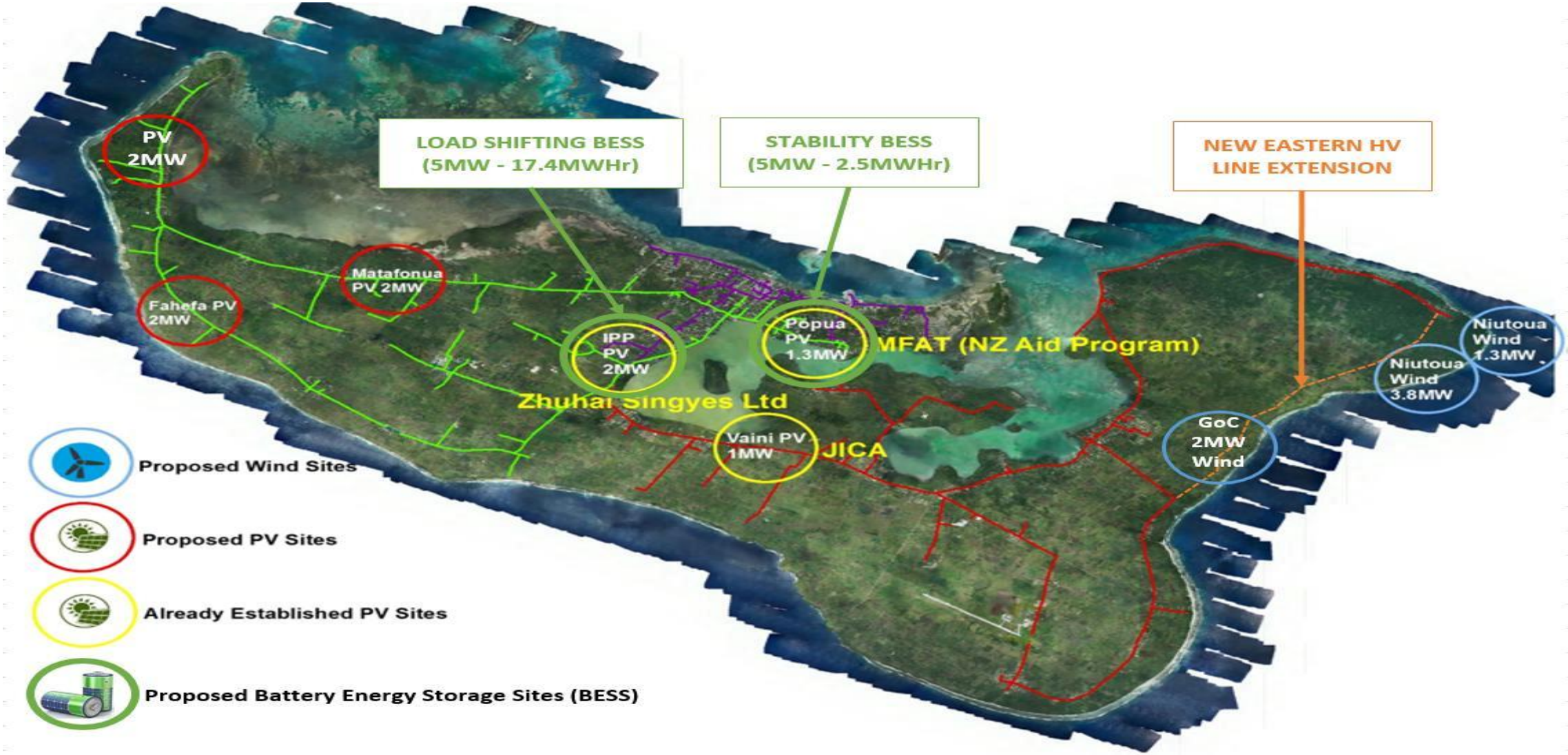




How do we get there?



Renewable Energy Road Map

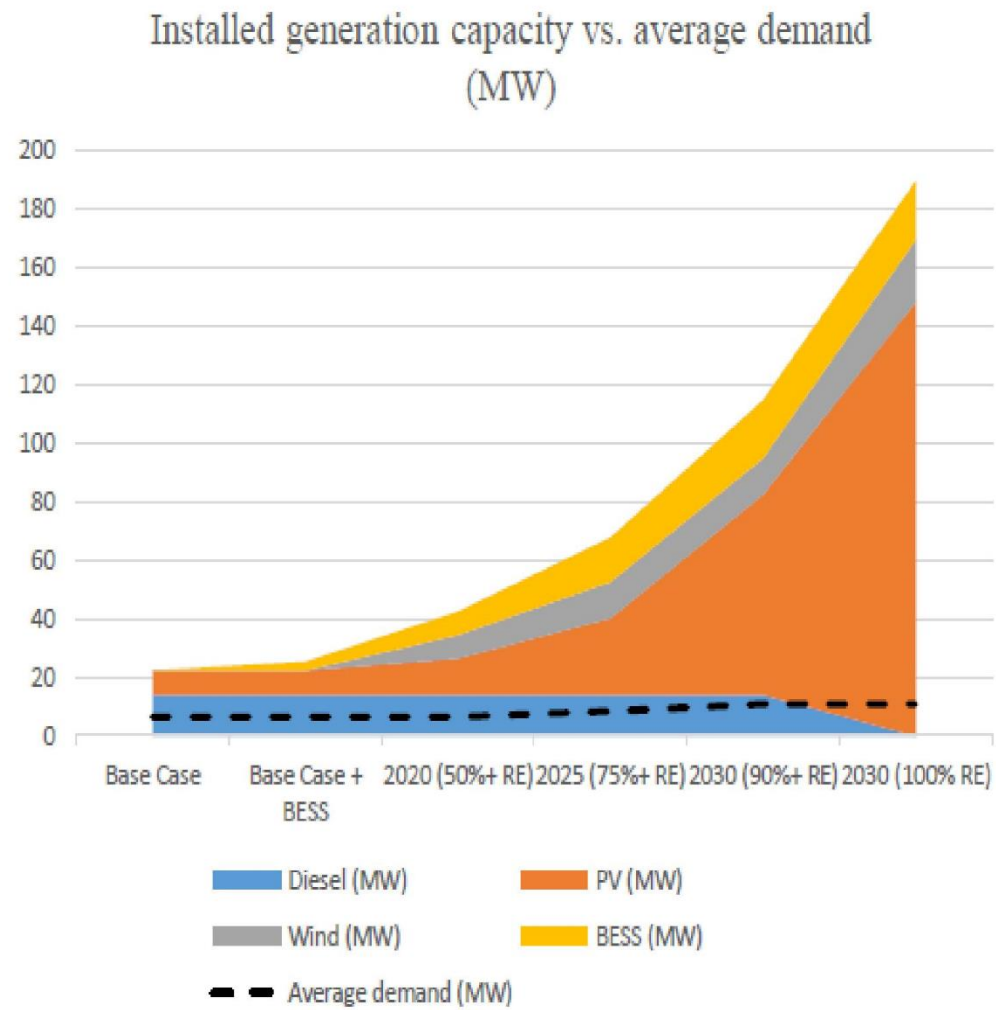


	Plant	Capacity (AC)	Installed	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Future
Existing	6x Caterpillar (CAT-1750kVA-50Hz-CP_C)	9.6	2004													Phase out
	2x MAK 2.886CM32	5.6	2014													Maintain
	Solar PV (Maama Mai)	1.3	2014													25 year (Refurb 2039)
	Solar PV (Vaini)	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	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	32.8	+2MW/year for growth

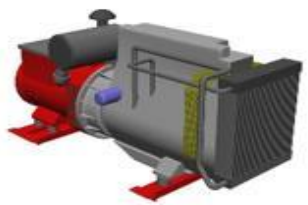
Past, present and proposed generation for Tongatapu

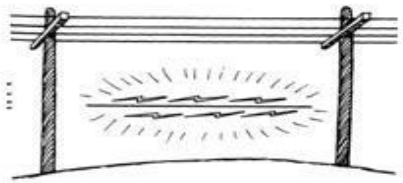
System configuration results

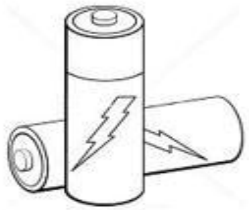
	Demand models						
	Unit	Base Case	Base Case + BESS	2020 (>50% RE)	2025 (>75% RE)	2030 (>90% RE)	2030 (100% RE)
Diesel Generation	MW	14	14	14	14	14	-
PV #1 Grant	MW	2.3	2.3	2.3	2.3	2.3	2.3
PV #2 $0.15/kWh	MW	2	2	2	2	2	2
PV #3 $0.12/kWh	MW	4	4	4	4	4	4
Additional PV @ $0.12/kWh	MW	-	-	4	18	60	140
Wind Farm #1 JICA Grant	MW	-	-	1.4	1.4	1.4	1.4
Wind Farm #2 GoC Grant	MW	-	-	2.2	2.2	2.2	2.2
Additional wind @ $0.15/kWh	MW	-	-	4.4	8.8	8.8	17.6
ESS - Peak Power	MW	-	3	8	15	20	20
ESS - Energy Capacity	MWh	-	8.4	26.3	73.5	147	273
Average demand	MW	6.56	6.56	6.56	8.36	10.72	10.72



- Hybrid System Plan to reach 50% Renewable Penetration by 2020







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

Summary

	Current Actions	3 year	10 year
TPL Utility	• Installing RE project with an aim to reach 50%R RE by 2020 • Invest in our workers by trained them	• Target to reach 50% RE by 2020 • Re-design our network to best suit our installed RE (eg. Using ring feeder)	• Target 70% RE by 2030 • Change from manual operation to automation
Consultants	• Help with designing of RE projects to achieve goal	• More consultation on RE plans especially operations • Train engineers on maintaining and operating these RE	• Operations to become automations • More training for engineers on operating and maintaining the RE projects
Tonga Govt	• Work closely together with TPL	• Let TPL be involved in their(Government's) Energy planning	• Continue working together with TPL toward funds on the upcoming projects to achieved goals
Research	• Research on types of RE technologies like battery, biomass, tidal, etc. that best suited Tonga	• More training and research on other RE technologies	• Start presenting what will be the best technology for Tonga
Donors/finance	• Decrease the amount of paper works needed in order to release funds		

MALO AUPITO….Any Question??

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