

Introductions to Mini-Grids & Standalone Home Solar (SHS) System



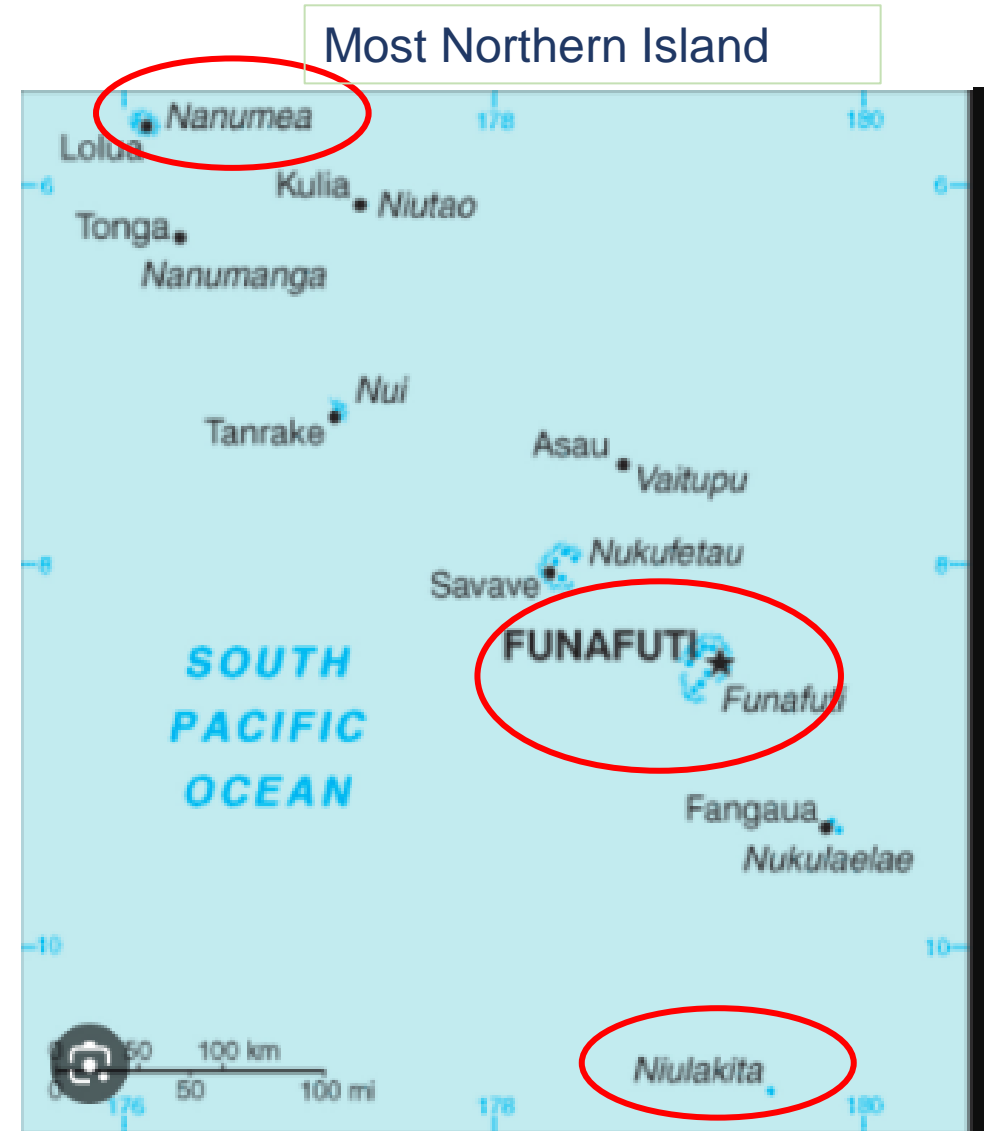
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TPCC

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Background Information

- Eight (8) atoll islands in Tuvalu
- Access between the islands ONLY by boat, and soon by plane
- Distance between the islands:
 - From Funafuti to the most Northern Island – 462kms
 - From Funafuti to the most Southern island – 119kms
- Seven (7) islands on mini-grid + two (2) other sites, one on SHS, and the main island on grid-connected systems
- Six (6) islands on LV 3-phase and one (1) island on 11kV system network
- Access rate to electricity – ~100%
- Outer Islands electricity supply – from 2000 18hrs/day by diesel generators and in 2015 - 24/7 by mini-grids.
- Climate Target – 100% RE by 2020, 2025 and recently to 2030.



Most Southern Island

Solar PV Mini-Grid & SHS System in Tuvalu

1. Role of Solar PV Mini-Grid

- Improved living standard
 - availability of communication systems includes, telephone, mobiles phones, internet connectivity
 - proper facilities for storage of vaccines
 - kids able to study at night etc
 - more economic activities done
- Contribute to the Country target of 100% RE and 30% EE
- Minimize the use of diesel fuel



2. Current Mini-Grid System

Site	Capacity			Installation	Comm	Type of Battery (Lead Acid)	Remarks
	PV (kWp)	Battery (kWhr)	Gen (kVa)				
Nanumea	195	1,440	160	Ground	2015	Maint. Free	Battery replacement
Nanumaga	205	1,584	160	Ground	2015	Maint. Free	Battery replacement
Niutao	230	1,728	160	Ground	2015	Maint. Free	Battery replacement
Vaitupu	400	2,880	160	Ground	2015	Maint. Free	Battery replacement
Nui	80	864	180	Ground	2015	Maint. Free	125kWp September install 2023
Nukufetau	97	1,008	180	In the Estuary	2015	Maint. Free	118kWp install August 2023
Nukulaelae	45	586	114	Ground	2015	Maint. Free	40kWp install July 2023
Maritime Institute	8	96	120	Rooftop	2017	Maint. Free	Increase Capacity & storage
Motufoua Sec. School	46	576	114	Ground	2009	Wet Batt	Battery Replacement

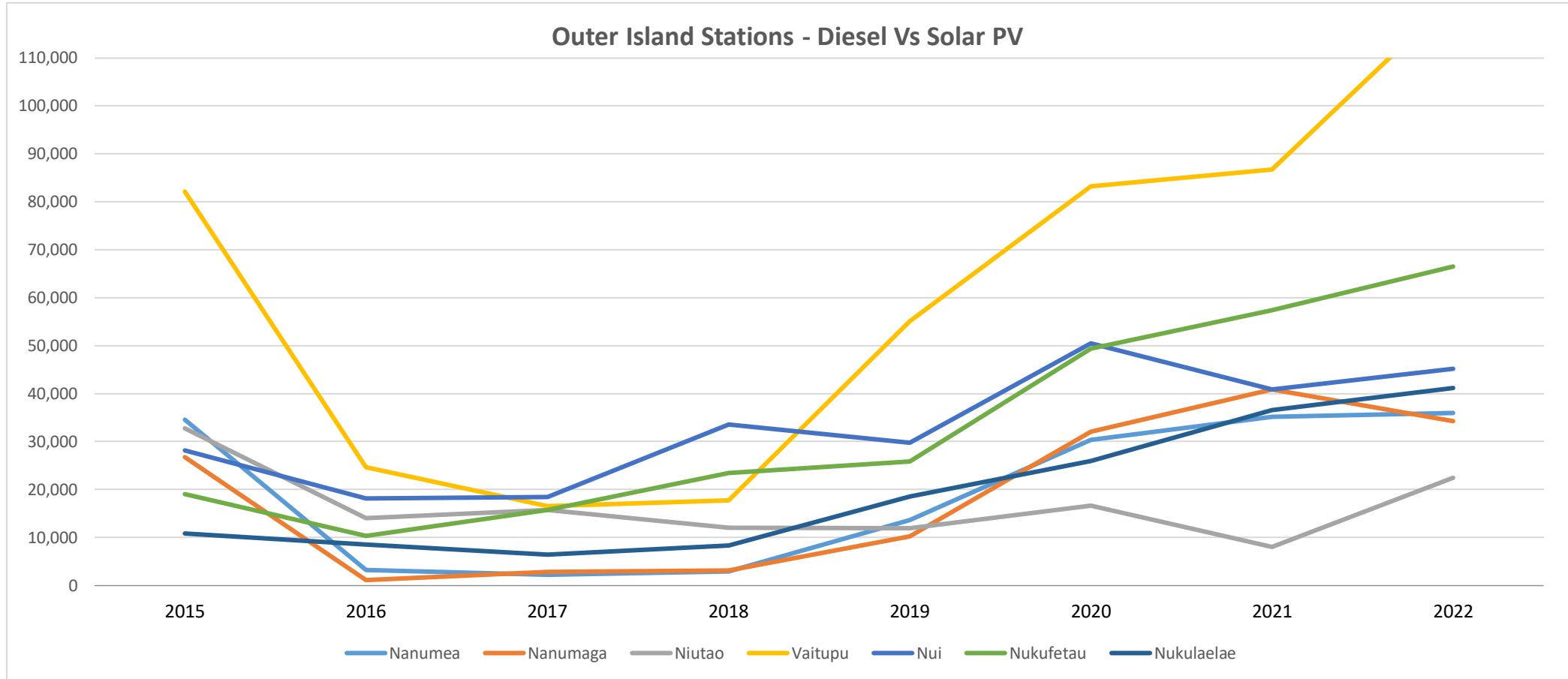
2. Current Mini-Grid System

Site	Capacity			Installation	Donor	Total Cost
	PV (kWp)	Battery (kWhr)	Gen (kVa)			
Nanumea	195	1,440	160	Ground	NZ MFAT	NZ\$20million
Nanumaga	205	1,584	160	Ground	NZMFAT	
Niutao	230	1,728	160	Ground	NZMFAT	
Vaitupu	400	2,880	160	Ground	NZMFAT	
Nui	80	864	180	Ground	EU	EU2.4million
Nukufetau	97	1,008	180	In the Estuary	EU	
Nukulaelae	45	586	114	Ground	EU	
Maritime Institute	8	96	120	Rooftop	Finland	USD\$30k
Motufoua Sec. Sch.	46	576	100	Raised Structure	Italy	USD\$700,000

3. Role of Mini-Grid – Share of RE

SHARE OF PV							
Stations	2016 (%)	2017 (%)	2018 (%)	2019 (%)	2020 (%)	2021 (%)	2022 (%)
Nanumea	94	95	93	79	55	36	45
Nanumaga	96	93	93	81	64	35	46
Niutao	93	91	90	78	74	13	67
Vaitupu	77	88	88	61	50	37	56
Nui	73	59	38	44	49	48	61
Nukufetau	83	73	53	47	42	52	2
Nukulaelae	14	67	70	49	36	52	67
<i>Outer Islands</i>	81	81	77	63	54	39	53
Funafuti	14	12	9	11	8	10	11
<i>Overall</i>	25	25	21	20	17	17	19

Mini Grid Vs Diesel Consumption



- Installation of mini-grid in 2015, diesel consumption decreases and after 2018, diesel consumption increases again
- Due to the deterioration of batteries in all the stations

4. Management/Institutional Structure

- TEC main office at Funafuti, Manage and Operate Outer Island Mini-Grid Systems
- 2-staffs on each station to look after the system
 - Supervisor and Operator
 - Also have a relieve staff on each island
- Island Council involve in the monitoring of staff
 - to represent TEC on the island and can report staff performance to main office and Management will deal with the matter accordingly.



5. Business Models/Tariff Setting

Tuvalu Electricity Corporation Lifeline Tariff

Table 1:-Tariff Rates Approved by Cabinet on 1st February 2008

Note
Fuel Cost \$1.29/litre

Tariff Category	Units	Current Schedule			Propose Schedule [Rates based on fuel price of \$1.29]				No Govt Subsidy
		Base Tariff	Fuel Tariff	Total	Base Tariff	Fuel Tariff	Out Stat	Fog	
Existing Domestic Tariff [Fogafale]	AUD	0.34	0.00	0.34	-	-	-	-	-
Existing Domestic Tariff [Outer Islands]	AUD	0.30	0.00	0.30	-	-	-	-	-
Existing Comm/Govt	AUD	0.47	0.00	0.47	-	-	-	-	-
New Level 1 Tariff 1 st 50kWh per month	AUD	-	-	-	-0.03	0.32	0.29	0.30	0
New Level 2 Tariff kWhs 51-100 per month	AUD	-	-	-	0.06	0.32	0.38	0.39	0
New Level 3 Tariff kWhs Above 100	AUD	-	-	-	0.23	0.32	0.55	0.56	0
Commercial/Government Tariff (All kWh)	AUD	0.47	0.00	0.47	0.23	0.32	0.55	0.56	0

Note:

- Cost of Electricity (COE) still not able to reduce.

Business Models/Tariff Setting

	Existing		Propose		
Category	Outer-Islands	Fogafale	<i>New Tariff</i>	<i>O/Islands</i>	<i>Fogafale</i>
• Residential					
○ 1 st 50kWh	0.29	0.30	<i>0.56</i>	<i>0.85</i>	<i>0.86</i>
○ 2 nd 50kWh	0.38	0.39	<i>0.56</i>	<i>0.94</i>	<i>0.95</i>
○ Above 100kWh	0.55	0.56	<i>0.56</i>	<i>1.11</i>	<i>1.12</i>
• Government & Commercial	0.55	0.56	<i>0.56</i>	<i>1.11</i>	<i>1.12</i>



- By law, all Government SOE's to submit Community Service Obligations (CSO) to Government on yearly basis
- CSO - to cover all unprofitable activities carried out by the SOE.
- In May 2023 Cabinet has agreed in principle for Government to subsidies whatever amount is required by TEC based on current tariff rate.
- Directed the Ministry to review calculation of tariff so as to determine a more realistic level of subsidies required in light of **other RE solar projects** current in progress and resubmit.

6. Experience & Challenges with Mini-Grid System

Experiences

- Good and reliable systems
- Meet island demand 24/7
- Able to reduce fuel consumption
- Less amount of fuel to the islands
- Reduce fuel handling costs
- Less capacity of fuel storage on the island
- Reliability of system, more use of household electrical equipment
- Need aggressive EE awareness programme prior installation of system
- Implement energy efficiency measures straight after installation to avoid increasing of demand
- Right skill set for system O&M
- Finance - Get tariff right or get the government support for the right subsidy



6. Experience & Challenges with Mini-Grid System

Challenges

- Distance between the islands, only access by boat
 - From Funafuti to the most Northern Island – 462kms
 - From Funafuti to the most Southern island – 119kms
- Capital intensive investment and need finance to maintain
- Rapid increase of demand
- Difficult to have the right skills on the island
- Monitoring of staff
- High cost of internet
- Difficult environment for electronic parts



7. Lesson Learnt

- Could have done differently, lots of coconut trees were cut down
 - Alternative means of installing PVs – rooftops, floating PV.
- Battery Failure
 - Oversized System - to able to cater for the increasing demand
- Minimize growth of demand
 - Using of prepayment meters
 - limit demand
 - improve collection
- To involve an authorize body for the monitoring of staff
- Identify right staff for O&M



7. Lessons Learnt

- Monitoring of Staff
 - To involve the Kaupule
- Communication is a need
 - On-line monitoring is necessary
 - VHF radio's for all station
- Need Frequent visit to the islands
- Invest in human resources to enable to maintain the systems
- Right tariff setting – need Government support.
 - regular presenting your case to Cabinet for finance support



Standalone Home Solar (SHS) System

Two Parts of the Project

Part 1 - SHS System for household, Meeting Hall and Church

Part 2 – Community Deep Freezer to drive economic activities



System Component

1. Household

- 2 x 140watts panel
- Inverter – 12v 300watts
- Sunsaver Controller
- 12v 250AH deep cycle VRLA battery



2. Community Deep Freezer (415ltrs, 3-star)

- Panels - 3 x 380 watts
- Inverter – 24v 800watts
- Charger Controller – Tristar MPPT
- Battery – 12 x 2volts 600AH VRLA battery



Management/Institutional Structure

- Ownership arrangement
- Individual household to look after their own system
- Maintenance – TEC to do the maintenance without any cost



Business Models/Tariff Setting

- On trial of Ownership arrangement
 - TEC to look after the main component
 - Owner, responsible for internal items.



Experience with SHS

- Provide quality lighting
- Activities can spread out into the night
- Children can do school work at night
- Able to access internet
- Able to use laptop and charge mobile phone
- Able to store vaccine.



20kWh lithium-ion battery

Challenges with SHS

- Residence request for more solar PV capacity
- Still some residence not able to look carefully at their system
- Deterioration of Batteries
- Increase the number of new residence
- Deep Freezer not fully utilized.



20kWh lithium-ion battery

Lessons Learnt

- Education program for residence to live within their means
- Training of residence for business opportunities
- Awareness program on the importance of SHS and its limitation
- System Sustainability - To involve the Island Council to manage and operate the system
- TEC is available to offer the technical expertise.



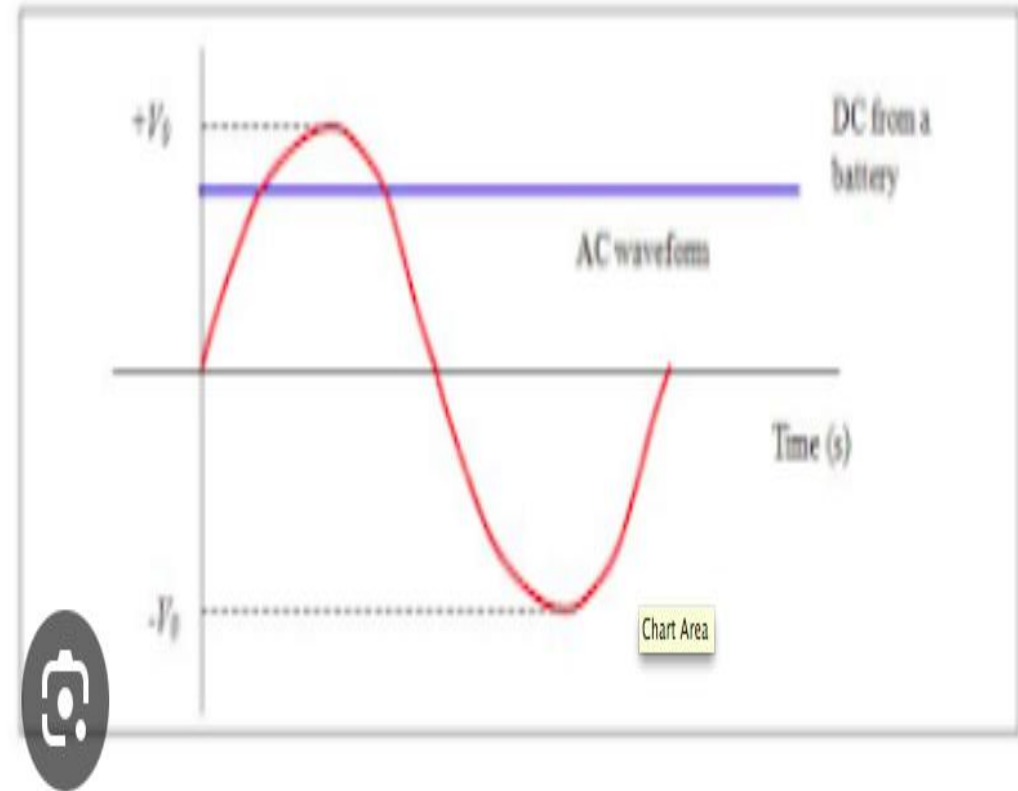
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DC & AC

- Which voltage is more Fatal?
- Why?



Private Sector Opportunities for Mini-Grid & Standalone Home Solar (SHS) System

- For TEC to source out Installation and O&M to the Private Sector.
- To achieve this arrangement the following actions MUST be done soon:
 - Energy Bill is to be endorsed by Parliament to assist further development of RE&EE.
 - Training & Certified of existing Electrical Contractors and others to be able to install and do maintenance on RE systems.
 - Include RE&EE modules at the TASTI Programme at the PWD.



Fakafetai Lasi