

Singapore 2022 Symposium on Microgrids

Tonga Rural/Remote Community Socio-Economic Productivity Improvement through Solar Power Generation Projects

Presented by:

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About Myself, Policy & Mission

**Clean Energy and Clean Water for Society at Large
Secure Society Critical Infrastructure & Power**



Education: Electrical Engineering Honours, University of New South Wales, Australia.

Experiences:

18 years of experience working on PV rural electrifications, microgrid systems and grid-connected systems. These 18 rewarding years are with Mitsubishi Electric.

Coverage:

Rural Electrification Projects cover Asia Pacific Region, particularly in recent years completed many pacific islands Projects Including Cook Islands, Niue, Palau, Vanuatu, Micronesia, Marshall Islands and Tonga.

Areas of interest:

Besides Solar Photovoltaics, other interests and responsibilities in Mitsubishi Electric are: Water Treatment Plant Solutions, Transportation Rolling Stock Systems, Critical Power (UPS) Solutions for Data Center, SCADA & BMS Systems, Urban and Building Sustainability.

Awareness & Action for Climate Change, Supporting rural areas and communities.

Background of Project

Project: Tonga Rural/Remote Community Socio-Economic Productivity Improvement through Solar Power Generation Projects

Owner: Ministry of Meteorology, Energy, Information, Disaster Management, Climate Change and Communications (MEIDECC), Government of Tonga

Funding: Pacific Environment Community (PEC) Fund from Japan + Local Tonga Fund

Systems:

Total no of Solar Pumping Systems(SPS): 22 sets and Solar Freezer Systems (SFS): 40 sets

SPS - 17 villages in Vava'u installed with 22 sets of SPS (within in main Vava'u Island)

SFS - 11 villages in Vava'u installed with 21 sets of SFS (Outer Islands)

9 villages in Ha'apai installed with 19 sets of SFS (Outer Islands)

The first component of the project will significantly improve the lives of 23 Villages of Vava'u with a total population of 8730 (1636 households) expected to benefit from 27 solar powered water pumps that will be installed. As a result, these villages will be able to displace the need for or reduce diesel consumption for water pumping.

* 5 sets of SPS were not installed at that time as construction of wells are not in time

Background of Project

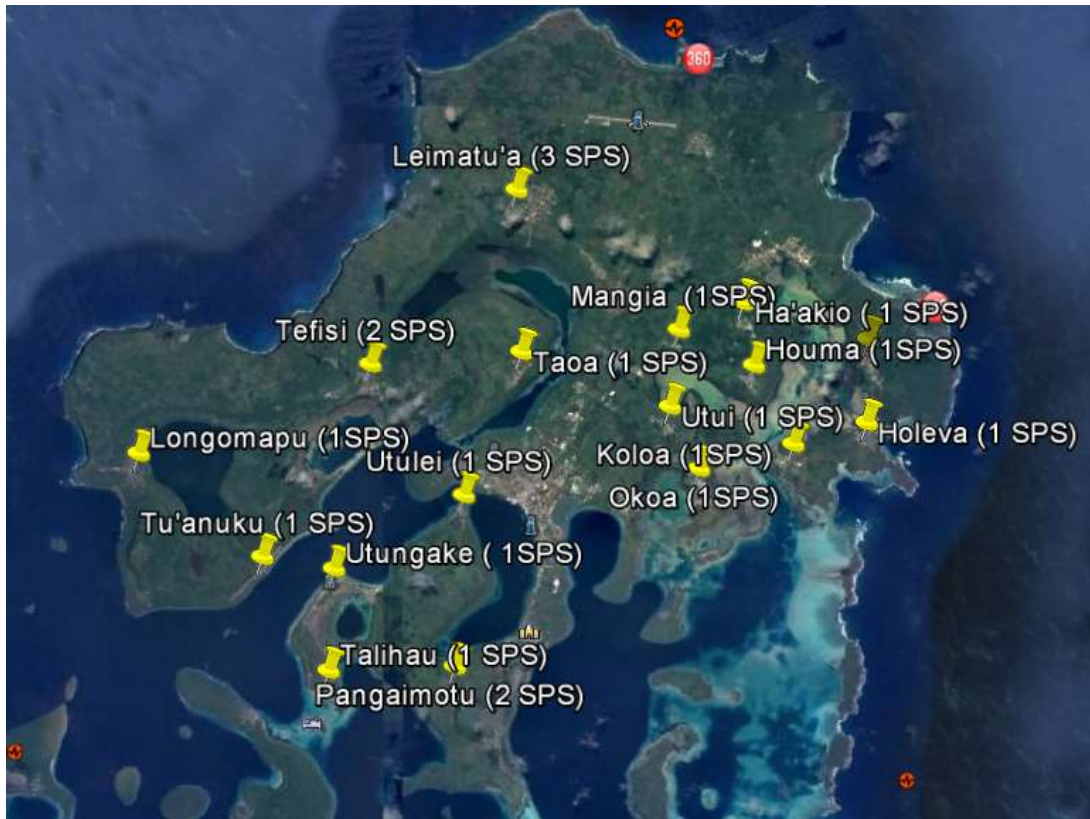
The second component of the project is on the provision of solar powered deep freezers. It is anticipated that 22 remote islands of Tongatapu, Ha'apai and Vava'u, consisting of 538 remote households with a total population of 2642 will benefit from chest freezers powered from solar energy.

The project will save approximately 41,000 liters of diesel annually; enhance households economic productivity; increases accessibility to healthy, reliable water and foods supply as well as employment opportunities for all age groups.



Vava'u Islands Installation sites (SPS – Solar Pumps System)

17 villages in Vava'u installed with 22 sets of SPS



Site	Site Information		
	Qty. of PV Modules (280Wp)	Well Depth	Water thickness
Koloa	6	26	1.2
Ha'akio	6	45.9	4.9
Mangia	6	32.2	2
Houma	6	33.5	0.5
Pangaimotu 2	14	31.9	1.8
Pangaimotu 1	14	23.8	1.43
Talihau	8	13.46	1.78
Okoa	14	9	1
Leimatu'a 1	24	70.2	3.7
Longomapu	36	51	3.5
Tefisi 1	14	53.2	2.9
Tefisi 2	14	54.2	2.46
Holeva	4	11	1
Tu'anekeviale 1	8	24.1	1.9
Tu'anuku	24	50	0.2
Utulei	6	40	0.5
Tu'anekeviale 2	8	NA	NA
Leimatu'a 2	36	54.5	0.46
Utui	8	NA	NA
Leimatu'a 3	36	61.35	5.4
Taao	24	NA	NA
Utungake	14	NA	NA

Vava'u Islands Installation site (SFS - Solar Freezer System)

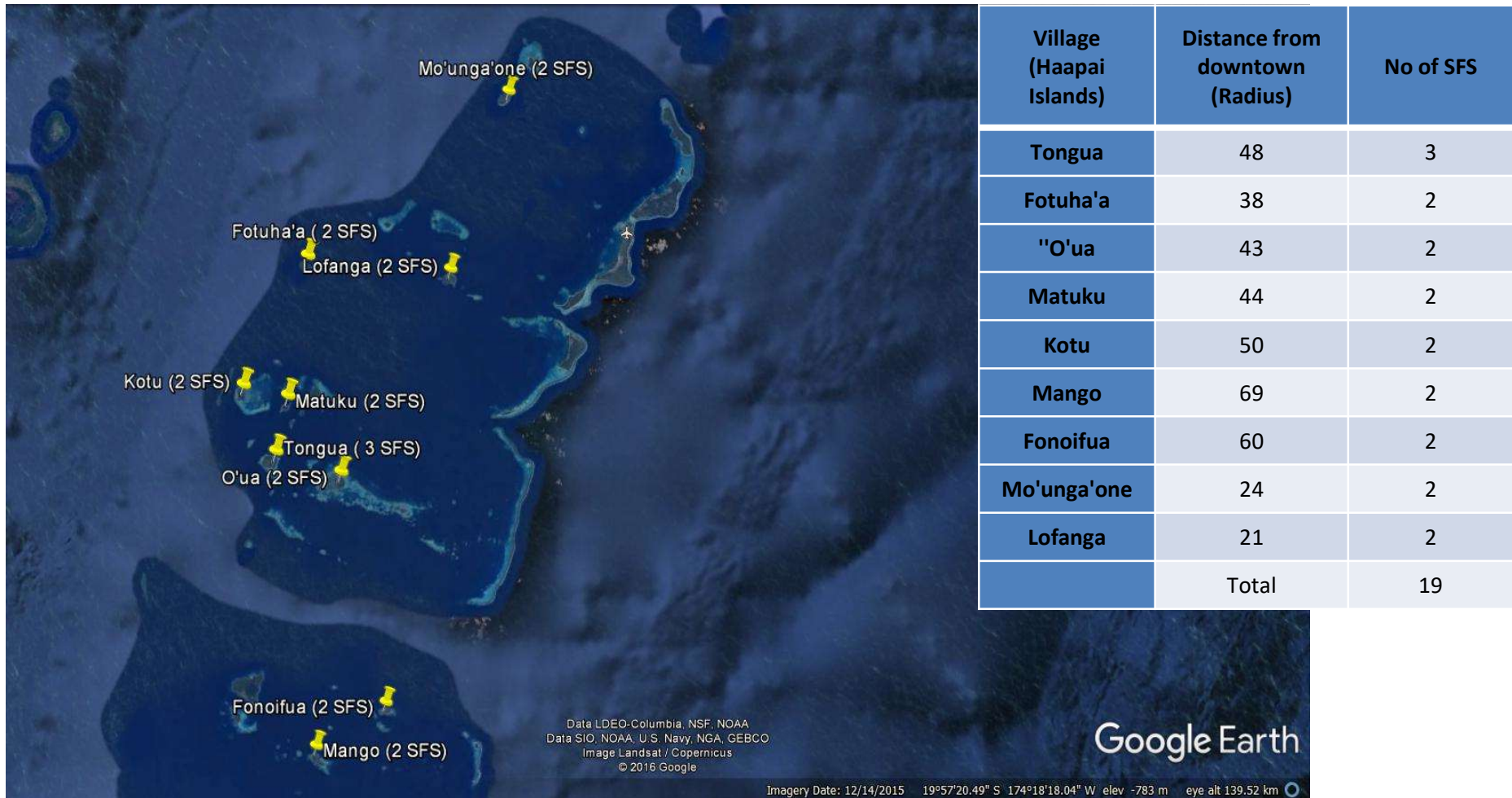
11 villages in Vava'u installed with 21 sets of SFS



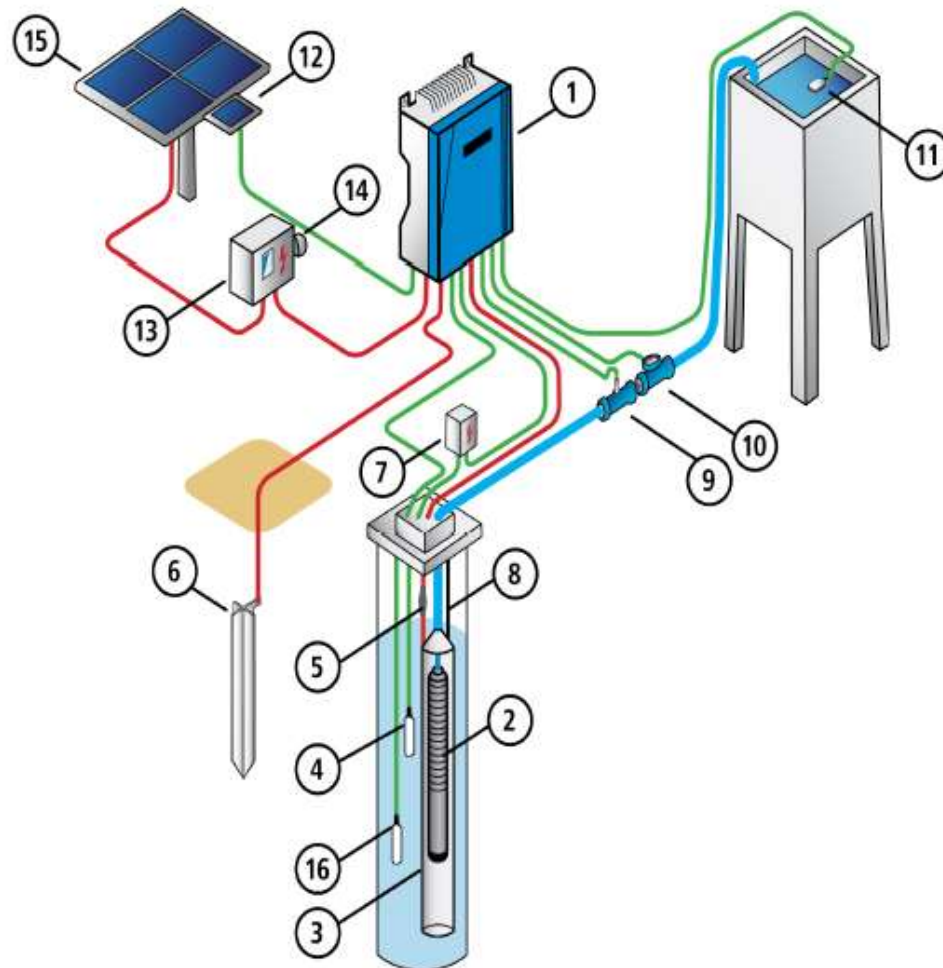
Village (Vava'u Islands)	Distance from downtown (Radius)	No of SFS
Kapa	9	1
Falevai	9	2
"Otea	7	2
Lape	14	1
Matamaka	12	2
Nuapapu	11	2
"Ovaka	16	2
Taunga	11	2
Hunga	15	3
'Olo'ua	3	2
'Ofu	6	2
Total		21

Haapai Islands Installation site (SPS and SFS)

9 villages in Haapai will be installed 19 sets of SFS (Outer Islands)



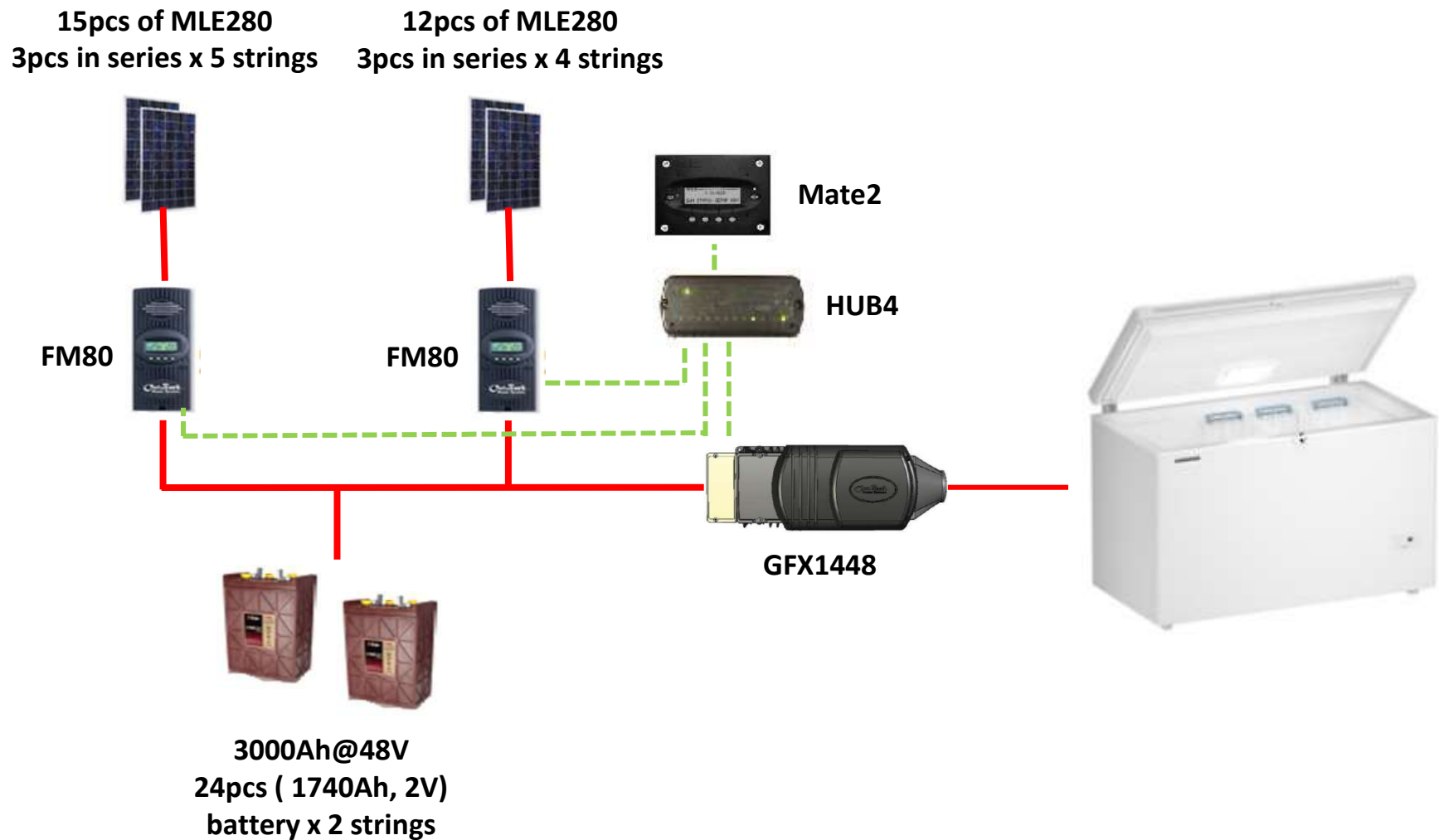
Solar Pump System Design



- 1: PS2 Controller
- 2: Submersible Pump
- 3: Stilling Tube
- 4: Well Probe
- 5: Cable Splice Kit
- 6: Grounding Rod
- 7: Surge Protector*
- 8: Safety Rope
- 9: Water Meter
- 10: Pressure Sensor
- 11: Float Switch
- 12: Sun Switch
- 13: PV Disconnect
- 14: Lightning Surge Protector
- 15: PV Generator

*It is recommended to install a Surge Protector at each controller sensor input.

Solar Freezer System Diagram



Solar Pumps System Installation Photos



Solar Pumps System Installation Photos



Solar Freezer System Installation Photos



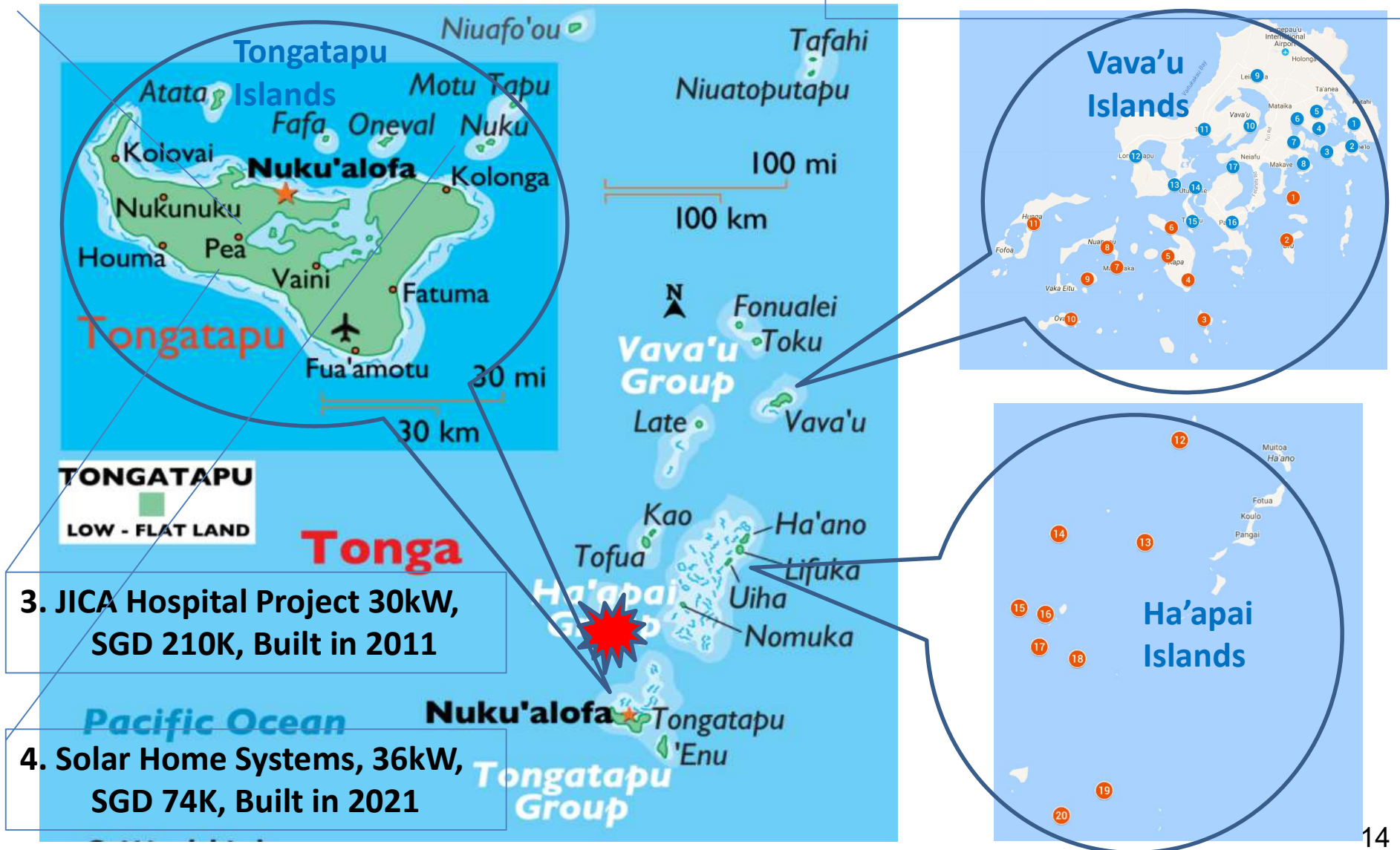
Solar Freezer System Installation Photos



Mitsubishi Electric Micro-grid and PV projects in Tonga

1. JICA Solar Farm 1MW, Built in 2014

2. PEC Fund, Built in 2017



3. JICA Hospital Project 30kW, SGD 210K, Built in 2011

4. Solar Home Systems, 36kW, SGD 74K, Built in 2021

Other Projects – DRC Congo funded by JICA



Other Projects – Chuuk, Micronesia funded by World Bank

Completed World Bank Project in Chuuk, 400kW in October 2019



Chuuk Power Utility Corporation 211kW



**Chuuk International Airport
Carport 132kW**



Underneath the carport system



**Chuuk Water Treatment
Plant 50kW**

Where next? – Ebeye Island, Marshall Islands funded by JICA

Ebeye Island, the most populous island of Kwajalein Atoll in Marshall Island, electricity supply is highly dependent on diesel generation using imported fuel. It suffers energy instability with the island experiencing extended power outage due to local utility's generator repeatedly broke down.

The introduction of photovoltaic power generation system is effective to obtain stable energy supply. Coupled with BLEnDer™ Energy Management System, Mitsubishi Electric PV system allows **higher PV penetration** and **safeguard the stability of network**. It uses batteries as energy storage to obtain the necessary spinning reserved when facing intermittent output from PV equipment. The designed energy storage system will then pick up the load dropped by the PV source, ensuring sufficient energy for the generator in the network to handle the increased load.



Where next? – Ebeye Island, Marshall Islands funded by JICA

Owner: KAJUR (Utility), Marshall Government

Scope of Work:

Mitsubishi Electric BLENder™ EMS

Mitsubishi Electric PLCs, LVSG

Mitsubishi Electric Aicon Systems, Ventilators

Mitsubishi Electric Solar Panels

Grid Connection Facilities

Challenge:

Small Installation Area (<6,000m²)

Installation site has risk of high tides

PV panels installed over frame structure of 5.5m above sea level

Highlights:

600 kW Photovoltaics System

743kWh Lithium-Ion Battery Capacity

Grid connection with existing transformer

SDG 7: Ensure access to reliable, sustainable energy for all

