



Trends in Micro-Grids and Smart Grids to Scale-Up Solar PV in the Pacific

May 20, 2019

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Agenda

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Welcome & Introductory Remarks

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Overview of the Clean Energy Solutions Center

- **Matthew Keighley**, Asia-Pacific Node Coordinator, Clean Energy Solutions Center

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Presentations

- **Sam Booth**, Senior Project Leader, NREL
- **Kamleshwar Khelawan**, Senior Energy Specialist, World Bank
- **Gavin Pereira**, Sustainable Energy Advisor, GIZ

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Question and Answer Session

- Moderated by
- **Tim Reber**, Project Manager, NREL

Solutions Center: Background & Vision

- Multilateral initiative, of the Clean Energy Ministerial, is co-led by the Australian Department of the Environment and Energy, and the U.S. Department of Energy.
- Additional funding from Power Africa & the Hewlett Foundation
- The Solutions Center is a unique CEM initiative assisting countries in all regions of the world in strengthening clean energy policies and finance measures
- Supporting transition of clean energy markets and technologies



Solutions Center: Partnerships

More than 35 international partners:

- Asian Development Bank (ADB)
- Climate Technology Center and Network (CTCN)
- International Energy Agency (IEA)
- International Renewable Energy Agency (IRENA)
- International Solar Alliance (ISA)
- Low Emission Development Strategies Global Partnership (LEDS-GP)
- Pacific Center for Renewable Energy and Energy Efficiency (PCREEE)
- Pacific Region Infrastructure Facility
- Sustainable Energy for All (SEforALL)
- United Nations Environment Programme (UN Environment)
- World Bank

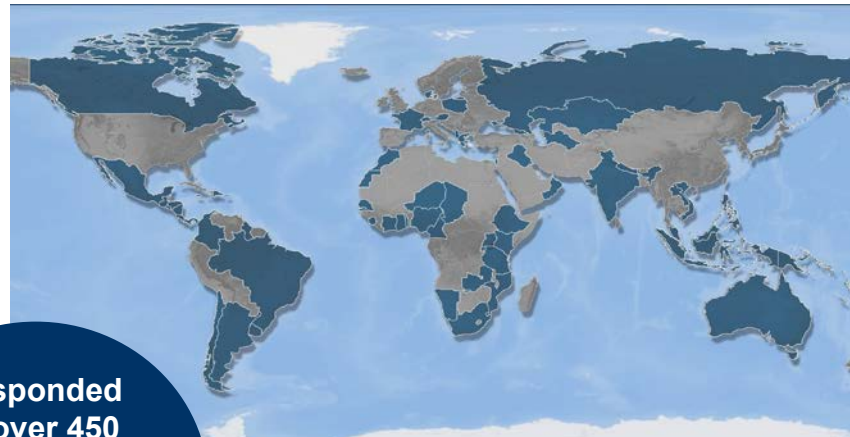


Ask an Expert: Our Experts in Action



We connect you to a global network of energy experts for personalized attention and quick response technical assistance on **strategies, regulations, standards, financial incentives, and energy transition programs** for a broad range of clean energy sectors and technologies including:

- Renewable Energy
- Energy Access
- Energy Efficiency
- Smart Grid
- Transportation
- Utilities



Responded to over 450 requests for assistance from over 90 countries.

To request assistance, register on <http://cleanenergysolutions.org/expert>



Pacific Region Infrastructure Facility



PRIF is a multi-development partner coordination, research and technical assistance facility which supports infrastructure development in the Pacific.

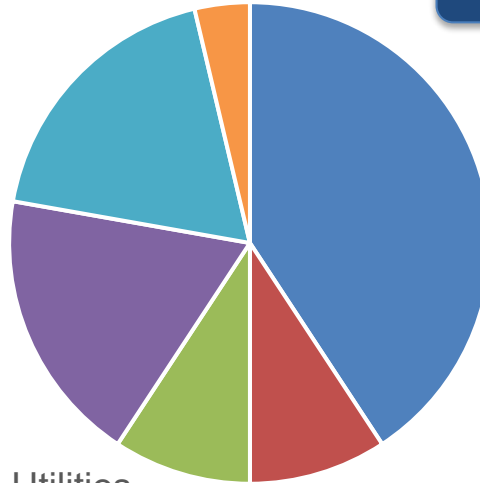


Participants

72
registrants

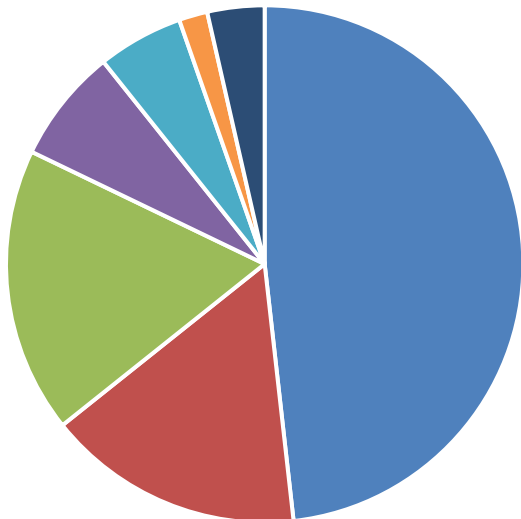
25
countries

Region



- Australia & NZ
- Asia
- Pacific Islands
- Africa & Middle East
- Americas
- Europe

Industry



- Energy, Chemical, Utilities
- Education
- Consulting
- Government
- Banking, Securities & Financial Services
- Manufacturing
- Other

Sam Booth, Senior Project Leader, NREL



Sam Booth is a Senior Project Leader at the National Renewable Energy Laboratory. He has over ten years of experience in the clean energy industry working on renewable energy, microgrids, and finance.

He is currently leading work to support the Power Africa Beyond the Grid Program with microgrid implementation. He has also worked on numerous other international projects such energy access in in Indonesia, renewable energy development in Haiti, and island energy planning in Brazil. He is also currently helping to build the most advanced scale microgrid in the U.S. Department of Defense and researching transactive energy projects with blockchain.

He has engineering degrees from the University of Colorado and a Masters of Business Administration (MBA) from Boston University.

Kamleshwar Khelawan, Senior Energy Specialist, World Bank



Kamleshwar Khelawan is Senior Energy Specialist at the World Bank and has over 30 years of engineering, commercial, management, and corporate governance experience in the energy sector in the Asia Pacific region.

His past roles have included Director and senior management positions with the Australian Energy Market Commission, AGL Energy Limited, Pacific Power and the Fiji Electricity Authority.

In his current role, Kamleshwar supports the World Bank's engagement in the energy sector which is aimed at supporting developing countries secure the affordable, reliable and sustainable energy supply needed to end poverty and promote shared prosperity – consistent with the UN's Sustainable Energy for All (SE4All) Initiative.

Micro grids – A solution for electricity access in the Pacific Island Countries

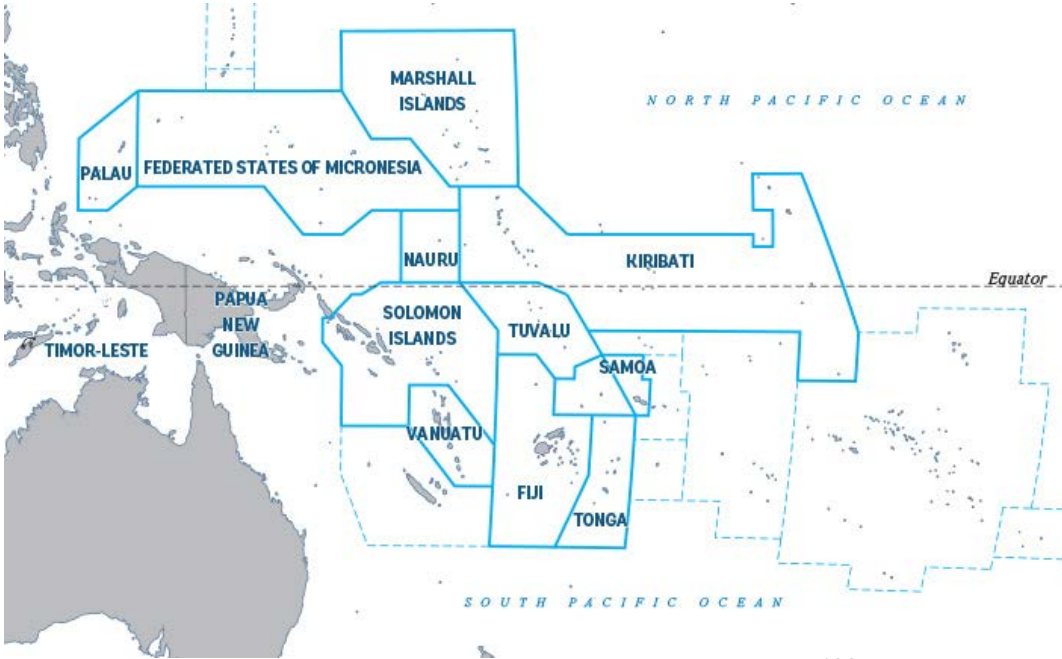


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•Kamleshwar Khelawan

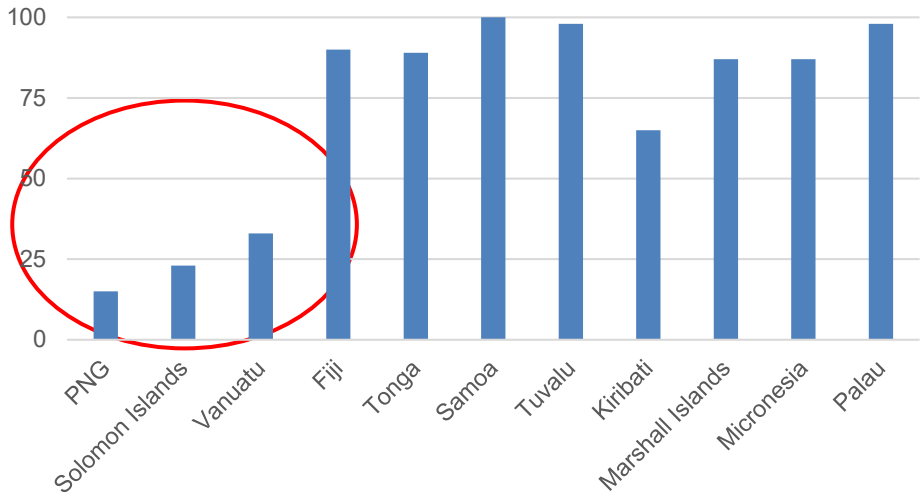
•July, 2019

World Bank Group - Pacific energy operations



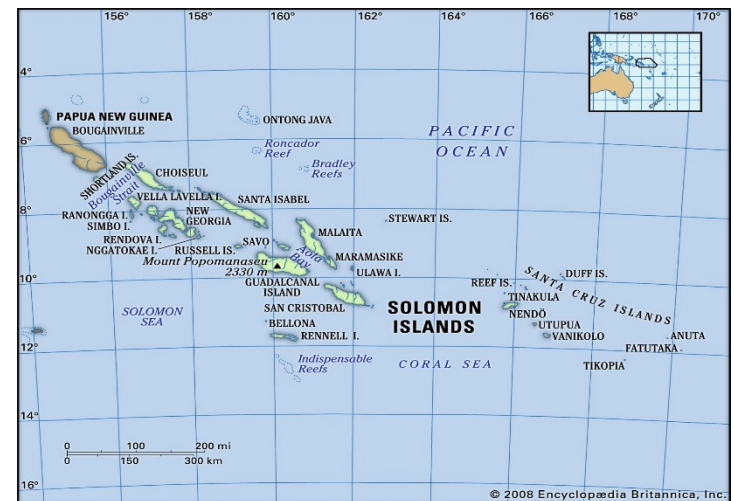
- 13 countries, 10M people, 8 with populations less than 200K
- Low access in PNG 15%, SI, 20%, Vanuatu 35%
- Small systems 3MW Tuvalu to 370MW PNG
- Mainly diesel, most lack indigenous fuel sources
- Demand for productive use
- RE integration issues
- Natural disasters

Energy access rates %



Energy sector challenges – scale/expertise/finance

- Demand – small islands, low demand, mostly not “grid” suitable
- Dispersed communities, low income, limited technical expertise, remote from main centers, markets thin (size/number), limited scale
- Weak supply chains, small private sector, limited financial sector reach
- Lack of finance for borrowers (loans) and investors/suppliers (working capital/loans/equity)
- Weak policy, planning and legal and regulatory frameworks (governance).
- Weak institutions and capacity
- Community land ownership
- Telecommunications available



Energy access options – grid and off grid

- Grids: main islands, high density
- Mini/micro grids:
 - utility models for larger population centers
 - purchase options for smaller single user applications
- Solar Home Systems (SHS) for dispersed communities
- “Plug and Play” systems for the very remote isolated homes and businesses



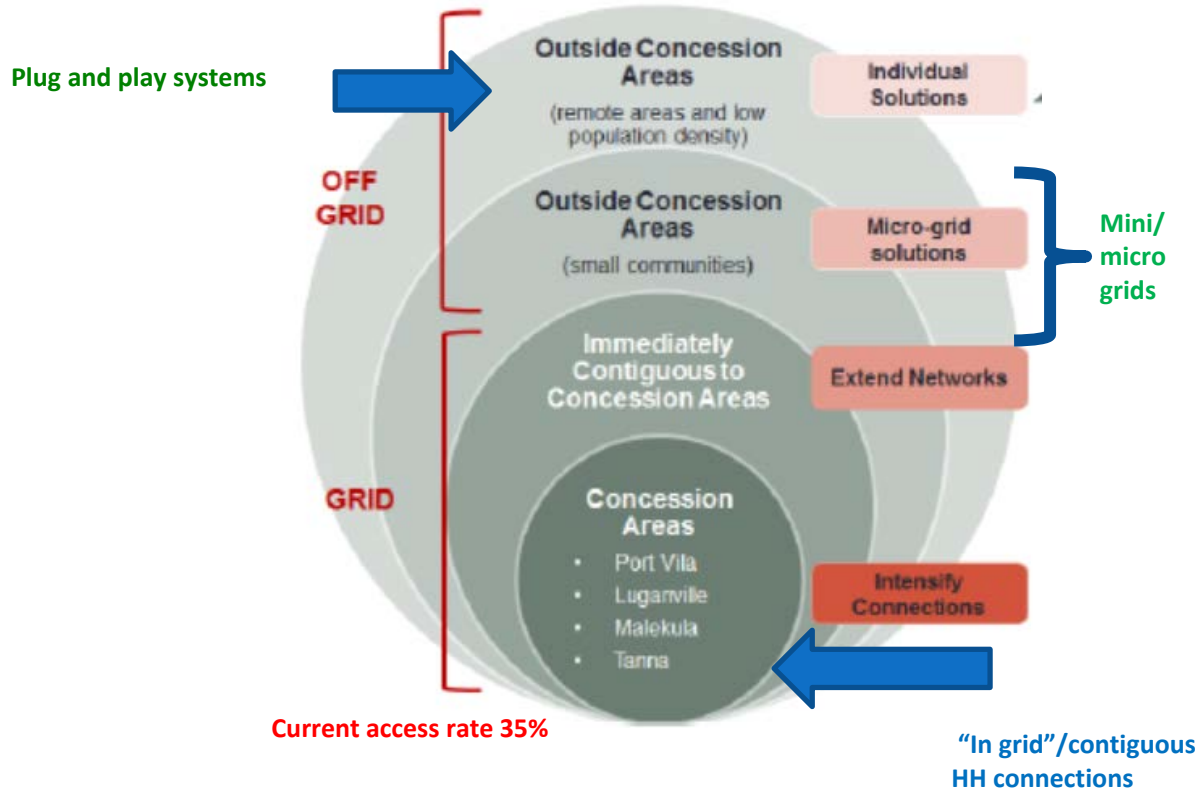
Source: IRENA



Photos: Courtesy DoE, Vanuatu and Fiji



Energy Access Framework for Vanuatu



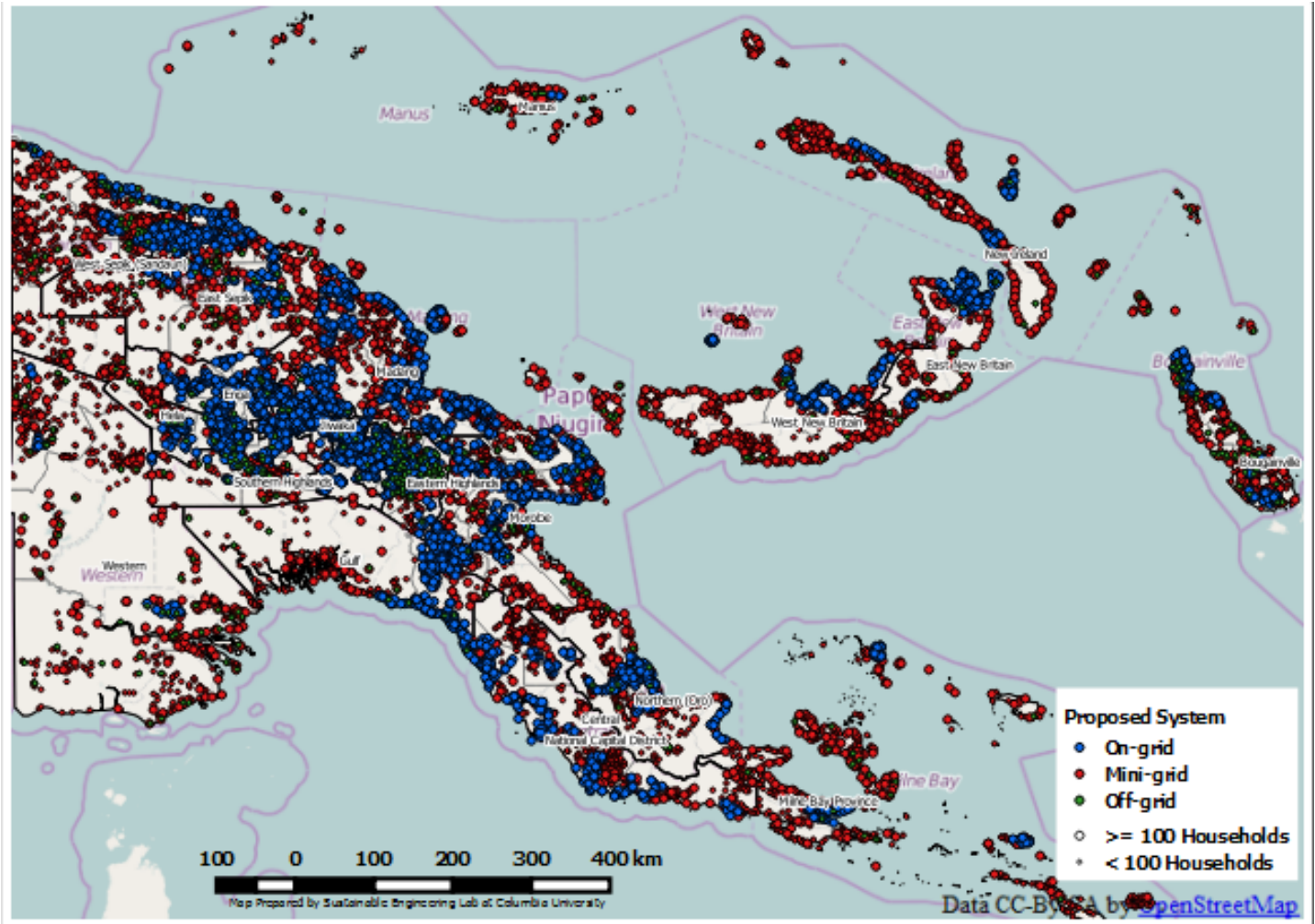
Private sector delivery models

Mini grid potential in PNG – NEROP

Grid for more densely populated coastal & highland areas

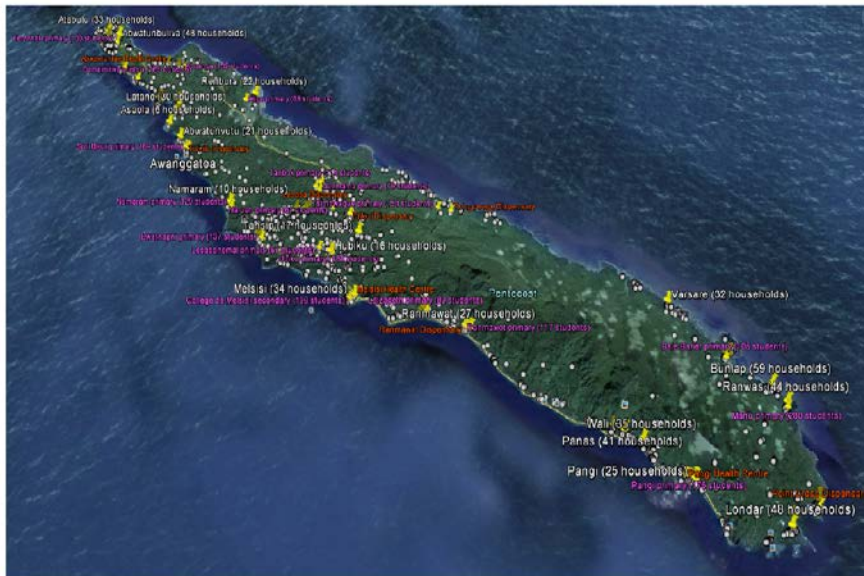
Mini-grid for sparsely yet sufficiently populated areas & islands

Off grid recommended for sparsely yet densely populated areas & islands



Summary mini/micro grid solutions - framework

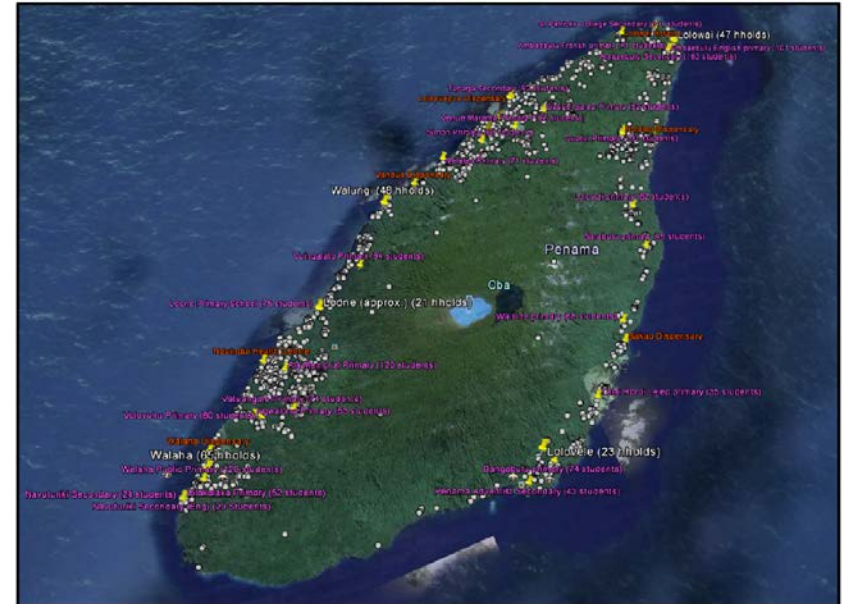
- Private sector operating models for sustainability (financial and operational)
- Need for scale/equity for viability
- Scalable to meet increase in demand, initially 1.2kWh/day, 30 – 40 kWh /month per household



Pentecost Island

Total Villages = 278 (18809 population / 4035 households)

Largest Village = 69 households (297 population)



Ambae Island

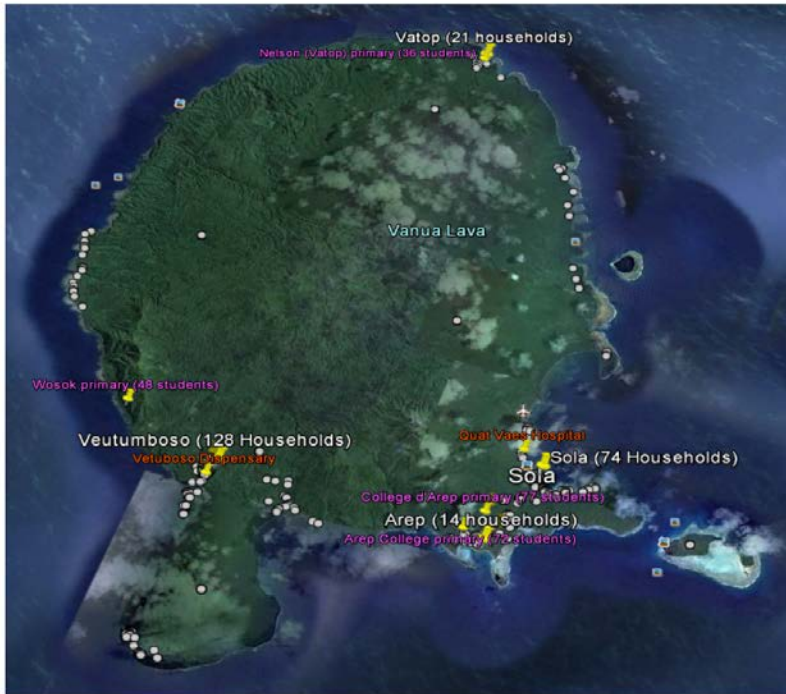
Total Villages: 105 (11061 population / 2376 households)

Largest Village = 65 households (275 population)

- Low costs to match capacity to pay – around US\$20-30/month
- Community engagement to address land issues
- Social and environmental approaches to minimise impact

Summary mini/micro grid solutions - technology

- Least cost, proven technology, resilient
- Energy management and SCADA for grid integration (Kiribati)
- Service levels and operating duty targeted to affordability



Vanua Lava Island

Total villages = 30 villages (3110 population / 587 households)
Largest village = 128 households (591 population)



Photo: Courtesy PUB, Kiribati

- Periodic maintenance with basic on-site support
- Remotely operated and managed with metering & IT platforms for off grid
- Pre-payment/Pay As You Go (PAYG) systems



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Gavin Pereira, Sustainable Energy Advisor, GIZ



Gavin Pereira is a renewable energy professional that has spent the last 9 years working on sustainable energy solutions in the Pacific Islands region as a consultant, advisor and business owner.

Gavin is currently the Sustainable Energy Technical Advisor under the EU-GIZ Adapting to Climate Change and Sustainable Energy Program (ACSE). Under the ACSE program, Gavin has lead the technical design of 4 PV Diesel-hybrid systems, including a 160kW system in Solomon Islands; a 50kW and 30kW system for Fiji, and a 20kW system for Kiribati. In addition, Gavin is also leading a project with utilities in Federated States of Micronesia to implement net-metering (for increased RE penetration) across their 6MW state-wide utility.

EU-GIZ Adapting to Climate Change and Sustainable Energy

- An 18M EUR programme funded by EU, with sustainable energy projects in 7 Pacific Island countries
- Relevant to our discussion are:
 - PV diesel mini-grids for boarding schools (160kW PV in Solomon Islands, 30kW in Fiji, 20kW in Kiribati) and for un-electrified rural communities (50kW and 90kW for 2 Fijian communities)
 - Load Analysis, load shifting and demand side management techniques
 - Battery technology choice (OPzV Gel lead acid VS Lithium)
 - Oversize of PV vs Days of Autonomy
 - Utility sensitivities (competition, tariff setting, allowance for IPPs)
 - Creating a management structure to oversee fee collections
 - Prioritising national suppliers in greenfield markets
 - Technician training



EU-GIZ Adapting to Climate Change and Sustainable Energy

- An 18M EUR programme funded by EU, with sustainable energy projects in 7 Pacific Island countries
- Soft support project to increase Renewable Energy penetration for utilities in Federated States of Micronesia through Net Metering, where grids range in size from 15MW to 5MW
 - NM impacts all utility business units; billing and accounts, planning and distribution, C-level investment strategy, linesman and electrical inspectors. GIZ created a manual to assist Pohnpei State implement NM and it required an intense 'hands on approach'
 - GIZ additionally is adding a training component for GCPV installers
 - Tariff setting is a hyper-sensitive exercise for utilities where revenues vary from 30M to 8M USD
 - Integration of storage and variable output generators when the generation network may only be 2 generators
 - Readiness for 14.2M EUR of funding from EU EDF 11 for energy sector in FSM with 5MW of PV; integration of 2.5MW of hydro and 1MW of lithium battery to reduce 'N+2' approach



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Question and Answer Session

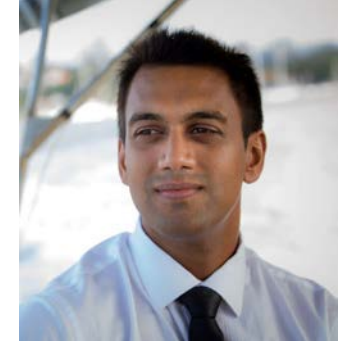


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