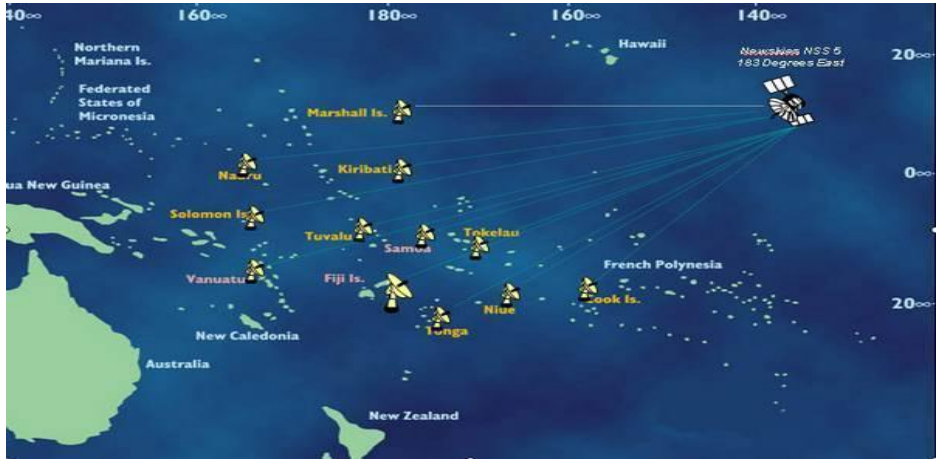
# Renewable Electricity Generation in the PICs An Overview

Atul Raturi

The University of the South Pacific

# The USP

Striving to develop  a well-trained cadre of professionals for the Pacific region and beyond




12 Member Countries, 14 Campuses, ~27,000 students spread over 30 million sq.km

# USP Strategic Plan
# ( 2013-18)

The overarching themes of the University's activities are **Human Security and Sustainable Development.**

**Priority Areas**

Learning and Teaching

Student Support

**Research and Internationalisation**

Information and Communication Technologies

**Regional and Community Engagement**

Our People

Governance, Management, Leadership and Continuous Improvement.

**Strategic Themes**

Pacific cultures and societies

Pacific Oceans **and Natural Resources**

**Human Capacity Building** and Leadership

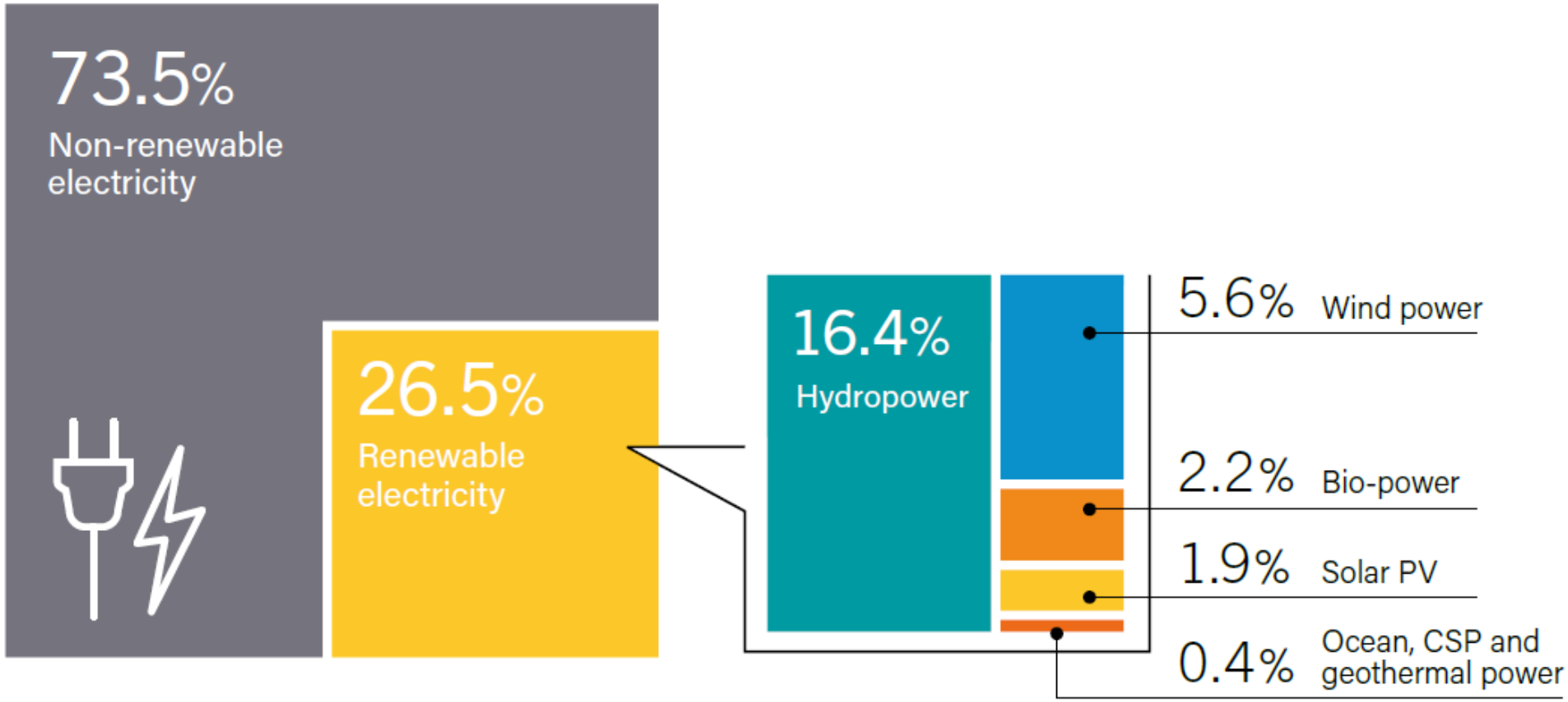
**Environment, Sustainable Development and Climate Change**

**Economic Growth**, Regional Cooperation and Integration for **Sustainable Pacific Economies**

ICT and the Knowledge Economy

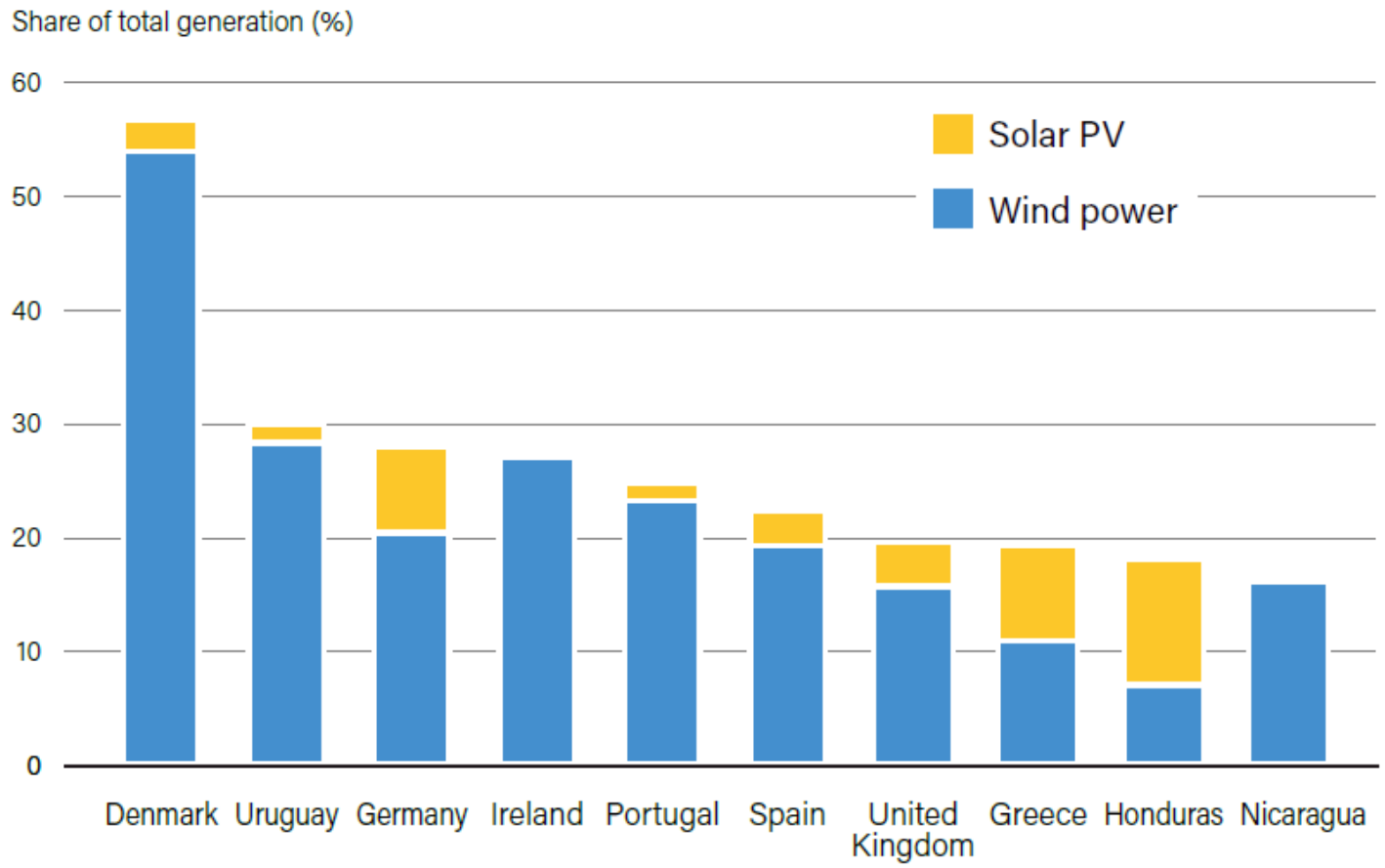
Government, Public Policy and Social Cohesion

# RE on the  Global Grid




REN21 Global Status Rreport2018

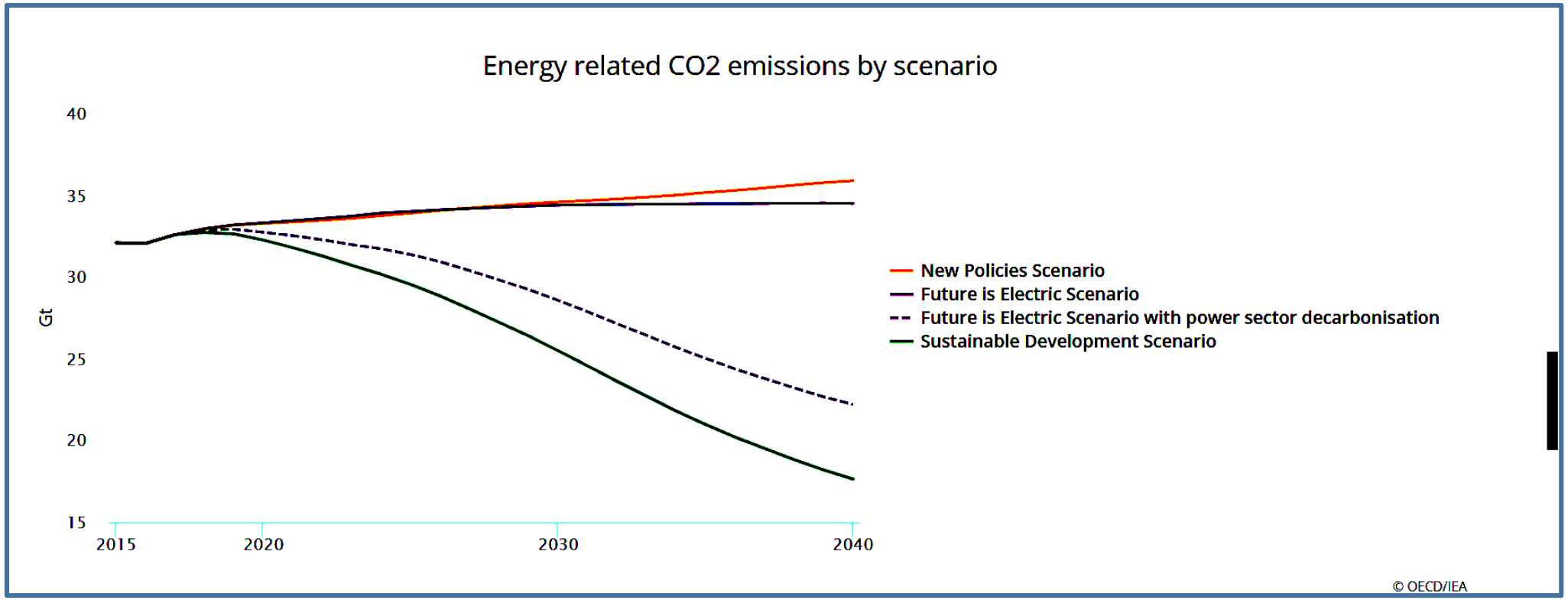
# Share of VRE : Top 10




Samoa has a solar penetration approaching 55%

REN21 Global Status Rreport2018

# Sustainable Future is Electric (IEA)

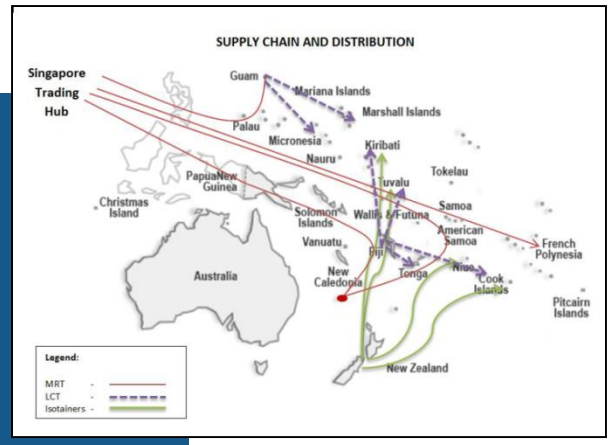



World Energy Outlook 2018

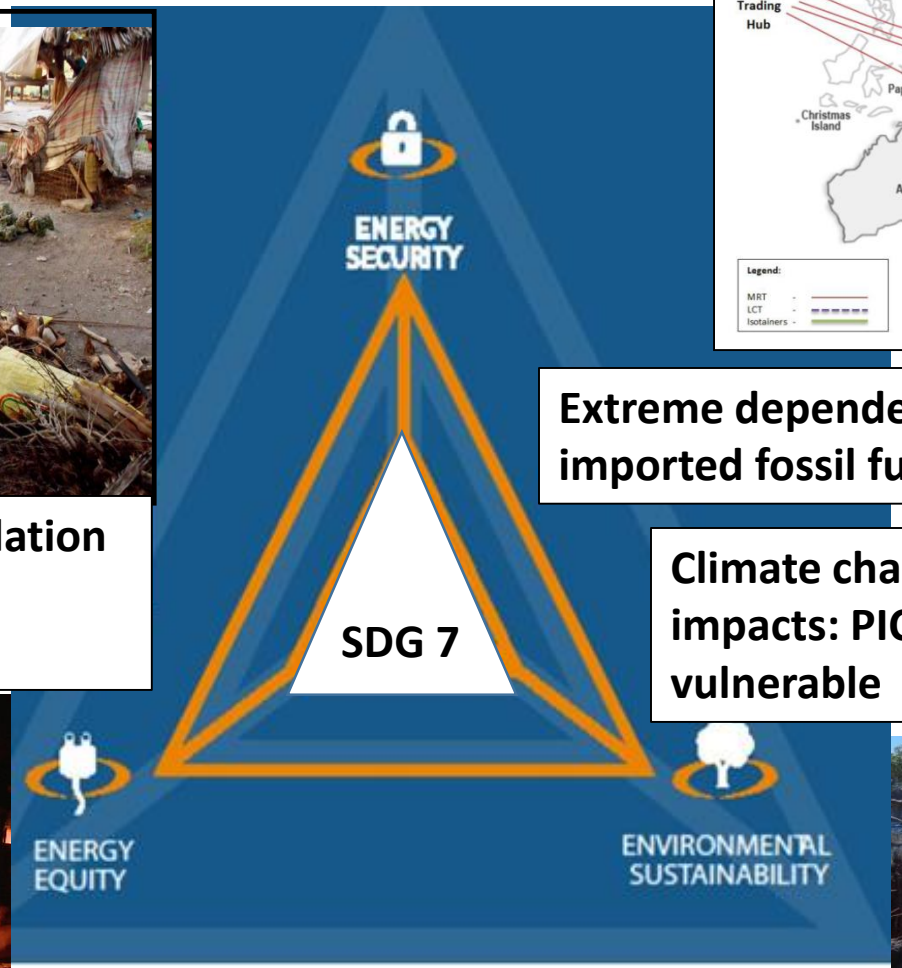
"The world's energy destiny lies with decisions and policies made by governments" IEA

# The Energy Trilemma for PICs

70% of population is without electricity




Extreme dependence on imported fossil fuels




Climate change impacts: PICs Most vulnerable

Adapted from WEC

**SDG Goal 7: Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All**

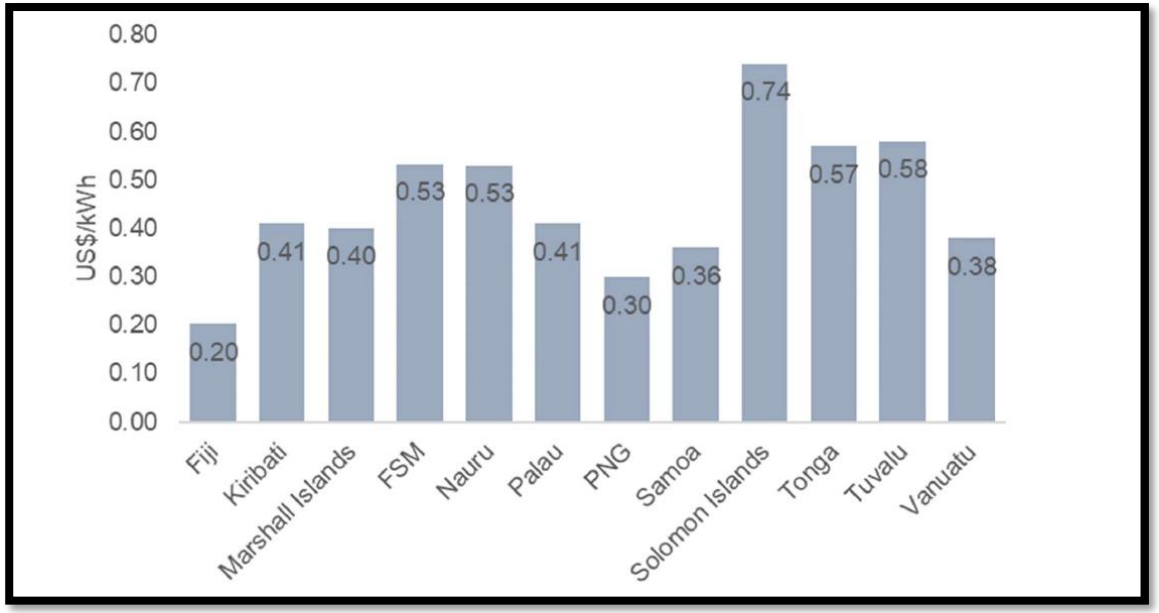
# Overview of PICs Electricity Sector

| Country | | Population[1] | Access to electricity | Installed capacity (MW) | Annual generation (MWh) | Share of RE (%) |
|---|---|---|---|---|---|---|
| Fiji |  | 899,000 | 89%[2] | 322[3] | 923,628[4] | 65%[5] |
| Kiribati |  | 114,000 | >65% | 8 | 23,000 | 10% |
| Marshall Islands |  | 53,000 | 87% | 32.2 | 101,000 | <1% |
| Micronesia, F.S. |  | 105,000 | 65% | 12 | 72,000 | 5% |
| Nauru |  | 13,000 | 100% | 6.5 | 31,700 | 3.2% |
| Palau |  | 21,000 | 98% | 29.4 | 89,300 | 2.3% |
| Papua New Guinea |  | 8,085,000 | 13%[6] | 470[7] | 1,127,716[8] | 67%[9] |
| Samoa |  | 195,000 | 100% | 69.1 | 140,000 | 50% |
| Solomon Islands |  | 599,000 | 16%[10] | 27 | 90,645[11] | 5% |
| Tonga |  | 107,000 | 89% | 16.5 | 55,400 | 13% |
| Tuvalu |  | 11,000 | 98% | 5 | 5,200 | 43% |
| Vanuatu |  | 270,000 | 33% | 35.6 | 74,390[12] | 29% |

**Pacific Energy Scene : A smorgasbord of opportunities and challenges**

Source: IFC 2018

# Electricity tariffs and OPVI




IFC

Among 39 most vulnerable developing countries , top 7 places are occupied by the PICs.

| Country | OPVI | Rank |
|---|---|---|
| Fiji Islands | 0.79 | 3 |
| Kiribati | 1.00 | 1 |
| Papua New Guinea | 0.66 | 7 |
| Samoa | 0.73 | 6 |
| Solomon Islands | 0.74 | 5 |
| Tonga | 0.80 | 2 |
| Vanuatu | 0.76 | 4 |

OPVI = oil price vulnerability index.
Source: ADB calculations.

# RE Targets in PICs

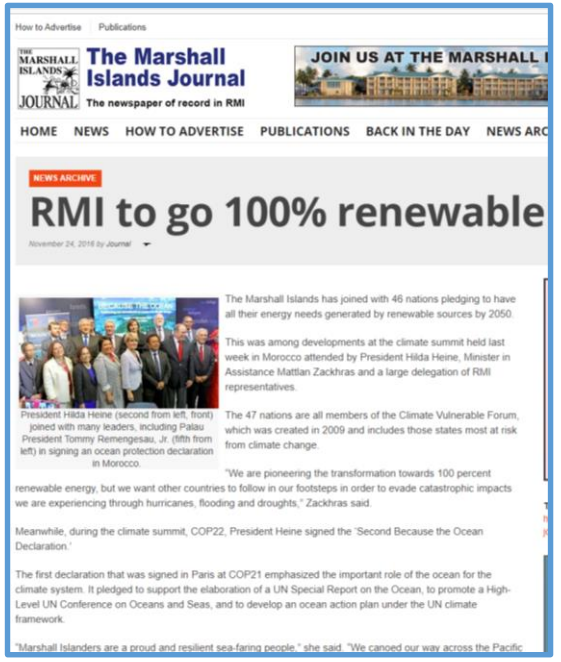


| Country | Target * | Target Date |
|---|---|---|
| Cook Islands | 100% | 2020 |
| Fiji | 81% | 2020 |
| Kiribati | 45% urban, 60% rural | 2025 |
| Marshall Islands | 20% | 2020 |
| FSM | 10% urban, 50% rural | 2020 |
| Nauru | 50% | 2020 |
| Niue | 100% | 2020 |
| Papua New Guinea | 50% GHG emission reduction | 2030 |
| Palau | 20% ** | 2020 |
| Samoa | 10% ** | 2016 |
| Solomon Islands | 50% | 2015 |
| Tonga | 50% | 2020 |
| Tuvalu | 100% | 2020 |
| Vanuatu | 65% ** | 2020 |

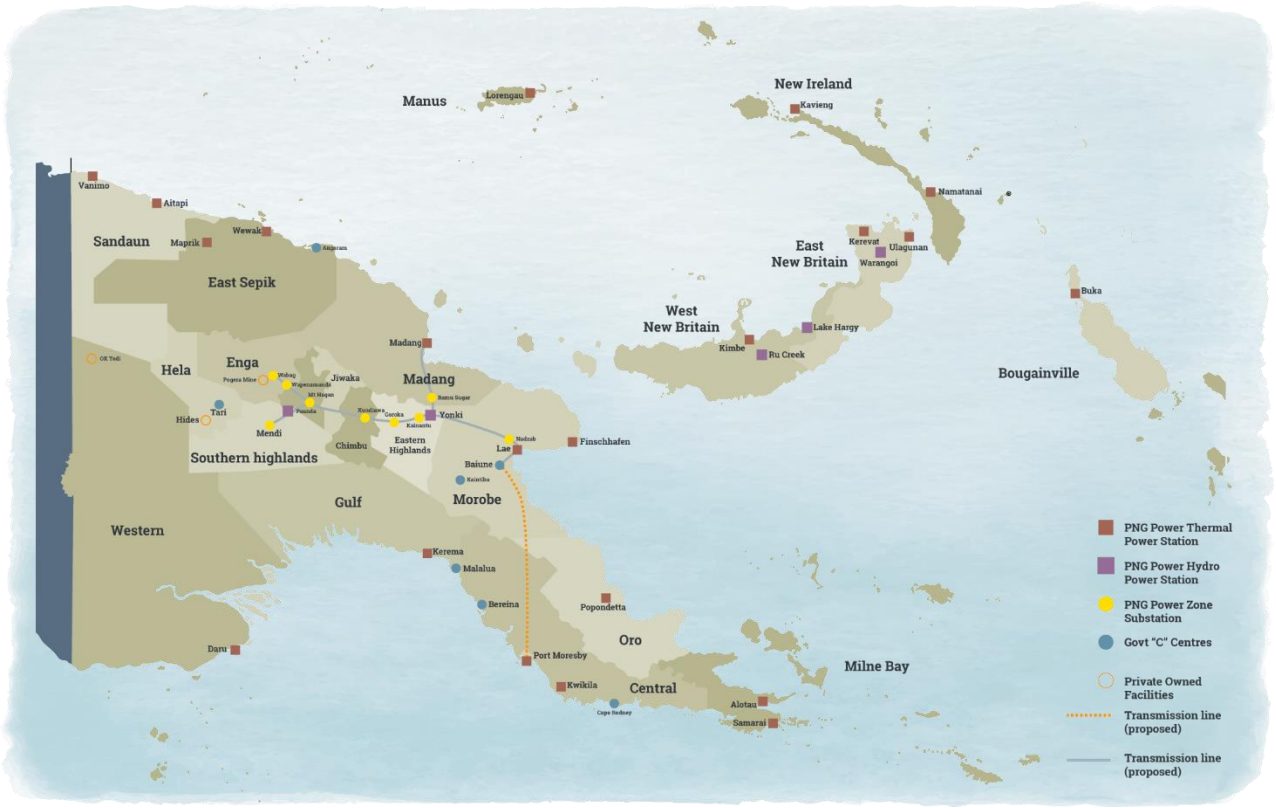
Resources 2015, 4, 490-506; doi:10.3390/resources4030490

Fiji-99% electricity from RE sources by 2030

* Electricity Target
** Primary Energy Supply Target

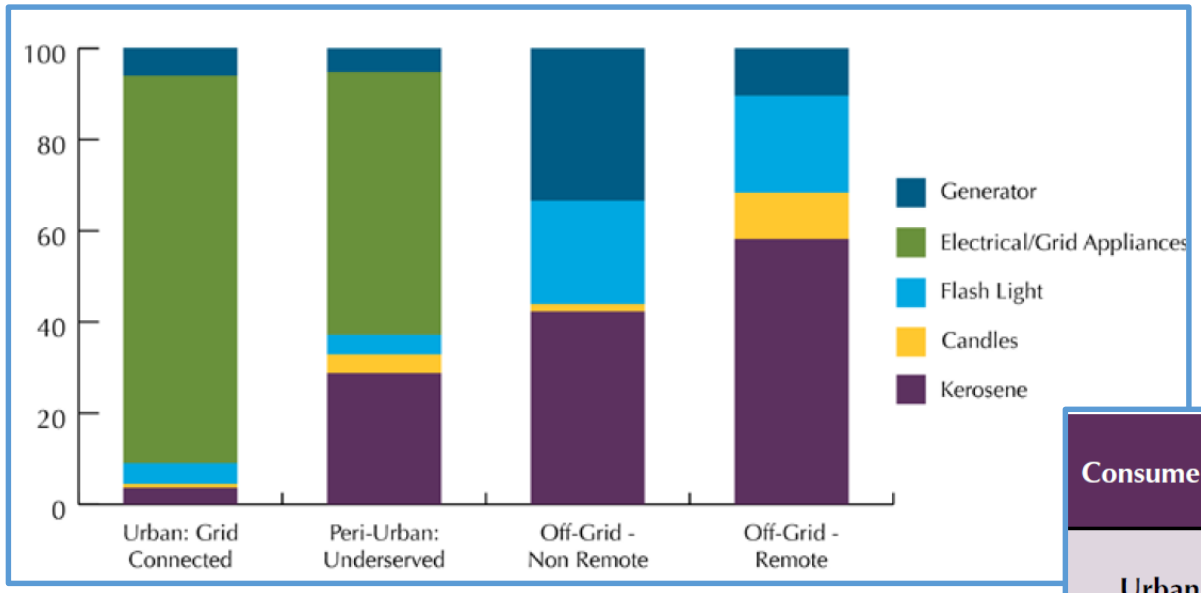



# Papua new Guinea




- 3 grid systems: POM (126 MW), Ramu (95 MW) and Gazelle ( 10 MW)
- 41% Hydro generation
- Grids Supply to about 10% of the population
- Mines and industry : 300 MW
- 150- 200 C centres: operated by local governments/NGO etc. (Mostly diesel)

# Lighting Sources and Costs



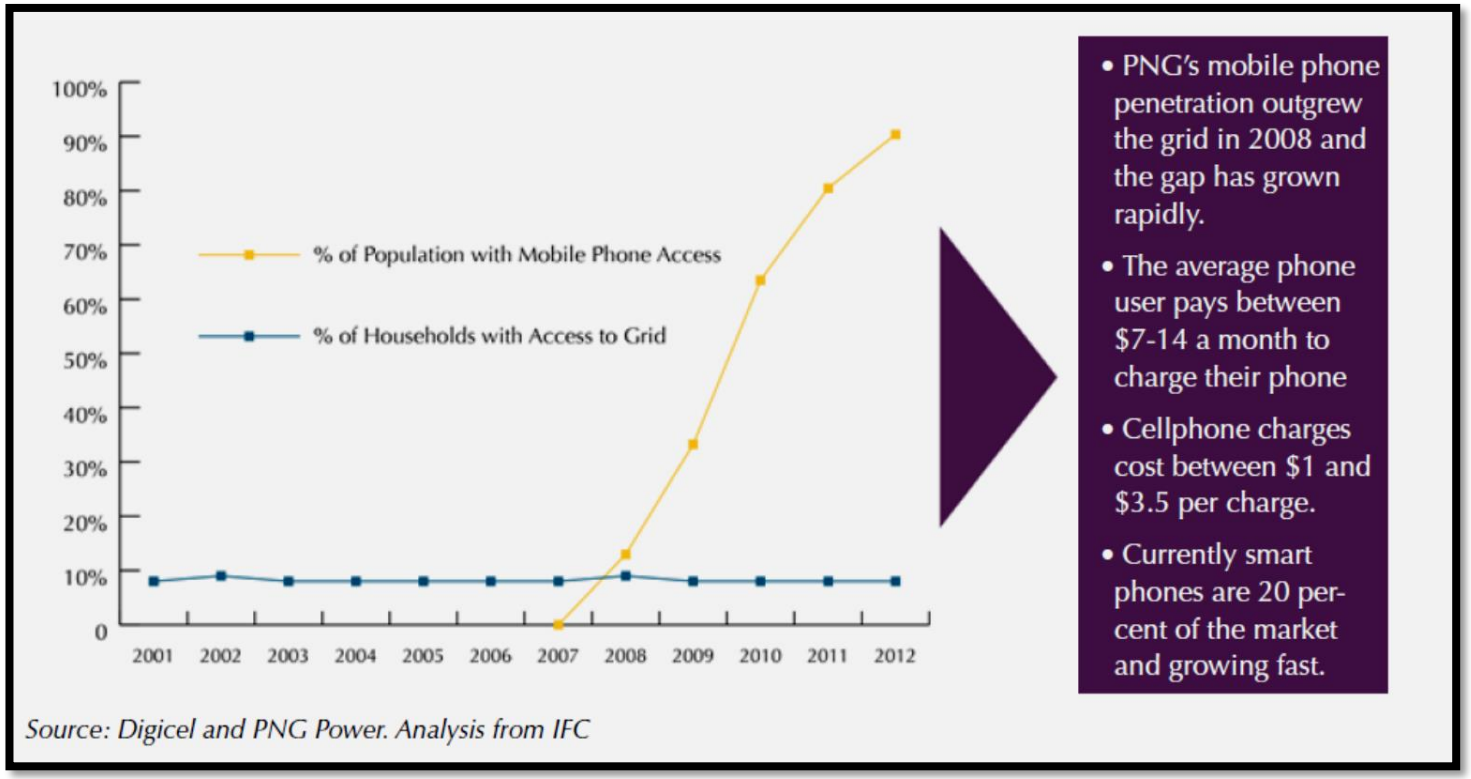

PNG Power/IFC

- 120 - 150 Million USD/annum spent on lighting Fuel and batteries
- Poor pay the most for energy as they do not have any access to more efficient ways of lighting.

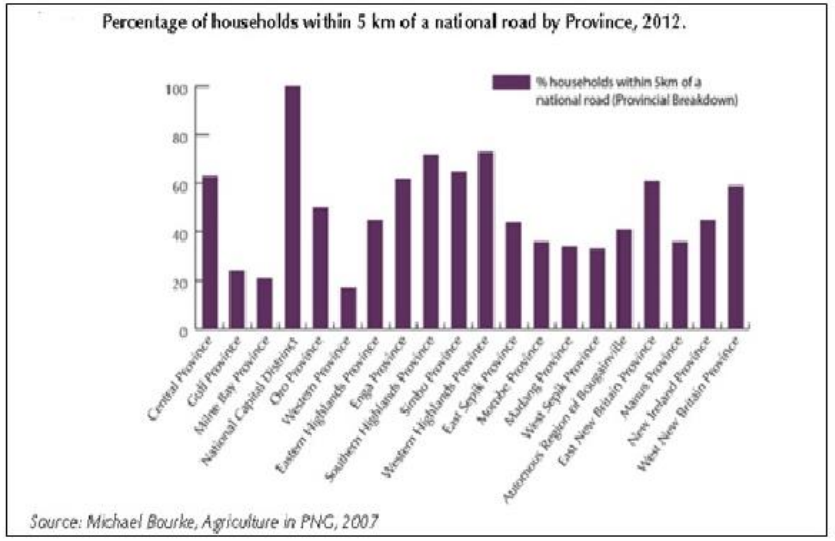
| Consumer Segment | Description | Estimated # of HHs | Dwelling Type | Average Monthly Off-Grid Lighting Costs (USD) |
|---|---|---|---|---|
| **Urban Based: Grid Connected** | City based, formal employment | 50,000 est. | Brick, Wood, Fibro | $41-49 USD |
| **Urban Based: Underserved** | Settlement based, informal urban employment | 41,000 est. | Metal Sheets, Tin | $16-25 USD |
| **Off-Grid: Non-remote** | Within 50km of provincial centers, farmers, formal employment & transportation | 400,000 est. | Wood, traditional bamboo | $82 - 95 USD |
| **Off-Grid: Remote** | Coffee, cocoa, palm oil, subsistence farmers | 900,000 est. | Traditional bamboo, mud | $20-35 USD |

Assuming 2 kerosene lamps/house and 4 hours of use, cost of energy ~ 20 USD per kWh!

# How do I charge my phone ?




- More than 90% of population has access to mobile phones.
- 55% of rural population lives more than 5 km from national roads.




Leapfrogging to RE future : the only solution

# PNG Electricity Sector

PNG has a goal of 70% electricity access in 2030 from the current 13%

**Pledge to provide electricity to Papua New Guinea (APEC 2018)**
www.japantimes.co.jp

RE Based Targets (PNG NEROP)

| SECTOR | INSTALLED CAPACITY (MW) | TRIPLING EXISTING CAPACITY BY 2030 AND COVER THERMAL | | | | | 2030 TARGET 2500 MW | DOUBLING 2030 TARGET TO 2050 (5000MW) | | | | | 2050 TARGET 5000 MW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2011 - 2014 | 2015 - 2018 | 2019 - 2022 | 2023 - 2026 | 2027 - 2030 | | 2031 - 2034 | 2035 - 2038 | 2039 - 2042 | 2043 - 2046 | 2047 - 2050 | |
| HYDRO | | 255.0 | 25.0 | 394.0 | 900.0 | 164.0 | 1483.0 | 654.0 | 826.0 | 0.0 | 2200.0 | 0.0 | 3680.0 |
| BIOMASS | | 0.0 | 30.0 | 0.0 | 32.0 | 0.0 | 62.0 | 0.0 | 2.0 | 30.0 | 2.0 | 0.0 | 34.0 |
| SOLAR | | 0.0 | 0.0 | 50.0 | 0.0 | 15.0 | 65.0 | 15.0 | 5.0 | 15.0 | 0.0 | 0.0 | 35.0 |
| WIND | | 0.0 | 0.0 | 10.0 | 10.0 | 10.0 | 30.0 | 0.0 | 20.0 | 0.0 | 0.0 | 0.0 | 20.0 |
| OCEAN | | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 | 5.0 | 0.0 | 5.0 | 0.0 | 0.0 | 0.0 | 5.0 |
| GEOTHERMAL | | 0.0 | 0.0 | 5.0 | 40.0 | 50.0 | 95.0 | 0.0 | 20.0 | 0.0 | 50.0 | 40.0 | 110.0 |
| TOTAL PNG | | 255.0 | 55.0 | 464.0 | 982.0 | 239.0 | 1740.0 | 669.0 | 878.0 | 45.0 | 2252.0 | 40.0 | 3884.0 |

https://aperc.ieej.or.jp/file/2017/12/13/PRLCE_Report_in_PNG.pdf

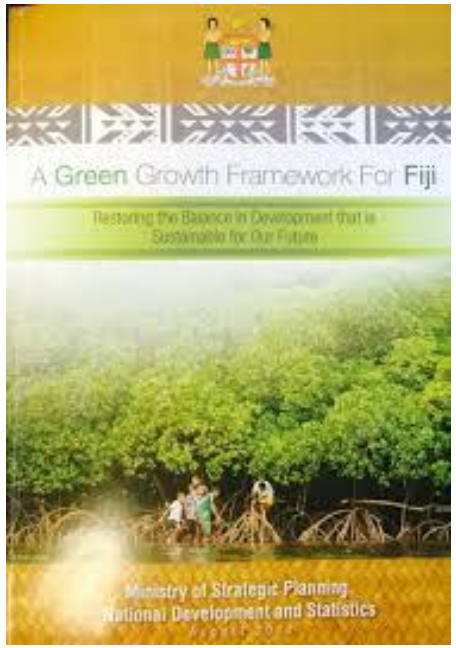
# PNG GCPV Programme

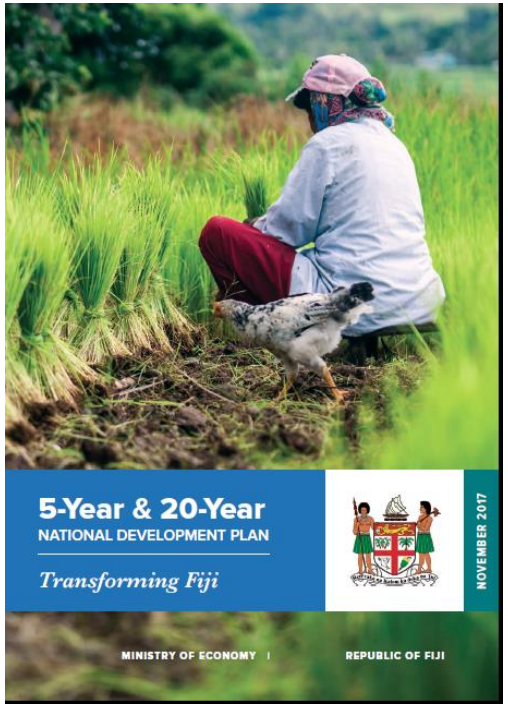
- PNG Power is now accepting applications on first-come-first-served basis for grid-connected solar PV systems
- The total approved capacity for **Net-Metered** GCPV systems is 2 MW- approximately 2% of the peak load in the Port Moresby system.
- Initially, only commercial customers are eligible
- Possible separate arrangements for larger IPPs.

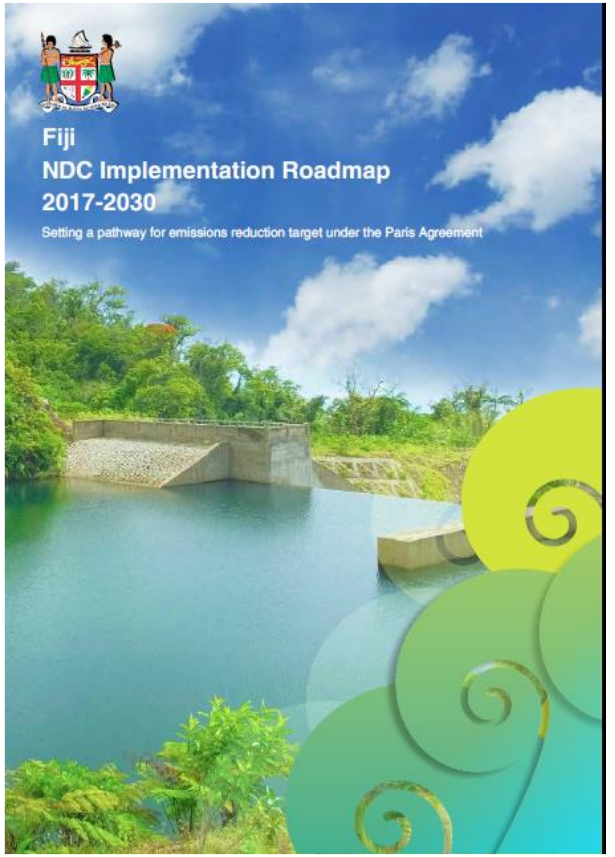
# Opportunities and Challenges

- There are more than 6 million people still waiting to access electricity
- PNG has abundant RE resources solar, hydro, wind, biomass and geothermal
- With more than 90% mobile phone access, people do have means to pay for electricity
- Difficult terrain, limited infrastructure
- Resource data and assessment lacking
- Conducive regulatory and institutional frameworks need to be strengthened
- Lack of technical and human capacity
- Financing /private sector involvement required

# Fiji

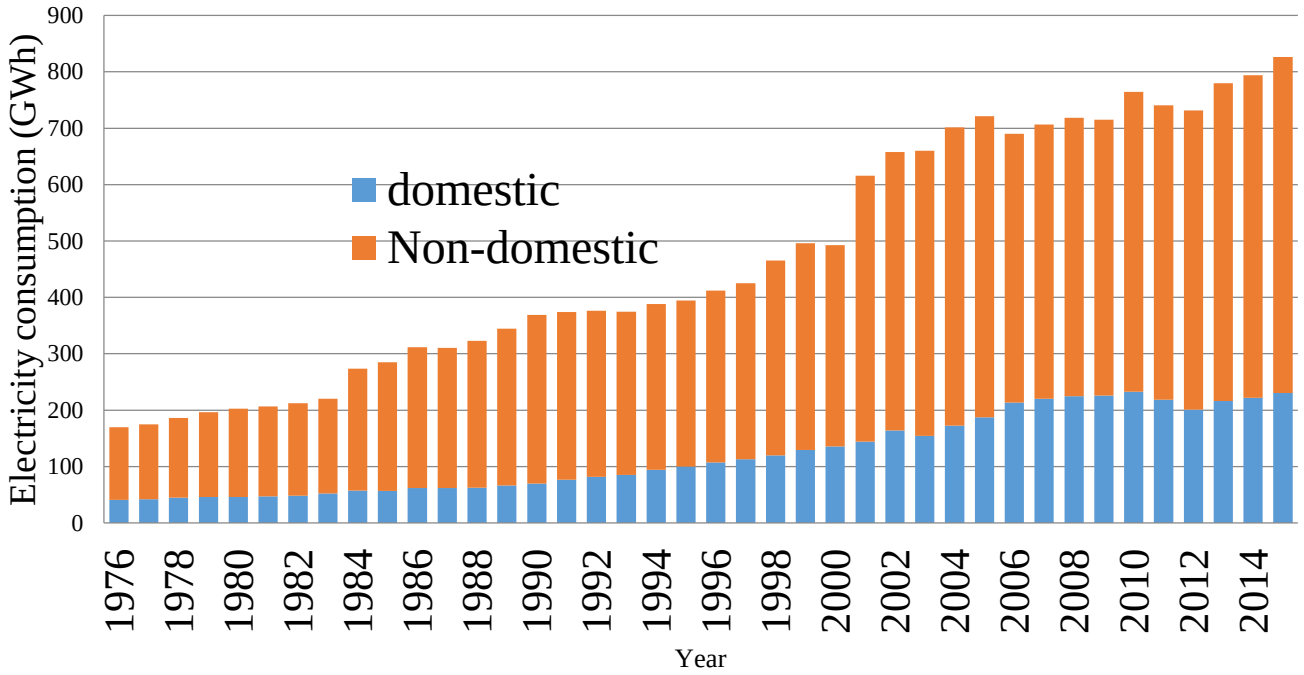


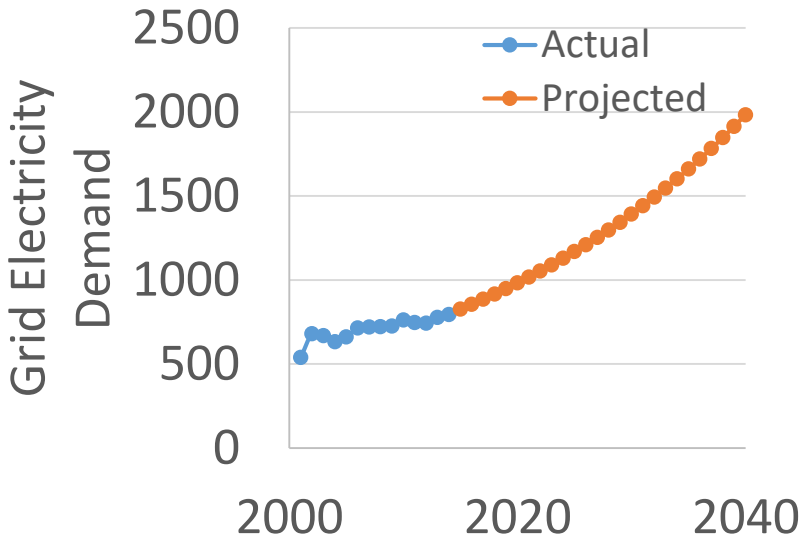




Low Emisssions Development Strategy

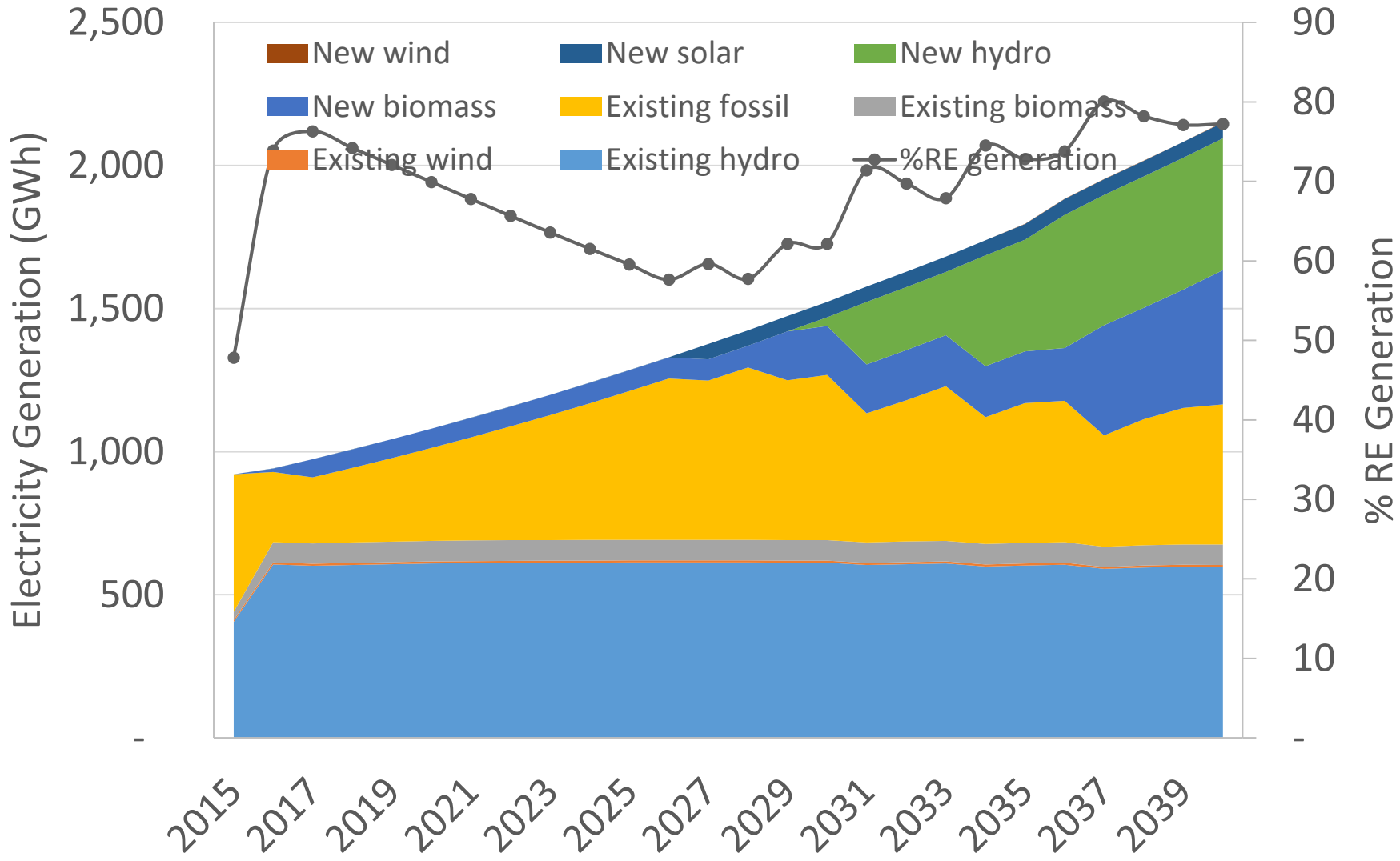
# Fiji Grid Electricity demand




- Demand is projected to increase at 3.5% per annum.



# Electricity generation




- Currently, hydro is the mainstay of Fiji's electricity sector
- Using new generation capacities but no storage., % RE generation increases from 48% in 2015 to 77% in 2040.
- Storage will be crucial at high solar/wind penetrations
- Fiji has the geography to establish "Pumped Hydro Systems" as storage
- Electrification of the land transport sector will increase the demand significantly
- More RE systems will be needed to meet this demand
- Maritime transport is a huge challenge

# Solar  PV in Fiji : Private Sector Drives the Agenda


RB Patel , Suva, 131  kW

Radisson Blu-412 kW

Photos:Sunergise/Clay Energy

Six  Senses Resort : Fully Solar + Tesla batteries

https://www.sixsenses.com/resorts/fiji/destination

Coca Cola Amtail, 1.1 MW


Mark 1 Apparel, 273  kW

# Energy for Sustainable Development and productive use

Solar water distillation

Solar PV powered  Refrigeration Systems

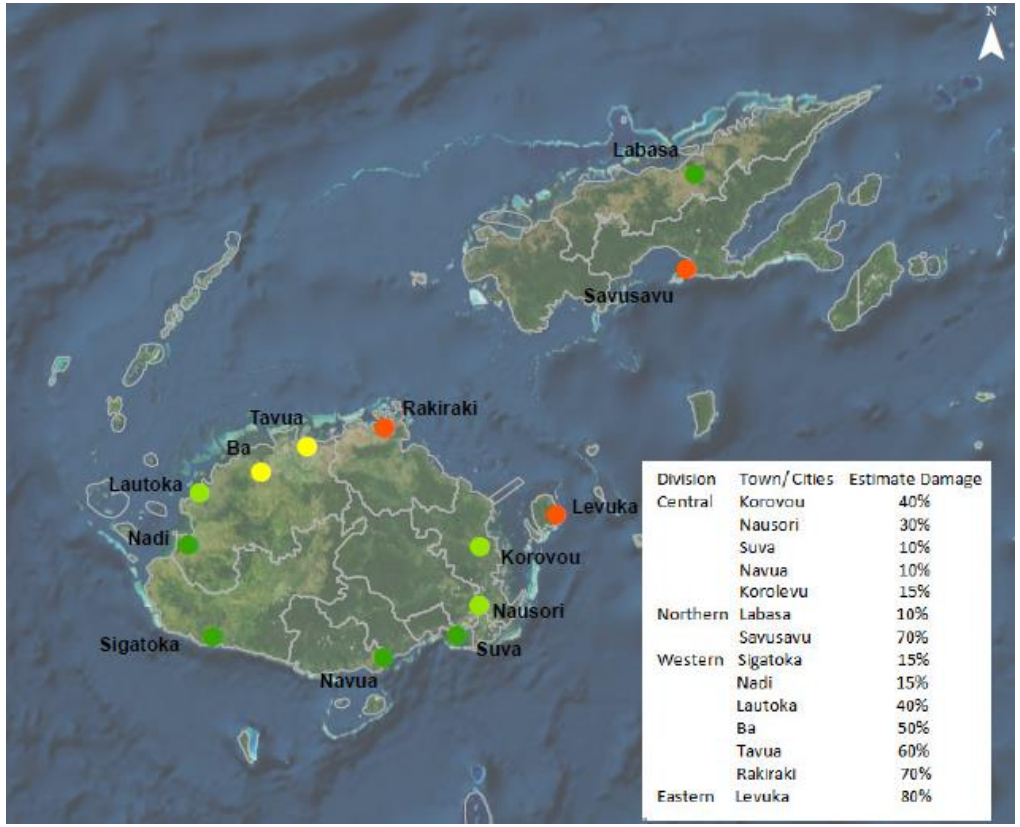
Solar water pumping

Solar lighting

# Opportunities and Challenges

- Tax free facility for RE equipment import
- Tax holidays for EV charging systems and Biofuel development
- Dedicated loan facility for Sustainable Energy projects
- Fiji is just starting off with large GCPV systems (5 MW) – scope for a lot more
- Policy and regulatory framework for grid-integrated VREs still in infancy
- Innovative financing mechanisms and private sector investment necessary
- Capacity development at all levels is imperative

# System Resilience




| Division | Town/Cities | Estimate Damage |
|---|---|---|
| Central | Korovou | 40% |
| | Nausori | 30% |
| | Suva | 10% |
| | Navua | 10% |
| | Korolevu | 15% |
| Northern | Labasa | 10% |
| | Savusavu | 70% |
| Western | Sigatoka | 15% |
| | Nadi | 15% |
| | Lautoka | 40% |
| | Ba | 50% |
| | Tavua | 60% |
| | Rakiraki | 70% |
| Eastern | Levuka | 80% |

TC Winston Damage to EFL grid (Fiji), NDMO 2016

Cyclone Maysak Damage (FSM), SPC 2015

Thank you for your attention