IRENA
International Renewable Energy Agency

IRENA Islands Initiative

IRENA Innovation and Technology Centre

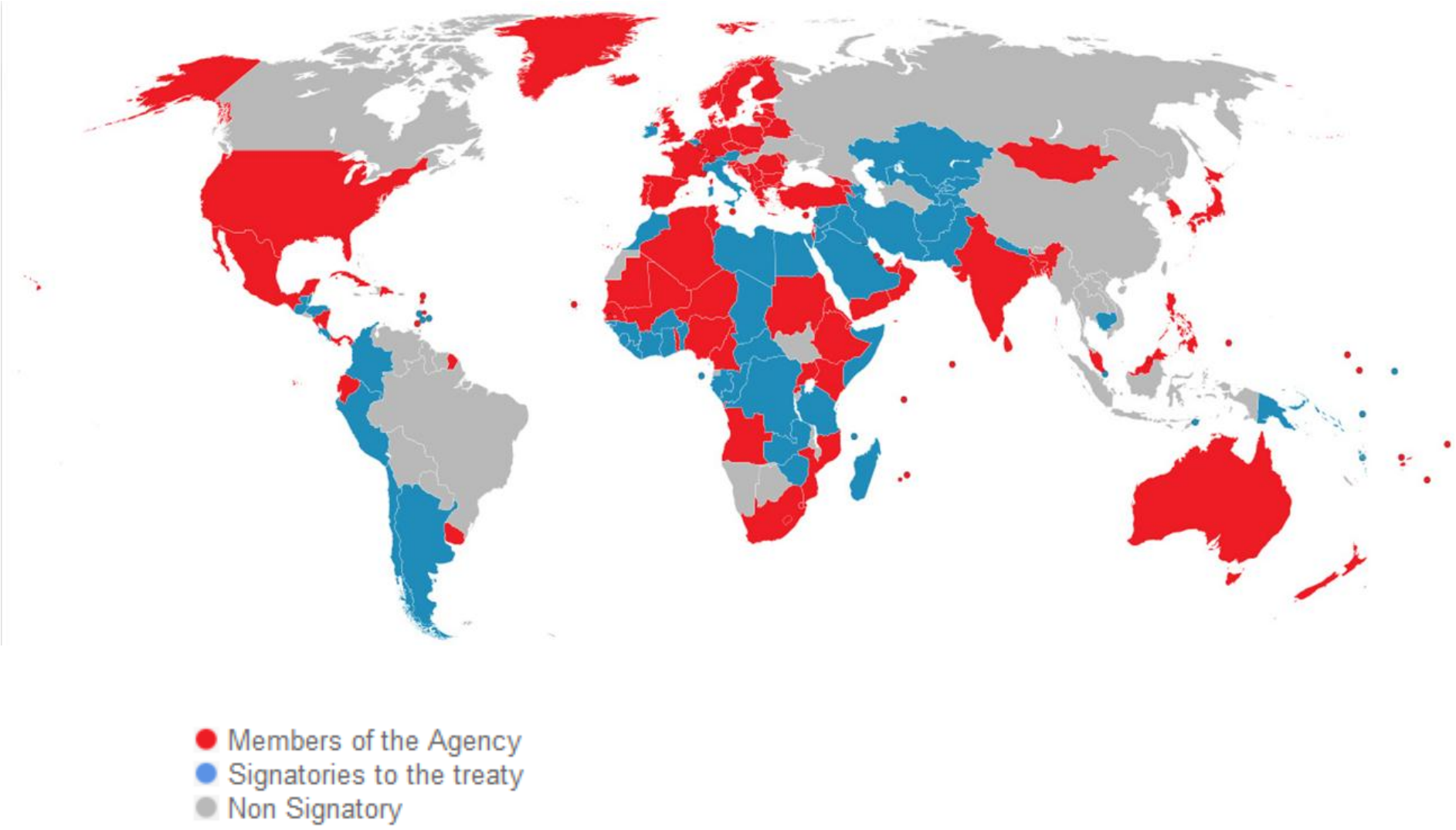
Vanuatu, 15 July 2012

About IRENA

	International Renewable Energy Agency
	Established April 2011
	The intergovernmental RE agency
Mission:	Accelerate deployment of renewable energy
Scope:	Hub, voice and source of objective information for renewable energy
Members:	159 countries are engaged; 99 ratified members
Mandate:	Sustainable deployment of the six RE resources (Biomass, Geothermal, Hydro, Ocean, Solar, Wind)
Location:	Headquarters in Abu Dhabi, United Arab Emirates
	Innovation and Technology Centre IITC, Bonn, Germany
Director-General:	Adnan Amin

IRENA Membership

IRENA
International Renewable Energy Agency



As of 10 July, 2012

IRENA Islands Initiative

- Many Small Islands Developing States (SIDS) are IRENA members
- Islands power cost are high and diesel must be imported
- Need for jobs and economic development
- Often good RE resources: wind, geothermal, solar etc.
- Islands as testbeds for a global energy transition to Renewable Energy

- 2012 focus region Pacific Islands
  - Engagement with Tonga roadmap since 2010
  - Experts Meeting, Sydney, 26 October 2011
  - Pacific Leaders Meeting, Abu Dhabi, 13 January 2012
  - Japan-IRENA workshop for Pacific, Okinawa, 26 May
  - IRENA-PPA workshop, Vanuatu, 15 July
  - Pacific roadmaps meetings
  - Post-Rio Islands summit, Malta, 6-7 September 2012
- 2013 focus region Caribbean Islands

Pacific Islands Energy Context

- Energy is needed for key human activities
- The share of energy cost is very high in the region
  - Energy costs account for a fifth of GDP (varies by country)
  - Heavy reliance on costly oil products
- The region has renewable energy potentials that can reduce oil dependency and energy costs
- Renewable energy should be combined with energy efficiency
- Islands can act as testbeds for a transition to renewable energy
  - Many successful examples in the region: Apolima, Kiribati, Fafa‘, Namara, Tokelau
  - Interesting insights from other islands elsewhere
- Countries and even island‘s resource endowment and energy needs vary: tailor-made solutions are needed
- Power generation and transportation are clearly the main energy areas
  - Access to modern forms of energy is still increasing in some countries

Ambitious targets

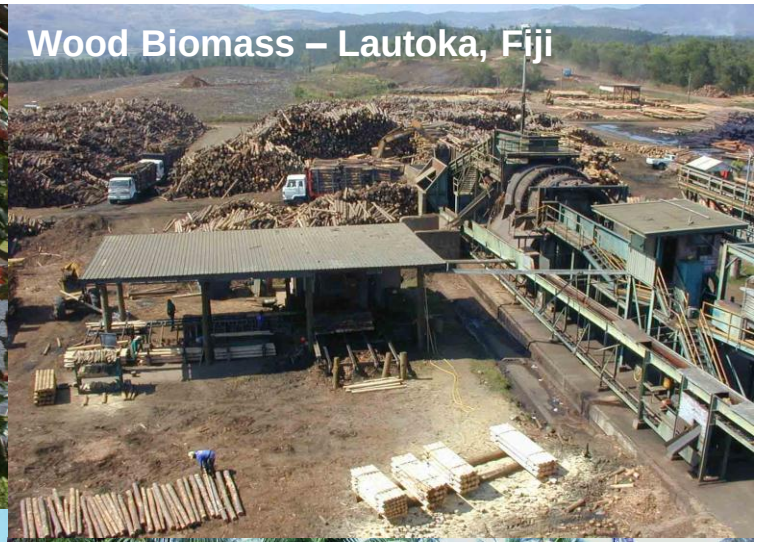
IRENA
International Renewable Energy Agency

Countries, Territories & Associated States	RE Electricity Generation	RE Electricity Targets	
	% of Total	% of Total	Year
Cook Islands	<1%	50%	2015
		100%	2020
Fiji	75%	90%	2015
FSM		Urban 10% Rural 50%	2020
Kiribati	<1%	10%[1]	ND
Marshall Islands	1%	20%	2020
Nauru	<1%	50%[2]	2015
Niue	3%	100%	2020
Palau	3%	20%[2]	2020
Papua New Guinea	46%	No Targets Set	
Samoa	42%	+ 20%[2]	2030
Solomon Islands	0%	50%	2015
Tokelau	1%	100%	2012
Tonga	<1%	50%[3]	2012
Tuvalu	2%	100%	2020
Vanuatu	19%	25%[1]	2012

[1]: Unofficial goals, [2]: Primary energy demand, [3]: 50% diesel fuel reduction through RE and 16% increase in energy efficiency

IRENA
International Renewable Energy Agency

Important efforts in renewable energy implementation



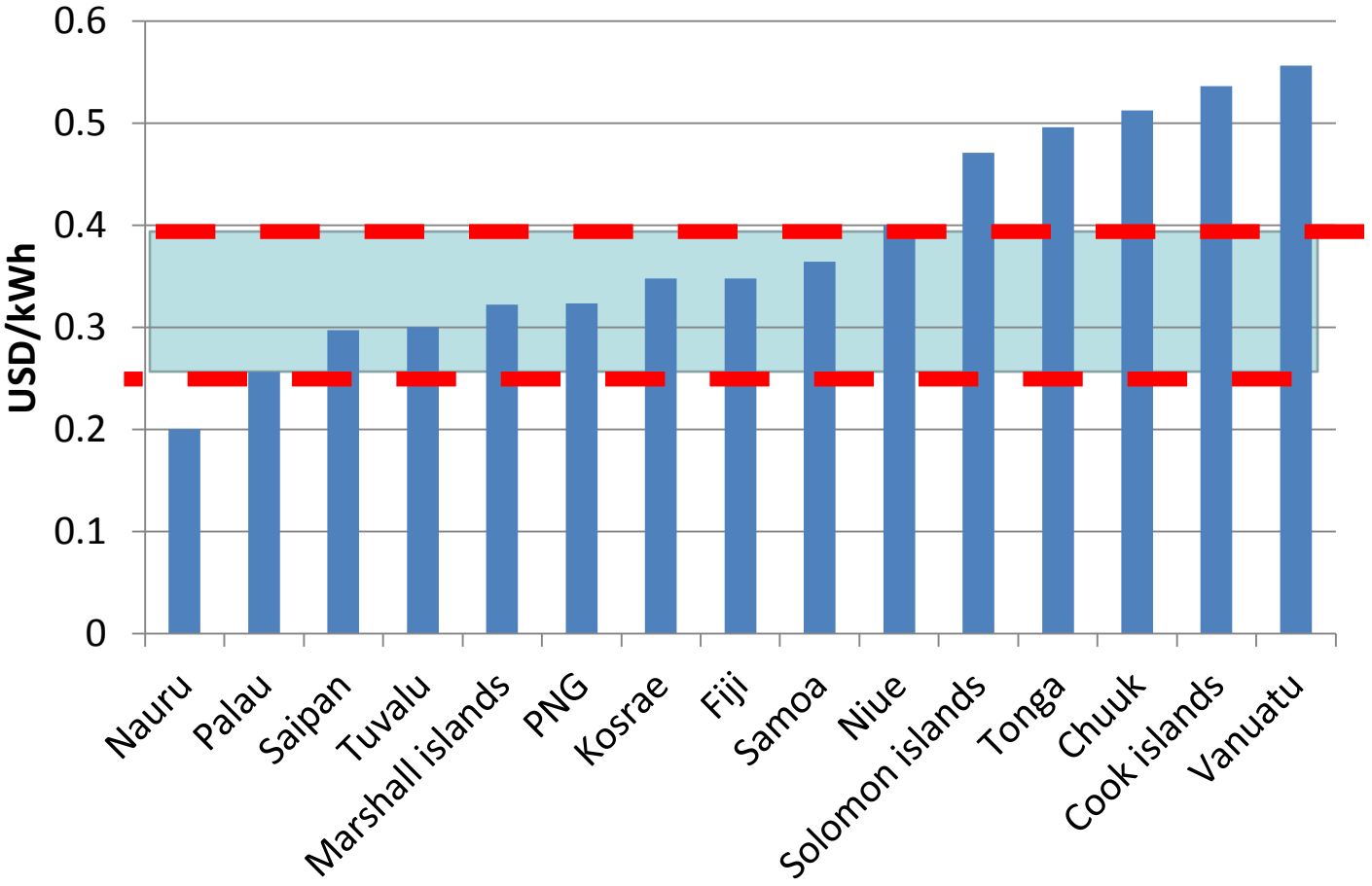
Source: Herb Wade, consultant

IRENA Activities for the Pacific region in 2012

- Developed together with country experts (Sydney workshop, October 2011)
- Endorsed by Pacific leaders (Abu Dhabi Pacific Leaders Meeting, January 2012)
  - Renewable power system stability assessment – in collaboration with PPA
  - Assess renewable energy solutions for the transportation sector
  - Land use, energy and water nexus – optimal strategies
  - RE resource assessment
  - Renewables readiness asessment - Kiribati
  - Capacity development for operation and maintenance
  - Support enabling environment for private sector (development of PPAs, IPPs)
  - One-stop-shop for technology RE information
  - Roadmaps: Nauru and comprehensive regional roadmap outlining the strategy ahead
- *IRENA Renewable Energy Coordinator for the Pacific region* hosted by SPC to help implement IRENA work programme for the Pacific

Pacific Power Prices (lower end, early 2011)

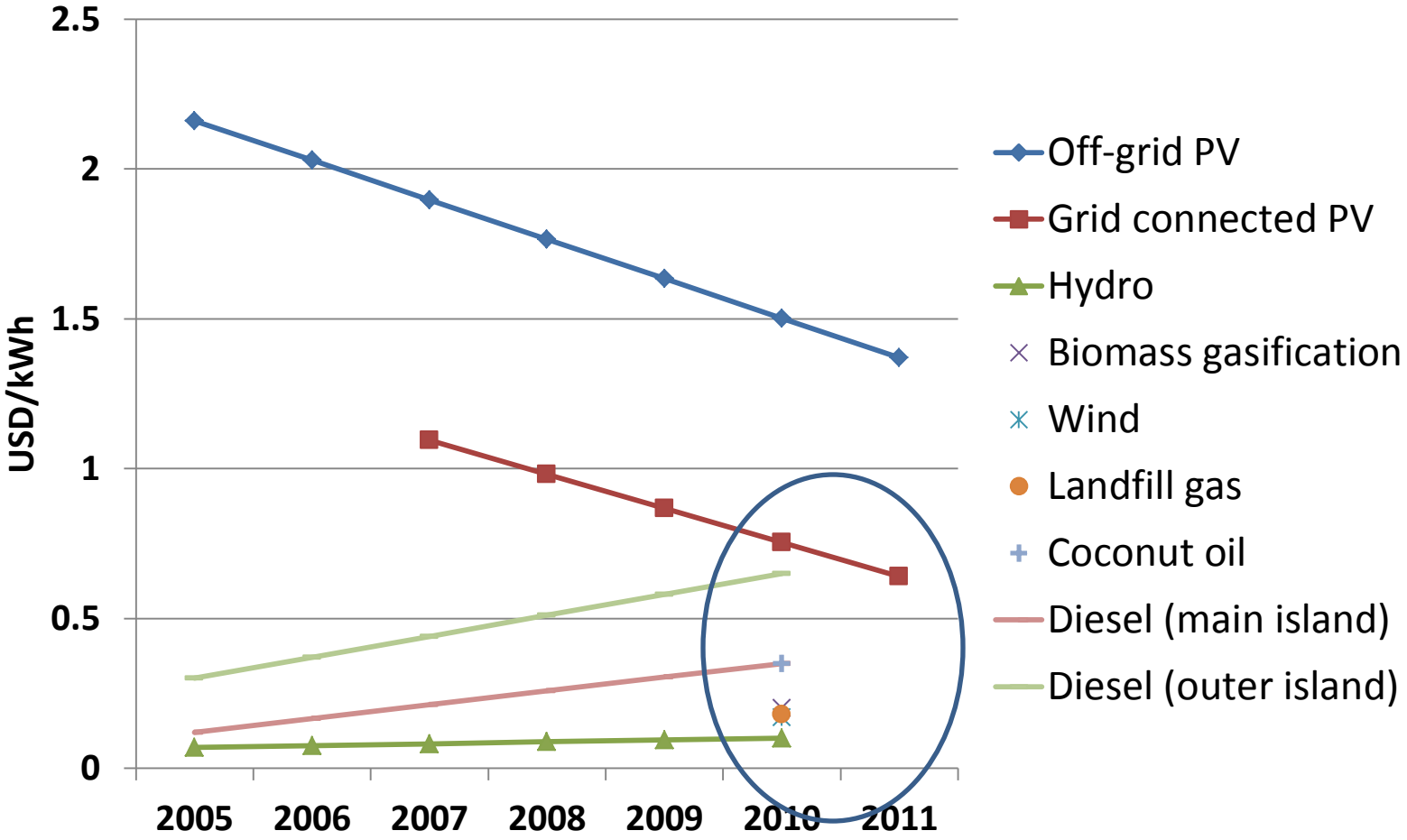
High oil cost determine power prices – early opportunity



Diesel – fuel cost only

Many Renewables are Cheaper than Diesel

Generation cost in the Pacific are high



Source: Syngellakis, 2011

Power sector transition challenges

- How to operate existing diesel generators with high shares of variable renewables
- Provide utilities confidence that power supply is reliable during and following a transition
- What is the role of electricity storage (IRENA storage reports)
- How much backup capacity is needed
- What can be done with demand side management
- How to fund a transition
- Focus on proven technologies but adjustment to local conditions may be needed

Grid stability assessment (in collaboration with PPA)

Objective: To assess how much the island grids can absorb variable renewables without affecting the power quality

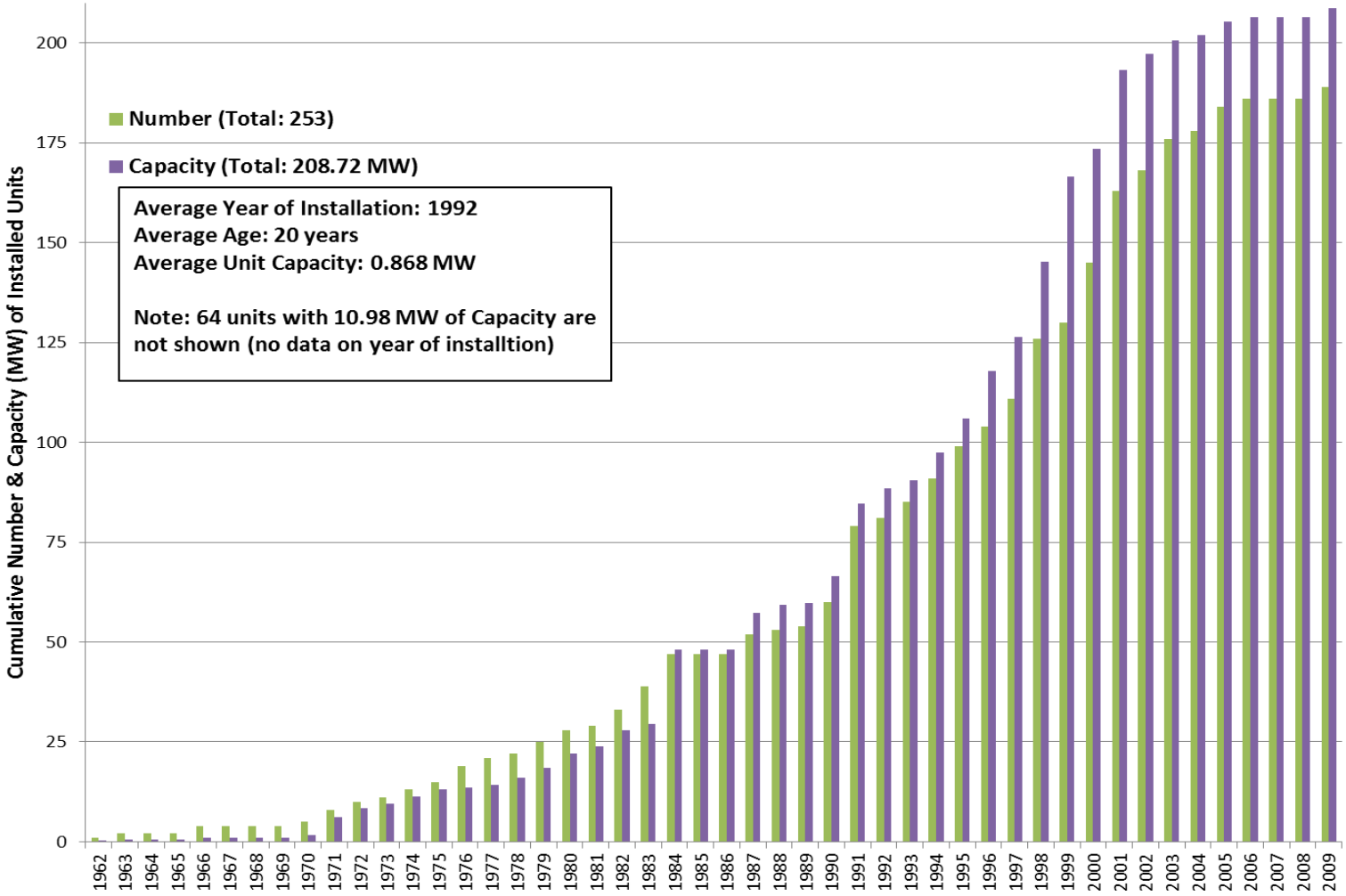
Grid stability assessment

First Step: Assess diesel generator stock and their potential to operate at partial and variable load.

Existing Pacific diesel generator stock - *Operating units only*

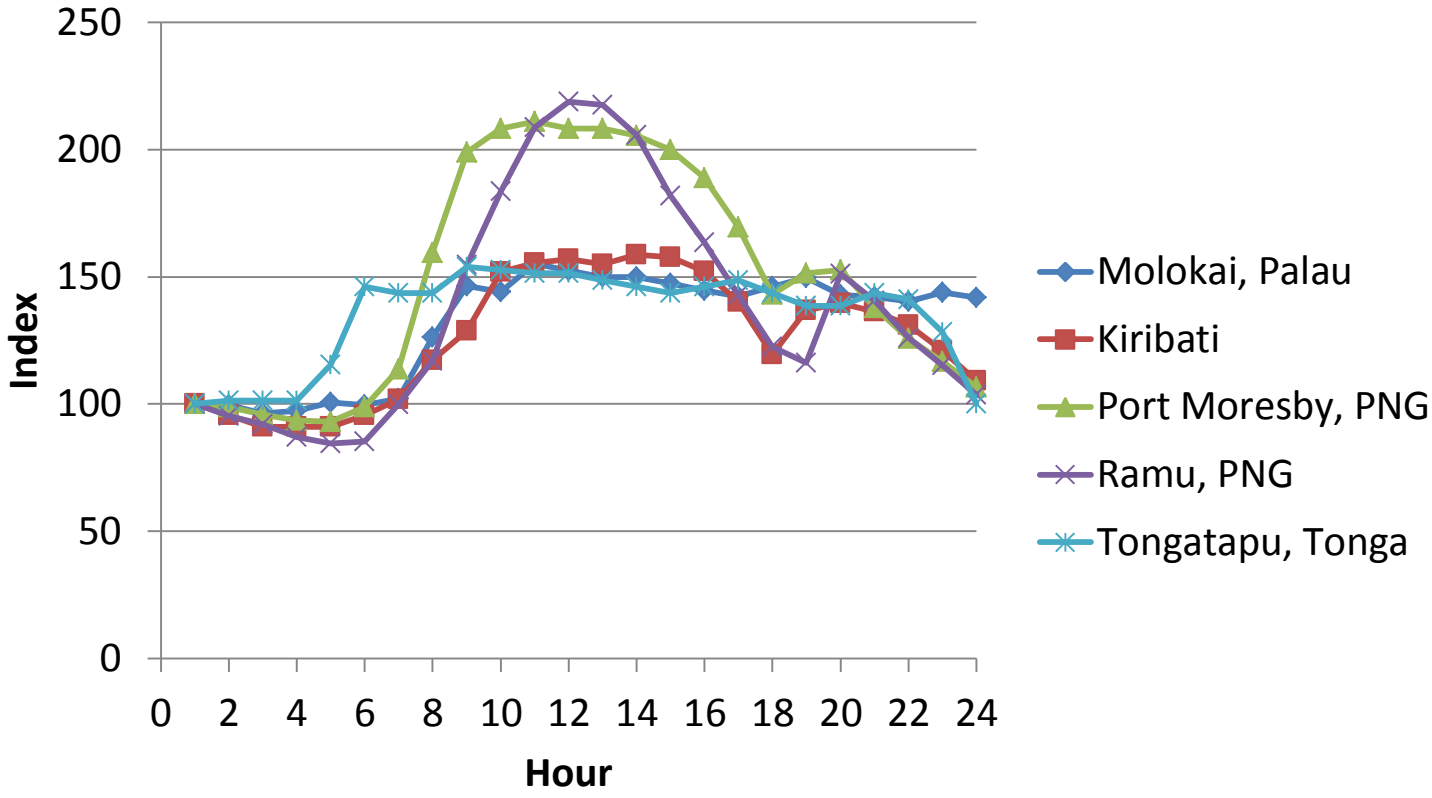
Country or State	Capacity	Units	Unit Size (MW)			1st Operational Year	
	MW	#	Min	Max	Avg.	Old	New
Cook Islands	11.04	24	0.025	2.1	0.460	1990	2009
FS of Micronesia	29.66	31	0.027	3.2	1.362	1974	2006
Fiji	112.17	43	0.06	10.15	2.621	1953	2005
Kiribati	9.40	13	0.135	1.4	0.989	1976	2005
Marshall Islands	41.90	33	0.06	6.4	1.270	1982	2003
Nauru	4.00	5	0.8	0.8	0.800	2002	2005
Niue	1.68	4	0.421			No Data	
Palau	26.83	13	0.2	3.4	2.064	1984	2000
Papua New Guinea	1050.51	120	0.1	60	8.754	1968	2009
Samoa	16.59	15	0.045	3.5	1.106	1979	2001
Solomon Islands	37.78	44	0.04	4.2	0.859	1971	2006
Tonga	14.44	19	0.056	1.729	0.760	1972	1998
Tokelau	No Data						
Tuvalu	3.71	30	0.045	1	0.124	1982	2001
Vanuatu	22.64	22	0.1	4.23	1.029	1962	2001
Total	1382.34	416					
Minus PNG & Fiji	219.66	253					

Cumulative capacity and age profile of the current diesel generators (excludes Fiji, PNG)



Pacific load curves

Day peak fits well with PV



Source: IRENA, 2012

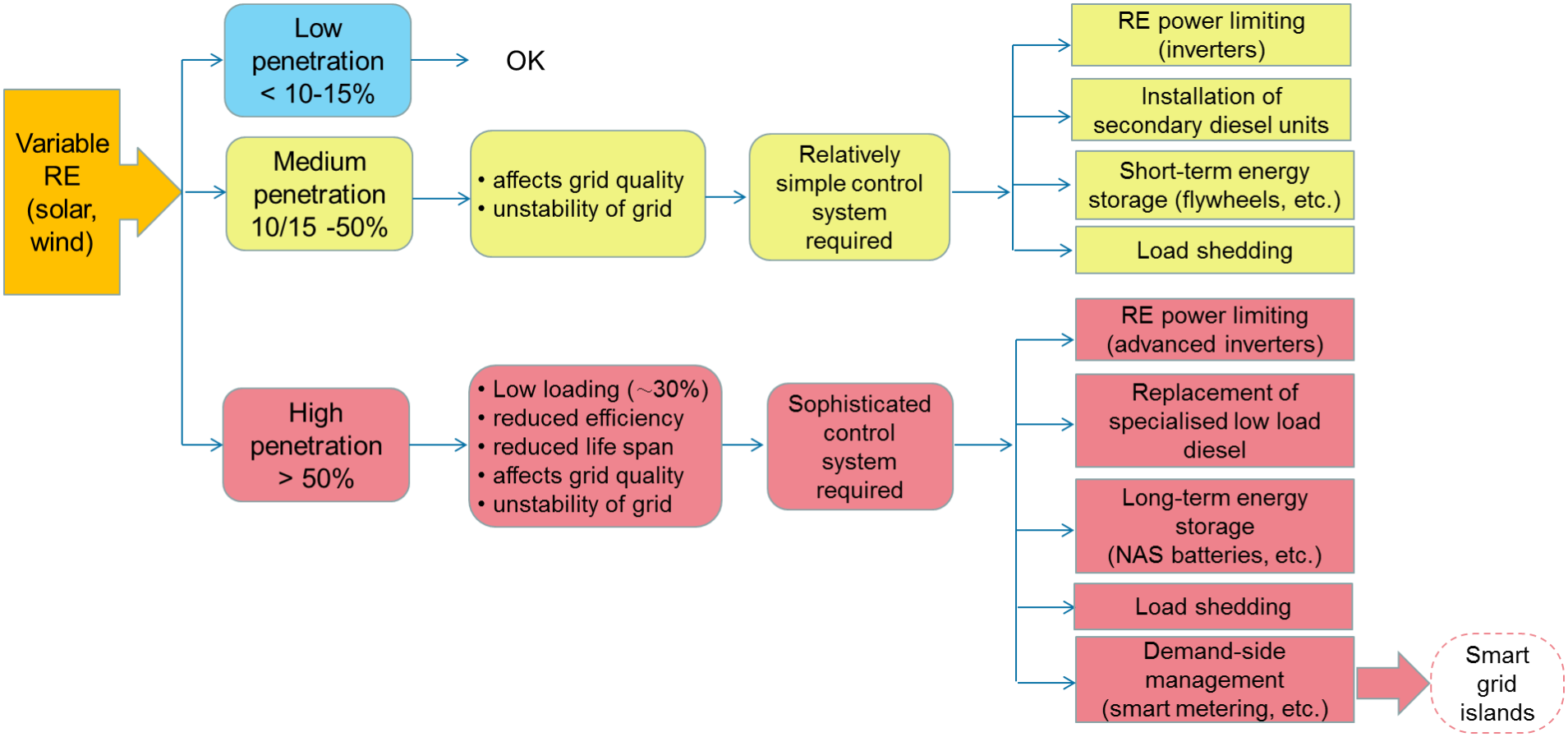
Grid stability assessment

Second Step: Grid simulation (1/2)

- Assessing the behavior of frequency and voltage is the key
- Dynamic modeling is necessary
  - Dynamic modeling contains “time” as one of the variables, attempts to capture behavioral changes of frequency and voltage over time
  - Static modeling examines power system performance under a single point in time – used for grid loss assessment (conducted by PPA)
- Purpose of dynamic modeling: to simulate the effects of frequency and voltage under the varying load conditions by renewables in order to identify the threshold point where those variables affect the efficiency of diesel engines.
- Data for dynamic modeling – frequency and voltage control on second/minute scale
- Various modeling packages (Simulink, PowerFactory, KERMIT, PSSE, PSLF, etc.) are available but many are for the large grids and not validated for small island grids
- The quality of the modeling results depends on the user

Strategies depending on the levels of RE integration

Values for RE penetration vary greatly depends on the type of RE resources and the individual systems.

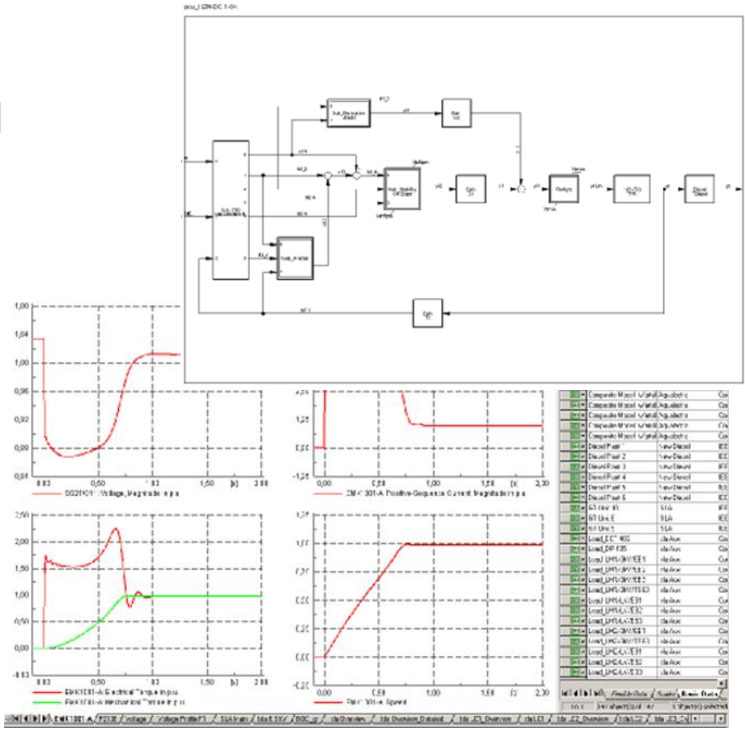


Grid stability assessment

Second Step: Grid simulation (2/2)

Key Criteria to select software packages:

- Have experience (reference) and or validated in small island
- Flexible to model key components of the island grids including advanced inverters and flywheels
- Publicly available and non-proprietary
- Provides trainings and support for user friendliness
- Presence in the Pacific region for support and maintenance

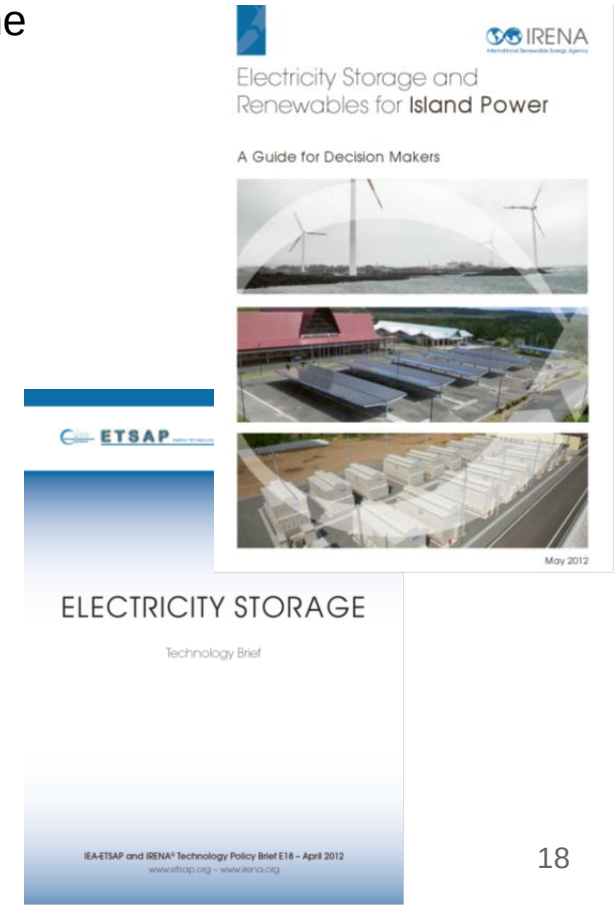


Source: From DigSILENT website

- Start with a pilot study on a single island to gain an experience of 1) developing a blueprint of the assessment process and 2) a *standard model* for the Pacific region.

Electricity Storage for Islands: Summary of findings

- Storage can significantly reduce diesel use and help integrate renewables
- Storage system can help stabilise the grid by improving the frequency control
- Many new storage technologies under development
- Storage technologies improving, but still expensive
  - Exceptions: lead-acid batteries, pumped hydro
- Storage *alone* can cut diesel use 25%
- Diesel + Renewables + Storage = lowest levelised cost
- Thoughtful system design and integration is essential



Smart grids can serve many purposes

- Higher energy efficiency
- Lower cost because of more efficient equipment use
- More accurate allocation of cost to customers
- Increased power system reliability
- Enabling technology for high shares of variable renewables, together with other measures such as:
  - Geographical spread of RE production units
  - Better forecasting
  - Portofolio of RE options
  - Selection of supply options that match demand (eg PV and Airconditioning)
  - Interconnectors
  - Electricity storage capacity
  - Backup capacity
- IRENA smart grids and storage roadmap (2012-2013)

Next steps

- Active implementation of IRENA acitivies for the Pacific region:
  - Grid stability assessments in collaboration with PPA – starting with a pilot study
  - Renewables for transportation – need shipping fuel consumption data
  - Roadmaps – Tonga TERM, Nauru, regional
  - Resource assessment
  - Capacity development
  - Technology assessments suitable for the region
- These should take into account of opportunities for increasing energy efficiency; not only the grid efficiency but also efficiency in electricity use (refrigerators, AC, etc.) – need data on electricity use

- Post-Rio Islands summit, Malta, 6-7 September 2012

Relevant publications

- Electricity Storage and Renewables for Island Power
- Technology Brief on Electricity Storage
- Technology Brief on Desalination powered by Renewables
- Strategies for International Cooperation in Support of Energy Development in Pacific Island Nations – NREL report in collaboration with IRENA
- Master‘s thesis on: “Renewable energy options for pacific islands:
- power generation and transportation“, “Water-Energy-Land nexus analysis in Tarawa: A case study”
- (DRAFT) Renewable Renewable Energy in the Pacific Island Region (including separate country profiles for each 15 Pacific island countries) → ***for your kind inputs and review***

IRENA
International Renewable Energy Agency

Thank you !

www.irena.org