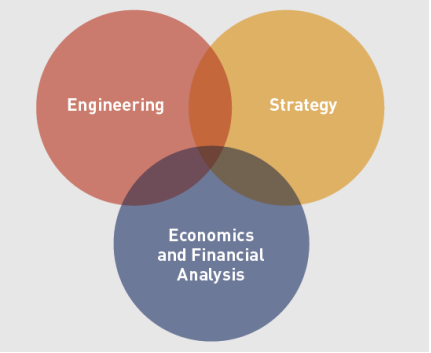
100% Renewable Energy for Islands

Case studies – Tuvalu & Tokelau

IT Power Renewable Energy Consulting

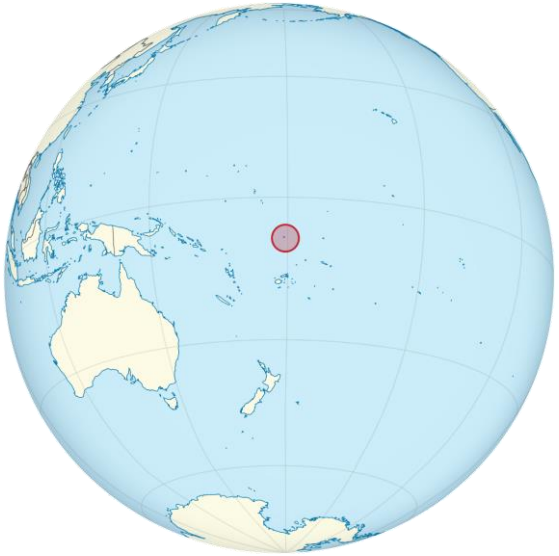
About ITP

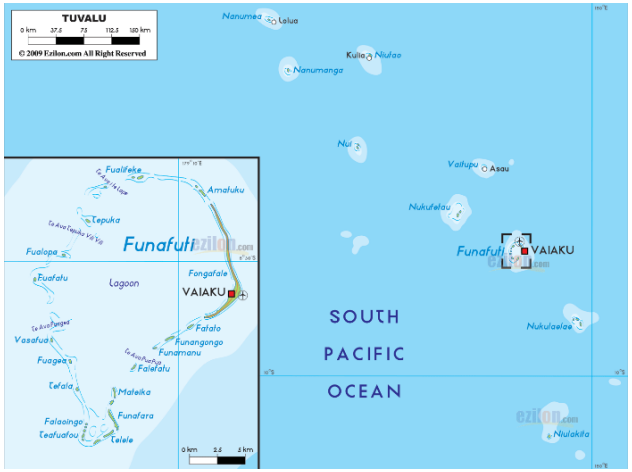
- Specialist renewable energy consulting firm
- Over 30 years international experience and 1,500 projects
- Founded in the UK in 1981
- Major regional offices in UK, India, China and Australia



- Head office in Canberra, offices in SA, NSW and NZ
- Active in Australia and the Pacific region for over 10 years
- Involved in RE projects of all scales (1 kW to 50+ MW)
- Services
  - Engineering Consultancy
  - Project Engineering
  - Energy Markets and Advisory
  - International Aid and Development

TERP – Tuvalu





- Nine small atoll islands
- Total population approx. 10,000
- 6,000 on the capital, Funafuti
- Other islands populations 100-1,500
- Outer islands only accessible by boat, typically 24hrs by boat to each island
- Irregular shipping (every 3-6 weeks)
- Shipping often disrupted by weather or boat unavailability

Case study – Tuvalu northern islands

- Existing low voltage AC electricity grids (diesel) since 2001
- Grids operated by electricity utility (Tuvalu Electricity Corporation)
- Local operators (TEC employees) deal with day to day running
- Technicians from the capital visit periodically or for repairs when required

Nanumea power station

Tuvalu northern islands- key issues

- Reliability
  - Only 12-18 hours of power per day normally (down to 2-4 hrs sometimes)
  - Frequent diesel shortages due to shipping unreliability
  - Generator breakdowns
  - Long delays for repairs (can take weeks to send a technician from Funafuti)

- Cost
  - Estimated ~$1.20 to $1.50/kWh cost of supplying energy (possibly more)
  - Vulnerable to diesel price changes
  - Vulnerable to utility cash flow issues
  - Tariffs ~25c/kWh – outer islands subsidised by main island and by government

- Remote diesel grids were built as a service to the community, but are very expensive for the government

Transportation

Transportation

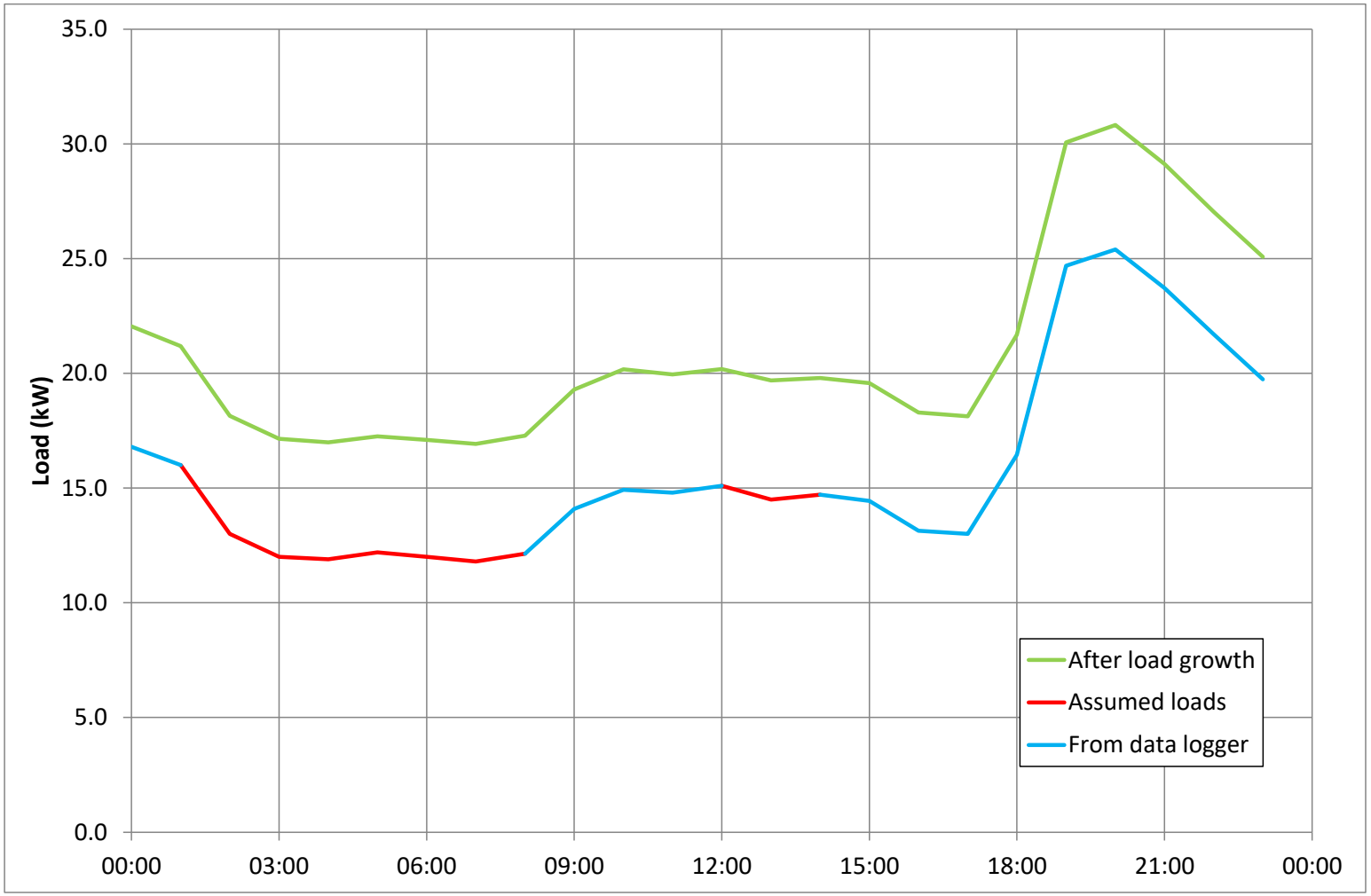
Vulnerability to weather

Aims of outer islands solar project

- Outer islands 100% renewable energy
- 24hr power
- System to last 20 years without need for major modification
- Reduce operating costs of outer islands power systems
- Improve power reliability (and availability during disasters)

- Grant-funded (NZ Govt)
- Eliminate need for aid fuel subsidies

Load curve – Nanumea island



Load estimate - Nanumea

- Average 550 kWh per day
- Little seasonal variation, but some “busy” times of year.
- Highest demand around Christmas and special events

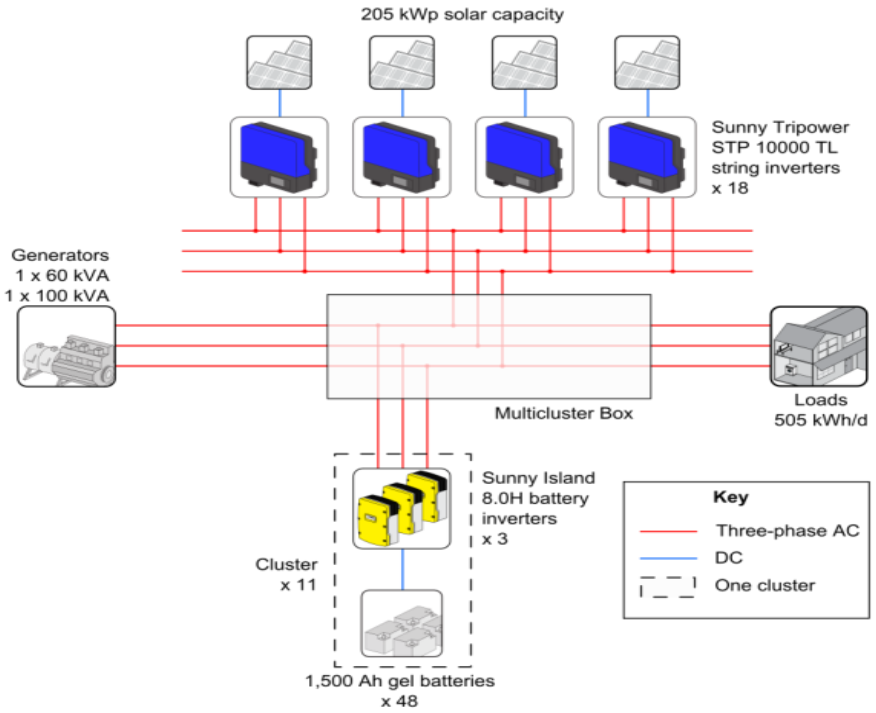
- 40% of demand during “solar” hours
- 60% evening/night time

- Allowance for extra days with poor sun – 2 days

- Use this to size battery bank
- Then size solar PV array to meet day time load plus enough extra energy to fully charge the batteries.

System sizing overview

- 33,000 Ah battery bank (sealed lead acid batteries)
- 200 kW solar PV array
- SMA modular inverter/charger units
- Diesel generator to be switched off normally.



Design features

- **Modular**
  - if one unit fails, most of the system can be kept online
  - Spares kept on island, easy to swap out
  - Off-the-shelf inverter/controller, easy to order a new one
- Robust and corrosion resistant
- Cyclone proof structure
- No air conditioning required
  - Because the air conditioner is often a failure point
- Low maintenance

Completed system

Performance so far

- System is very large for current loads
- Batteries drop to 80% overnight, are fully charged before midday if sunny
- Can go for 5 days of cloudy weather without generator
- 1 inverter failure – local operator successfully replaced it and sent it back for warranty claim
- Effective cost of energy supply reduced to about $0.55/kWh (from over $1)
- However this is still higher than the tariff ($0.25/kWh)

Training and operation

- Local operators involved from beginning of construction
- Training throughout construction and troubleshooting
- Other staff in Funafuti (capital) have been doing solar training over a longer period
- Very challenging for the outer island operators to adapt to the new technology

Community

Lessons/challenges

Less well-known challenges ITP has seen over the years:

- Systems becoming too reliable (operators stop maintaining generators totally/ get complacent)
- Social problems with 24hr power (e.g. loud music at night)
- Logistics can be very complicated
- Getting accurate data and information is difficult (e.g. powerhouse data, shipping schedules)
- Limited market for companies with experience in designing and building renewable energy systems on island environments

Questions

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