100% Renewable Energy for Islands

Case studies – Tuvalu & Tokelau
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
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