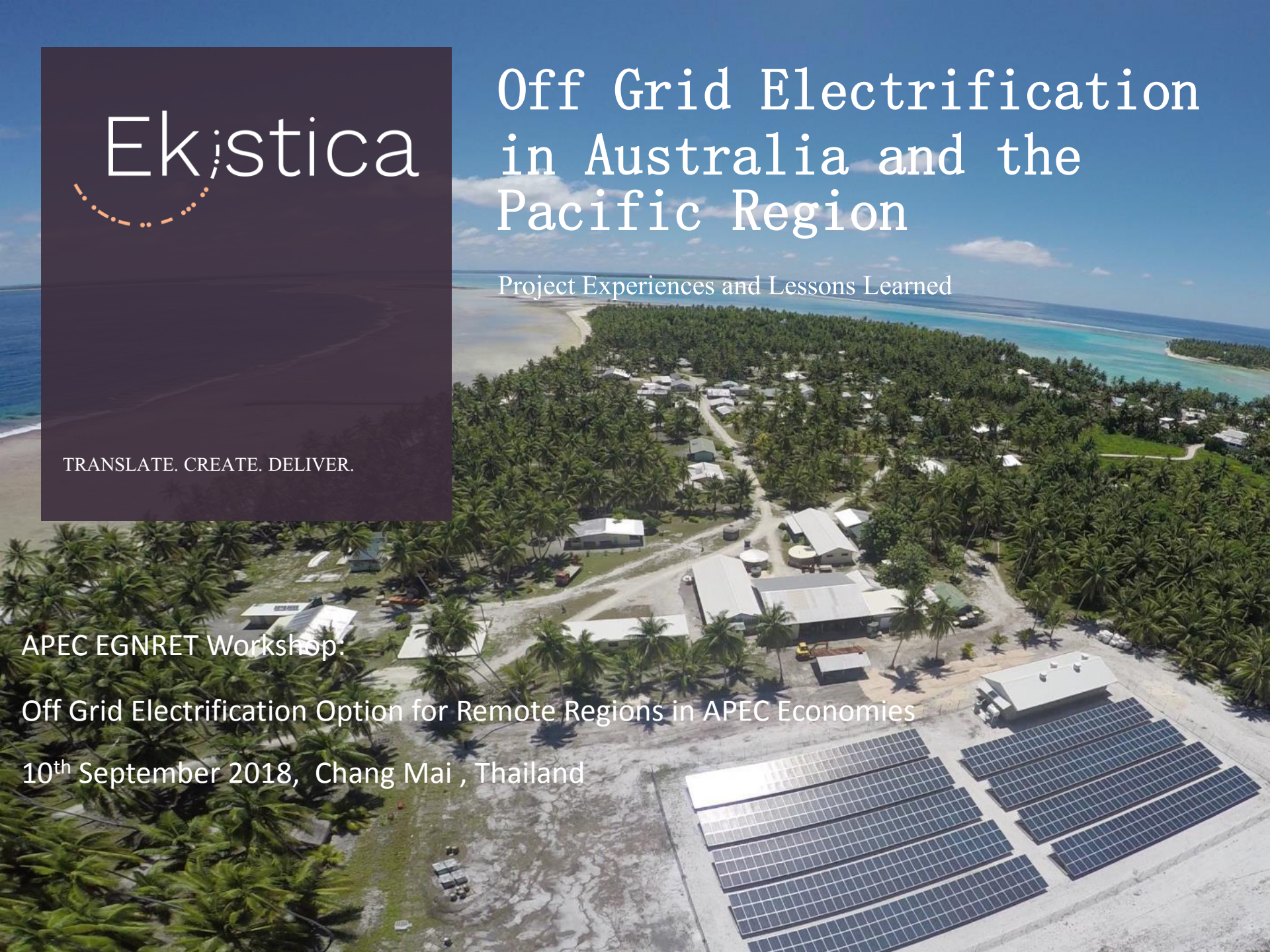
Ekistica

TRANSLATE. CREATE. DELIVER.

Off Grid Electrification in Australia and the Pacific Region

Project Experiences and Lessons Learned



APEC EGNRET Workshop:

Off Grid Electrification Option for Remote Regions in APEC Economies

10th September 2018, Chang Mai , Thailand

Overview

- Who is Ekistica
- Off Grid Electrification
  - Electrification and energy services
  - Scale of electrification
  - Energy supply options
  - Structural barriers
- Off Grid Electrification in Australia and the Pacific
  - Bushlight Program
  - SETuP
  - Cook Islands

Who is Ekistica

- Engineering Consultancy, based in Alice Springs, Australia
- Wholly owned by Centre for Appropriate Technology (CfAT) and indigenous owned and managed NGO
- Provide engineering advice, design and implementation services.
- Clients include World Bank, ADB, local, state and national governments, NGO’s and private enterprise
- Specialists in remote areas service delivery, renewable energy, power systems and water and sanitation
- Broad project experiencing in Australia and overseas including the Cook Islands, Fiji, Solomon Islands, New Guinea, Indonesia, Cambodia, India, Nepal and Kenya
- https://www.ekistica.com.au

Off Grid Electrification

The term **Off Grid Electrification** is a broad term encompassing a wide range of possibilities

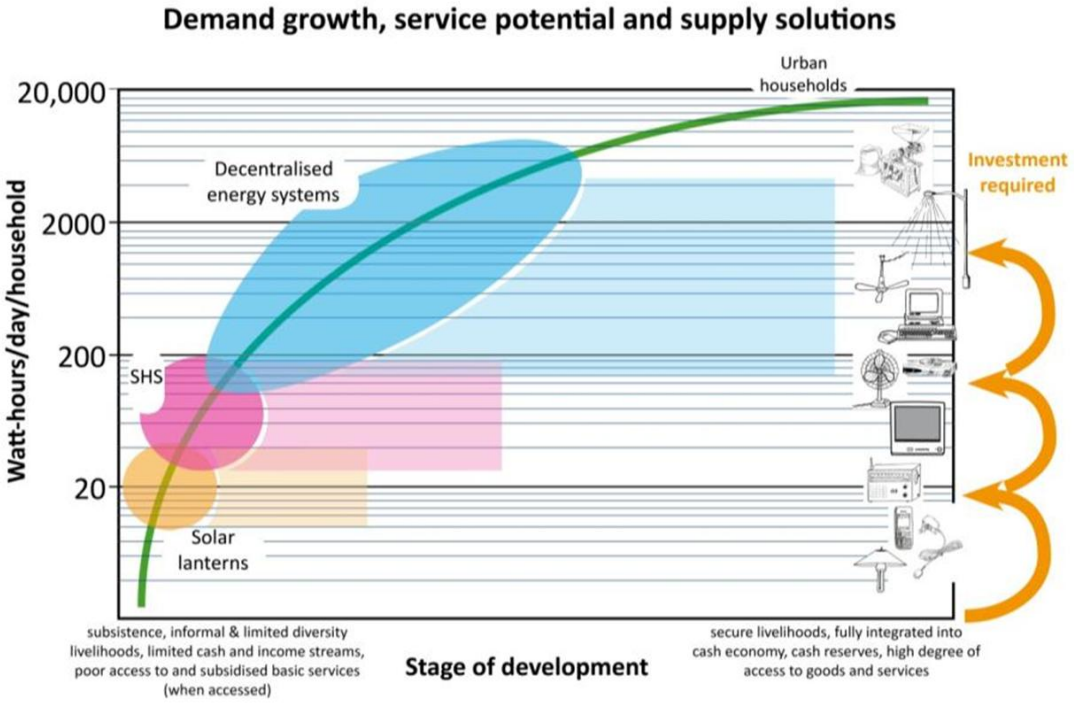
Definition :

"*The delivery of electrical energy services to persons, places and communities who do not otherwise have access to established centralized electricity networks*"

The key term here is **energy service**




Electrification and Access to Energy Services



Energy Services

- Connection is not the same as access
- Aim is to deliver a meaningful energy service
- What is the Level of Energy Service
  - Is it what end users need or want?
  - Is it affordable?
  - Can it be delivered

Important to define up front the energy service level that the electrification project/program aims to deliver as this

- Underpins the engagement with the end user, to manage expectations and set appropriate tariffs
- Informs the both the required scale of the power system(s) and the most suitable technology
- Allows for development of effective understanding of Capex/Opex and financing over the full project life cycle

Scale of Off Grid Electrification

- The required energy service level informs the scale of the required Off Grid Electrification system

Distributed Power Systems

Solar Lights(0-50W)

Solar Home Systems (50-500W)

Stand Alone Power Systems (0.5-10kW)

Centralized Power Systems/ Microgrids

Small (10-1000kW)

Medium (1-10MW)

Large (10–200MW)

Identifying Best Energy Supply Options

- For remote areas the identifying the best options for electricity generation depend on the following factors
  - Energy service to be delivered
  - Required scale of power system
  - Available energy resources
  - Available technology
  - Accessibility of site (road, sea, seasonal impacts)
  - The nature of the load (load profile)
  - Power requirements (availability, reliability, quality etc)
  - Regulatory requirements
  - Capacity of individuals and organization to design, install, operate and maintain system
  - System finances. Needs to be understood and managed over the whole project life cycle




Energy Supply Options

- Three main options include
  - Conventional generation (petrol, diesel and gas)
  - Renewable energy (solar PV, solar thermal, wind, hydro, biomass, geothermal)
  - Energy Storage System (ESS) (chemical batteries (BESS), pumped hydro, ultracapacitors etc)

System Scale	Typical Power Range	Typical Generation Options
Solar Lights/Charger	0 - 50 W	PV/BESS
Solar Home Systems (SHS)	50 – 500 W	PV/BESS
Stand Alone Power System (SPS)	0.5 - 10kW	PV/BESS/Hydro/Petrol/Diesel
Small Microgrids (Village)	10 – 1000 kW	PV/BESS/Hydro/Biomass/Wind/Diesel
Medium Microgrids (Town)	1 – 10 MW	PV/BESS/Hydro/Biomass/Wind/Diesel/Gas
Large Microgrids	10 – 200 MW	PV/BESS/Hydro/Biomass/Wind/Geothermal/Solar Thermal/Diesel/Gas

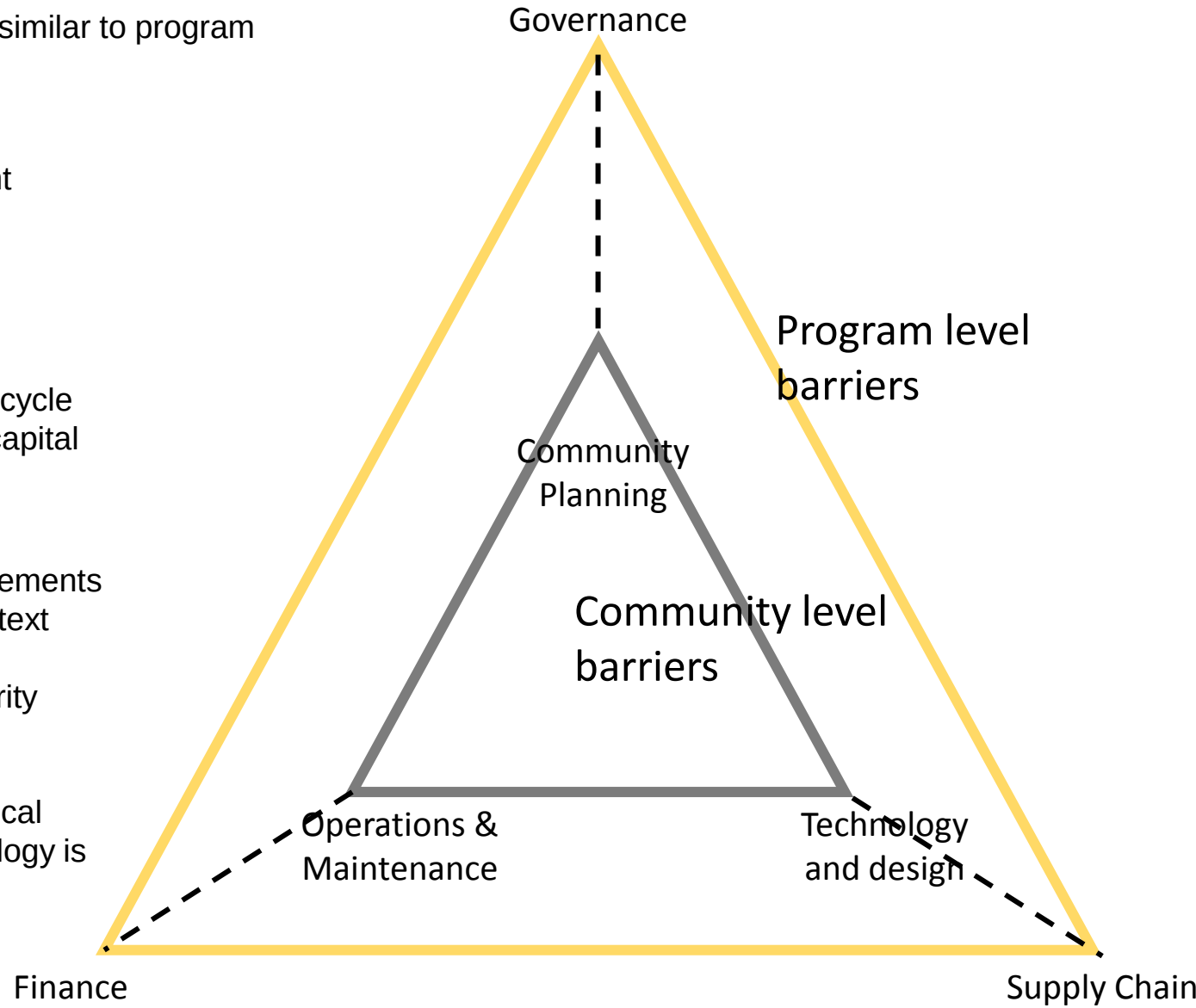
Structural Barriers to Off Grid Electrification in Remote Areas

Barriers at community level similar to program level, but aggregated

Governance
- Stakeholder engagement
- Capacity building
- Support and oversight

Finance
- Sourcing finance
- Required for system life cycle
- Perceived risk leads to capital constraints

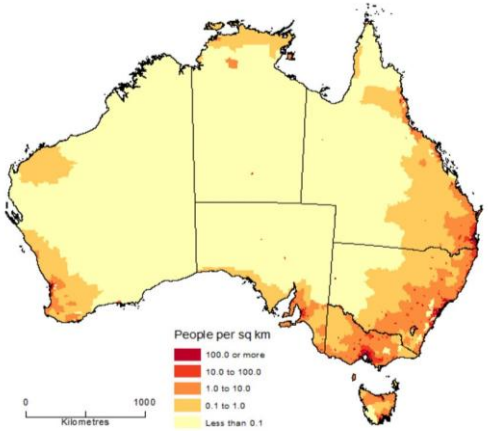
Supply chain
- Design/hardware requirements
  - Appropriate to context
  - Reliability
  - Scalability/Modularity
  - Serviceability
  - Portability
- Effective supply chain critical
- Standardization of technology is important enabler



Off Grid Electrification in Australia

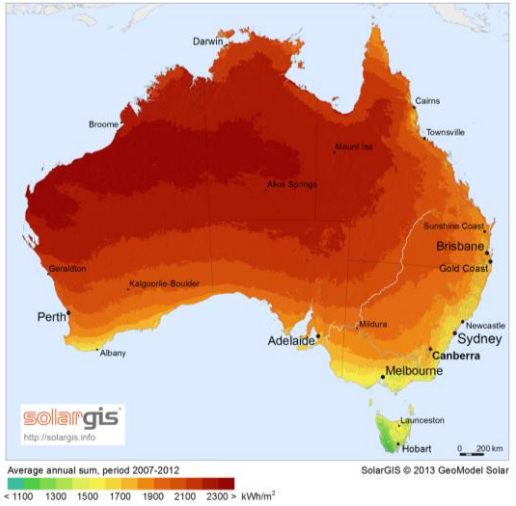
- Large land mass (larger than Europe, similar to mainland USA and China)
- Relatively small population (25 Million in 2018) predominately clustered around east coast
- Many remote towns, communities, outstations, mines, cattle stations, tourist facilities
- Network/grid coverage is large but limited to areas of higher population density
- Long history with Off Grid Electrification
- Traditionally powered by diesel/gas.
- Shift to renewables and in remote areas this means solar PV

Map: Population Density



Map: Network Coverage

Map: Solar Irradiance



Bushlight Program

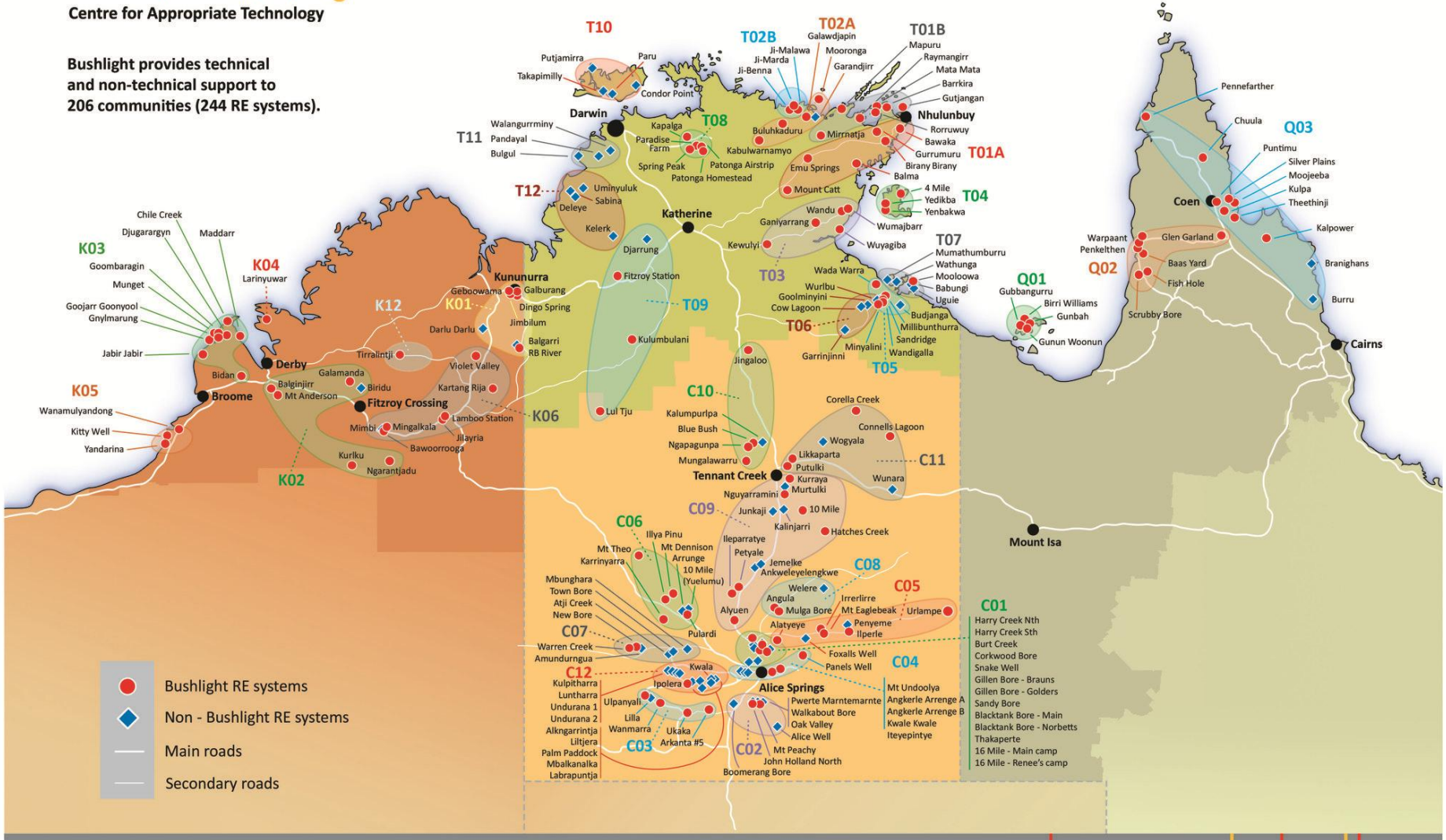
- Federally funded program aimed at reducing reliance on diesel generation in remote indigenous communities in Central and Northern Australia
- Replacement of diesel generation with PV/BESS
- 155 new or replacement PV/BESS or PV/BESS/Diesel hybrids installed
- Ongoing O&M for over 250 off grid power systems
- Strong focus on
  - Meaningful community engagement
  - Capacity building (industry, government and community)
  - Quality, reliability and serviceability
- Project commenced in 2003 and was defunded in 2013

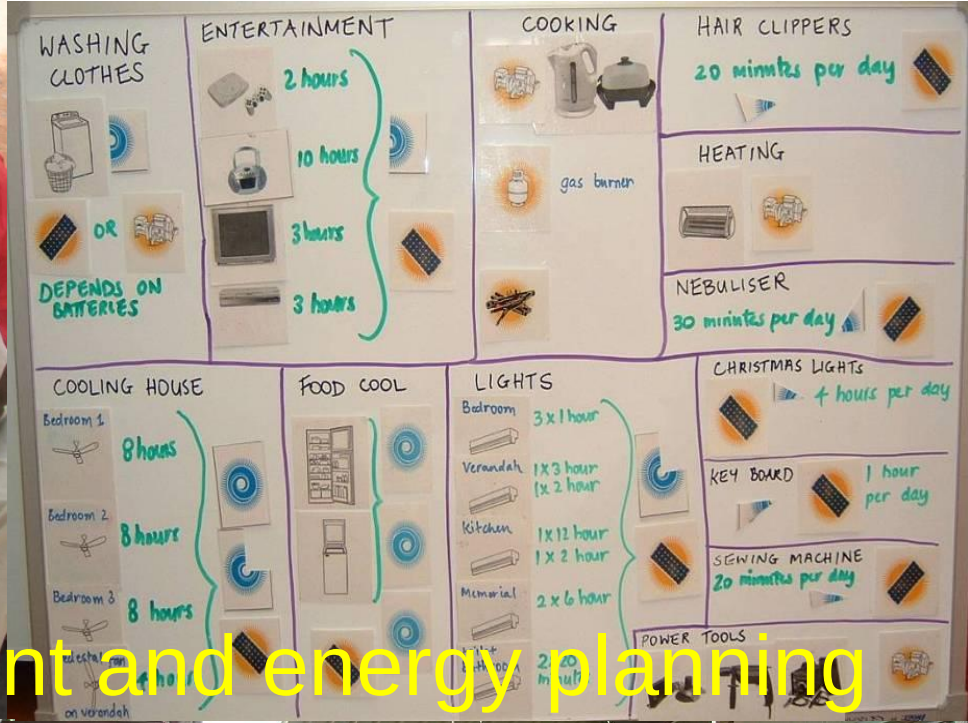
BUSHLIGHT

Centre for Appropriate Technology

Maintenance Program Service Runs July2013

Bushlight provides technical and non-technical support to 206 communities (244 RE systems).





Community engagement and energy planning

Capacity Building

Quality Hardware and Installation

Demand Side Management

Regular Maintenance

Lessons Learned

- Very successful program overall (was extended to India in 2009-2012)
- Critical elements of success included
  - Effective community engagement and capacity building
  - Ensuring quality components and installation
  - Demand side management
  - Ongoing operation and maintenance
  - Commitment to ongoing funding for O&M
  - Building installer/maintainer/support agency capacity
- Must take the long view and plan and implement for system life cycle

The Solar Energy Transformation Program (SETuP)

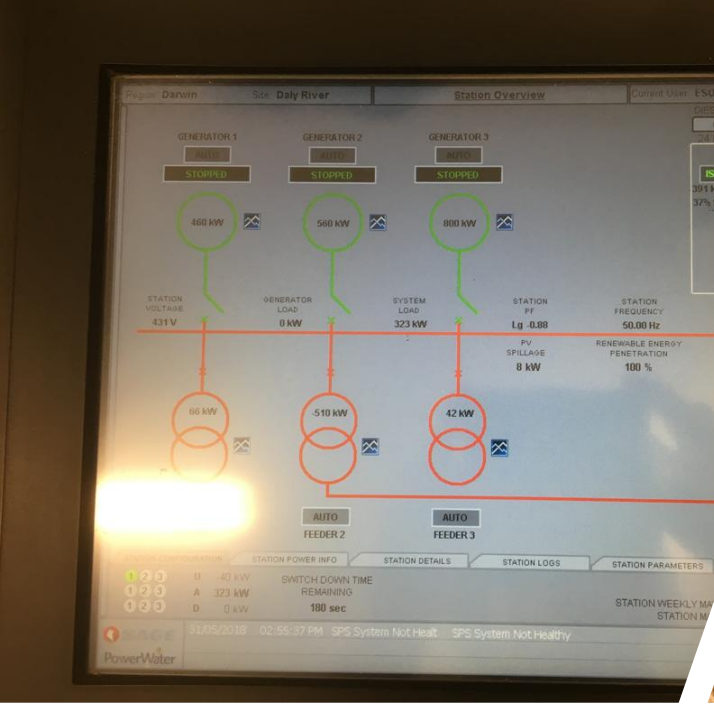
- SETuP is funded by the Australian Government through the Australian Renewable Energy Agency (ARENA) and the Northern Territory Government owned utility Power and Water Corporation (PWC). Commenced 2016.

- SETuP delivering a wide-scale rollout of 10MW of solar systems across 25 remote Indigenous communities where they currently operated diesel power plants

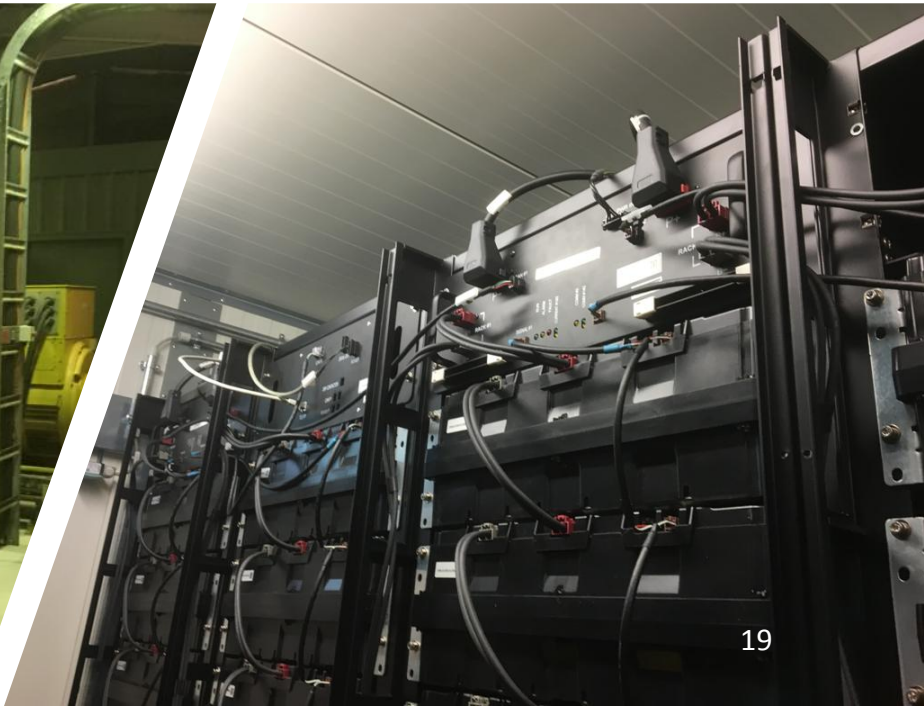
- Aim is to reduce diesel consumption by through low penetration PV (15-20%). Typically 300 to 500kW PV per site

- One site (Daly River) also selected to host large PV/BESS plant. Includes 1MW PV array and 2MWh Lithium Ion BESS.


SOLAR
SETUP
ARENA
NORTHERN TERRITORY GOVERNMENT
PowerWater
QINOUS


Station Overview
GENERATOR 1
GENERATOR 2
GENERATOR 3
STOPPED
460 kW
560 kW
800 kW
ISOCHRONOUS MODE
STATION VOLTAGE
431 V
GENERATOR LOAD
0 kW
SYSTEM LOAD
323 kW
STATION PF
Lg -0.88
STATION FREQUENCY
50.00 Hz
PV SPILLAGE
8 kW
RENEWABLE ENERGY PENETRATION
100 %
66 kW
510 kW
42 kW
AUTO
FEEDER 2
FEEDER 3
STATION POWER INFO
STATION DETAILS
STATION LOGS
STATION PARAMETERS
SWITCH DOWN TIME REMAINING
180 sec
PowerWater


BOSCH

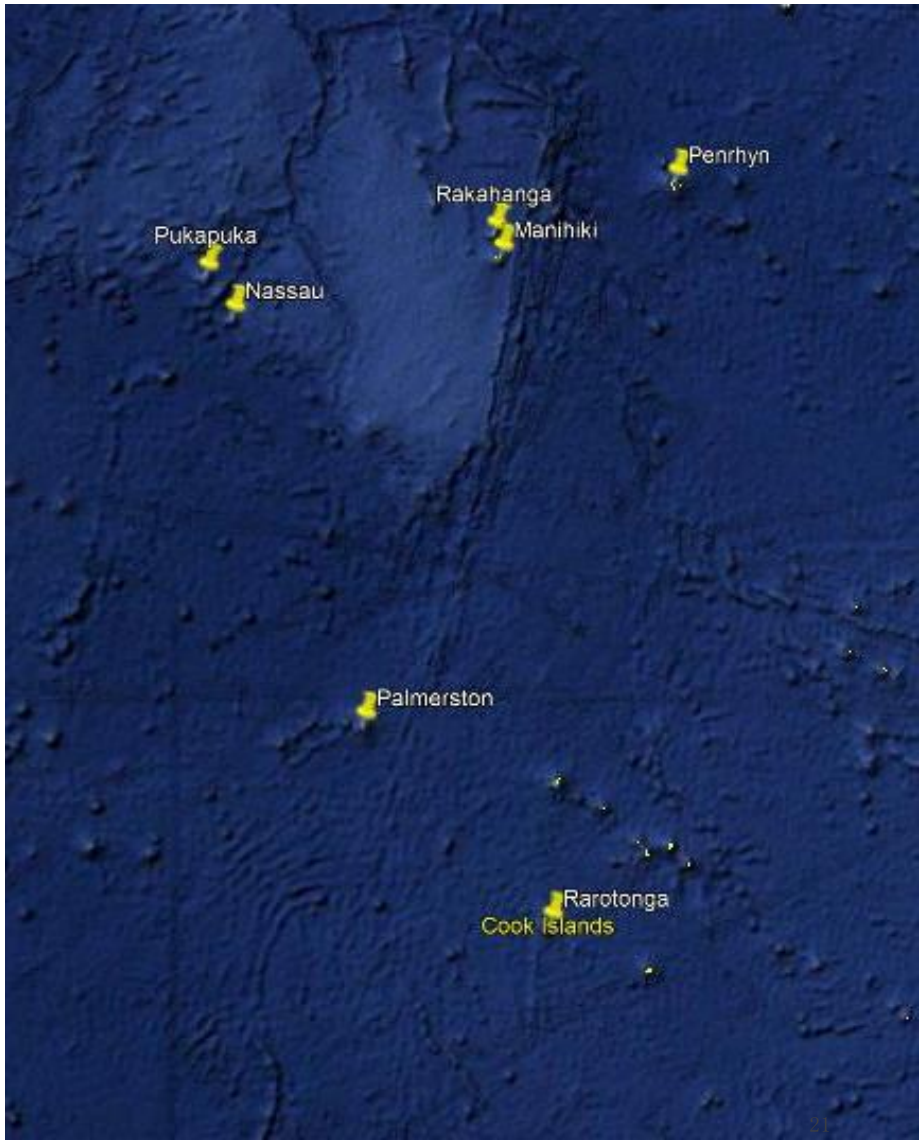


Project Outcomes

- Program commenced 2016 and still be rolled out
- PV/BESS/Diesel system has reduced diesel consumption by over 60%
- PV/Diesel systems have reduced diesel consumption by ~ 15%. This could be higher but utility is very conservative with control system
- Payback period approximately 5-6 years
- Potential for future rollout (another 50 similar sites available)
- Expansion of PV/Diesel system to PV/BESS/Diesel
- Project delays due to climate
- Lightning protection systems important in these northern areas

The Cook Islands – Outer Islands Project

- GoCI project with funding from NZMFAT
- Aim to reduce reliance on diesel generation
- Installation of eight PV/BESS/Diesel systems
- Very remote islands/atolls population (100-500)
- Key design issues include
  - Reliability
  - Portability
  - Modularity
  - Hot, humid and salt air climate
  - Cyclones and storm surges
  - Include remote monitoring
- Project completed in 2015
- Second Phase – Inner Islands underway




Pukapuka
Pukapuka
Community
Roto
Yato
Ngake
Airstrip

Lessons Learned

- Very successful project to date (3 years)
- Most systems operating above 95% PV energy fraction
- Risk has cost. Requirement to work through cyclone season increased costs
- Land access can be a major problem
- Additional project costs in upgrading existing enabling infrastructure
- Governance issue remain a concern
  - Recommended tariff structures not adhered to
  - Long term maintenance program not locked in
  - Lack of capacity building impacts local ability to manage

Ekistica

THANKS FOR WATCHING

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