Hydro Tasmania
Hybrid off-grid power systems capability

- Government Business Enterprise – owned by State of Tasmania
- Australia’s largest clean energy producer
- Responsible for generation, distribution and retail in the Bass Strait islands:
  - Serving industrial, commercial and residential customers,
  - Responsible for system security and reliability – keeping the lights on and factories operating.
- Developer, owner and operator of leading hybrid off-grid system on King Island – our test bed.
- Leading consultant to aid agencies and utilities, including: Yap, Pitcairn, Chatham Islands, Cook Islands, Rottnest Island, Coober Pedy, Thursday Island.
King Island location
Source: Google Earth
King Island power system
Drivers for renewable energy (RE)

Population approx. 1,600
2.5MW peak load
6MW diesel generation
12GWh pa
450km of 11kV

- Expensive system - diesel fuel is 80% of cost - incentive to use RE
- Adding RE is an integration challenge – RE displaces diesel generation
- High RE requires enabling systems – communication; control; services
- Complexity increases with higher RE – capability development required
- Requires holistic approach – planning; phasing development;
1998 – First Wind Farm
Low renewable energy penetration

“Low hanging fruit”
Deliberately limited RE installed
No impact to operations

15% reduction in diesel

Simplified example
2.45MW wind (1.2MW min load)
RE controlled (limited) protect diesels
Some RE is wasted (spilled)
Need to be conservative – slow speed of response

30% annual reduction in diesel

Simplified example
Enabling technology – Dynamic Resistor (Load bank) elements

- Resistive elements artificially increase the load: convert excess to heat
- Load balance is maintained (dynamically by resistors) – fast / accurate
- More RE is utilised – more diesel savings
- Diesel generators are protected

2008 – First enabling technology
Enhanced medium renewable energy penetration
Dynamic resistor
Effective spill management

- Converts wind spill to raise / lower reserve
- Enables renewables to control system frequency
- Allows diesels to run at minimum load
- Low cost / high availability
- Additional diesel saving
Dynamic resistor operation

Grey areas show dynamic resistor controlling system frequency using excess RE. Note reduction in diesel generation variability at these times – driving diesel savings.
2014 - Energy Storage
An enabling technology option for high RE penetration

- Battery can absorb excess RE (increase the load)
- Excess RE can be recovered (power injected)
- Maintain balance of load / supply
- Significant capital cost - more expensive than a dynamic resistor

Australia’s largest battery – 3MW / 1.5MWh King Island
2014 – Advanced hybrid system
Ability to operate at 100% RE penetration

Having to operate diesel generation is key barrier to RE utilisation

100% penetration systems require:
- Surplus RE capacity
- Full automation – high speed communication and control
- Enabling systems – replace all services provided by diesels

King Island flywheel – supports system without diesel generation
D-UPS provides system security "catches" system when diesel fails (as example)
Enabling systems integrated as one
Highly secure, stable system – supports renewables

Example of surviving WTG trip whilst 100% RE with no disruption to customers.
2014 - Demand management
Further optimise RE utilisation by altering demand to match available RE generation (another option)

- Aggregates controllable customer load to help balance demand / supply during high RE contribution and variation.
- Fast load shedding, smart EV charging, smart solar PV switching
- Monitoring customer load and providing data to customers via smart phone app.
2015 – King Island System Operation
Extended “diesel off” operation
Combined performance of enabling systems
2014 - Inline biodiesel blending
Flexible fuel use, de-risk biofuel use

- Displace as much mineral diesel as economically / technically viable
- Replace remaining fuel with sustainably sourced biodiesel
2015 - King Island System
Proven, robust, reliable MW class hybrid system
Result of planned, coordinated activity

> $24m in diesel savings (>2m per annum)  > 800 hrs of diesel off operation

**Renewable generation**
- 2014
  - 390 kW Solar PV
  - Total Capacity
- Solar photovoltaic
- Wind farm
  - 1998
    - 3 wind turbines
    - 750 kW
  - 2003
    - 7 wind turbines
    - 1700 kW

**Thermal generation**
- Existing diesel engines
- 6 MW total
- 2014 Biodiesel blending plant
- Diesel generators

**Enabling technologies**
- 2012 Diesel uninterruptable power supply (1MW)
- 2014 Biodiesel D-UPS
- 2008 Resistive frequency control
- Dynamic resistor
- 2014 Energy storage (advanced lead acid battery)

**Smart Grid - demand side management**

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*Winner 2013 innovation award*
King Island app & web site – real time data
www.kingislandrenewableenergy.com.au
King Island: 100% sustainable power (including use of biofuels)
King Island: 100% renewable power
(RE generation only, no battery)
King Island: 100% renewable power (RE generation with battery support)
2016 – Reduce cost of deployment
Integration activities traditionally costly and time consuming

King Island development required significant on site construction, expected as a first time development
2016 – Reduce cost of deployment
New approach: Scalable modular enablers & control

Flinders Island Hybrid Energy Hub Project – under construction
Aim is to reduce time, cost, risk of deployments
Thank you

Further information:

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“KIREIP” iPhone app