



The power of natural thinking
The King Island Renewable
Energy Integration Project
ESMAP Knowledge Exchange
Event, Vienna, June 16, 2015

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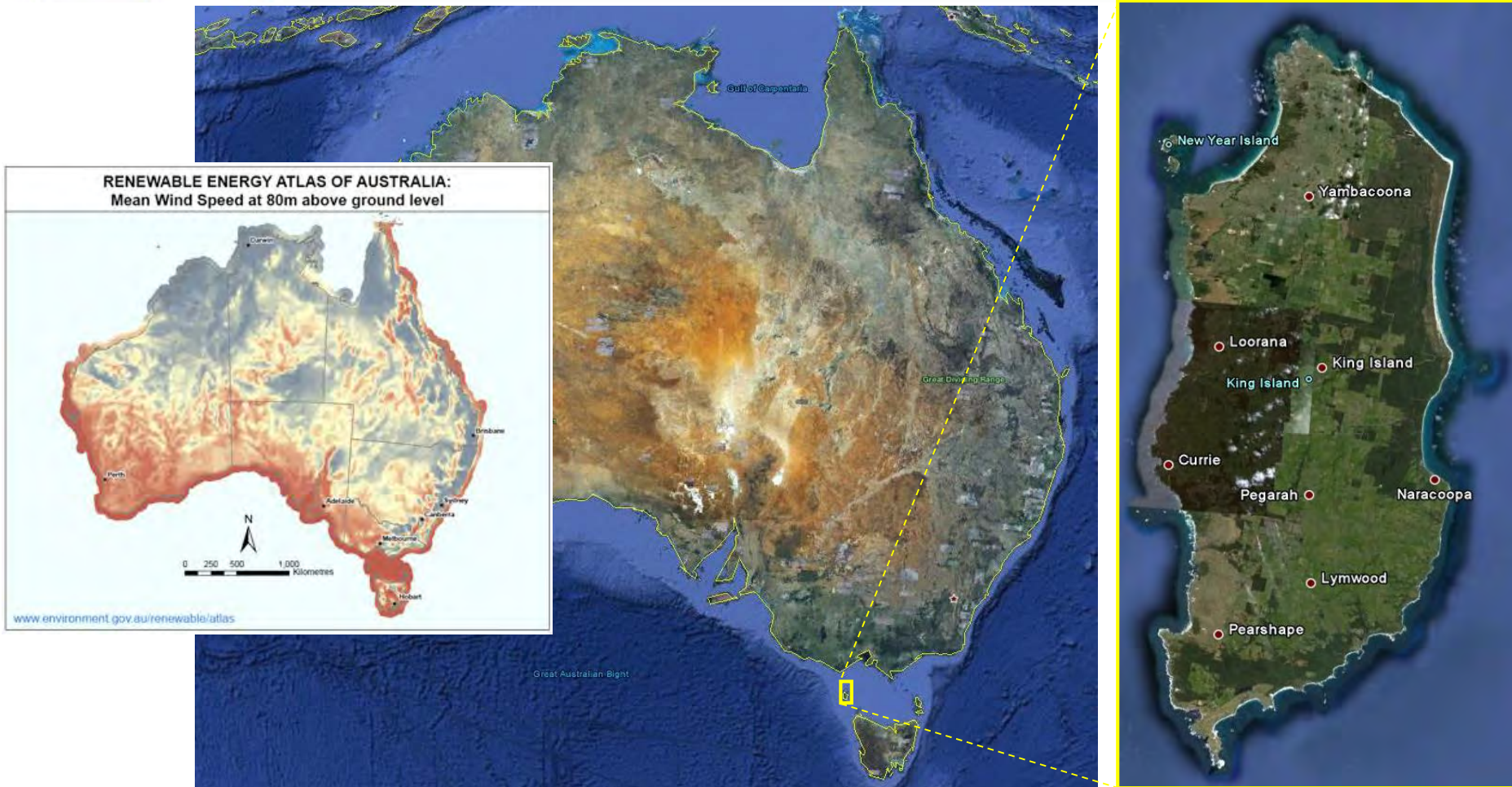
Hybrid off-grid power systems capability



- 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, Rottneest 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

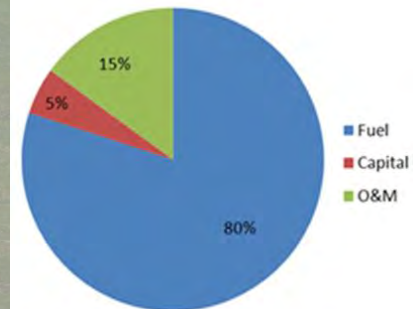
6MW diesel generation

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;



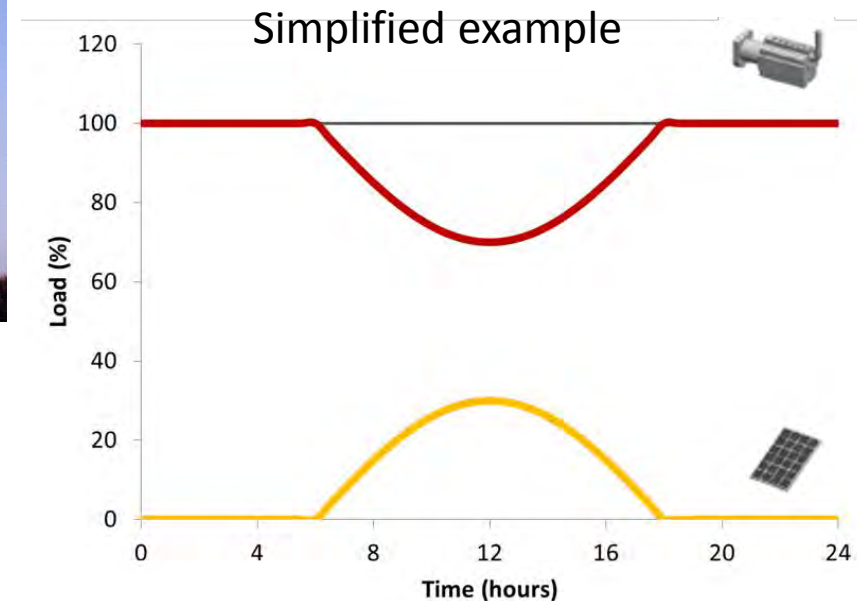
1998 – First Wind Farm

Low renewable energy penetration



15% reduction in diesel

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



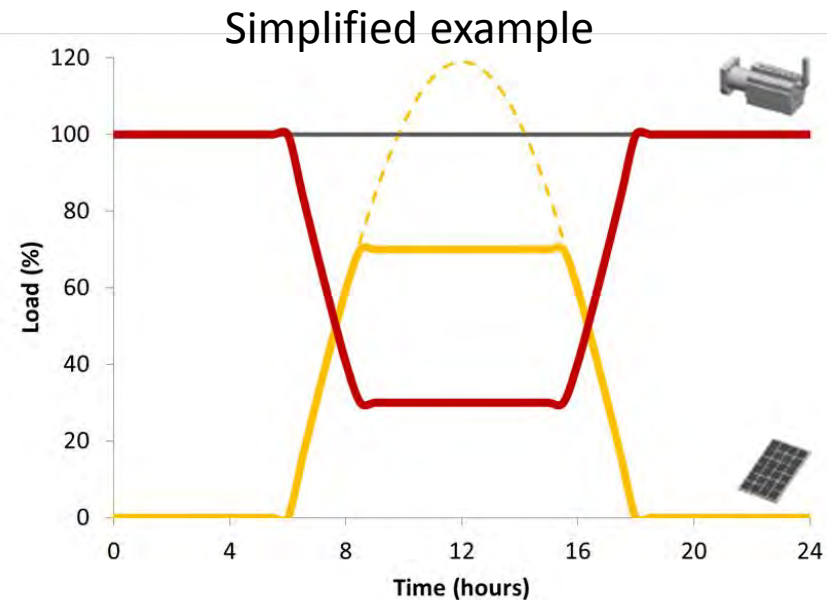
2004 – Wind Farm Expansion

Medium renewable energy penetration



30% annual reduction in diesel

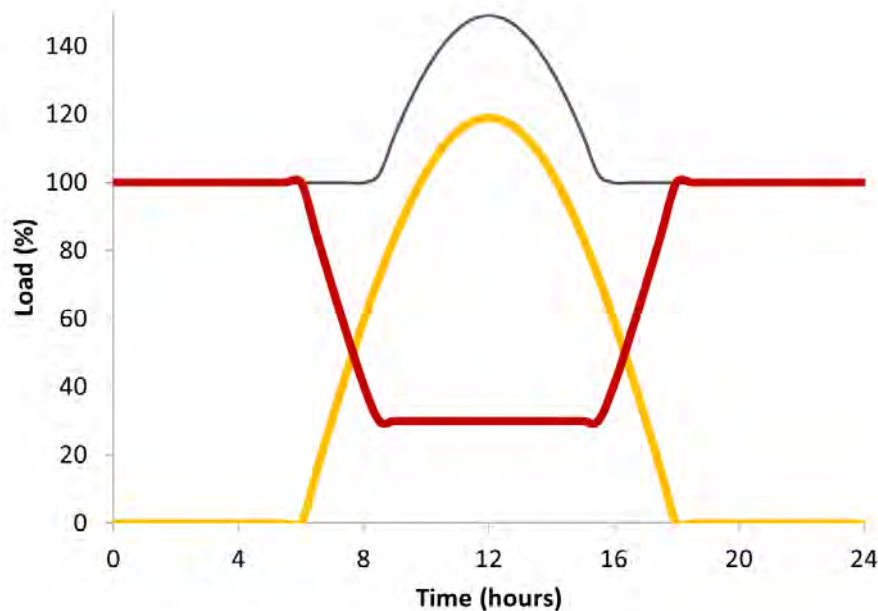
- 2.45MW wind (1.2MW min load)
- RE controlled (limited) protect diesels
- Some RE is wasted (spilled)
- Need to be conservative – slow speed of response



2008 – First enabling technology

Enhanced medium renewable energy penetration

Enabling technology – Dynamic Resistor (Load bank) elements

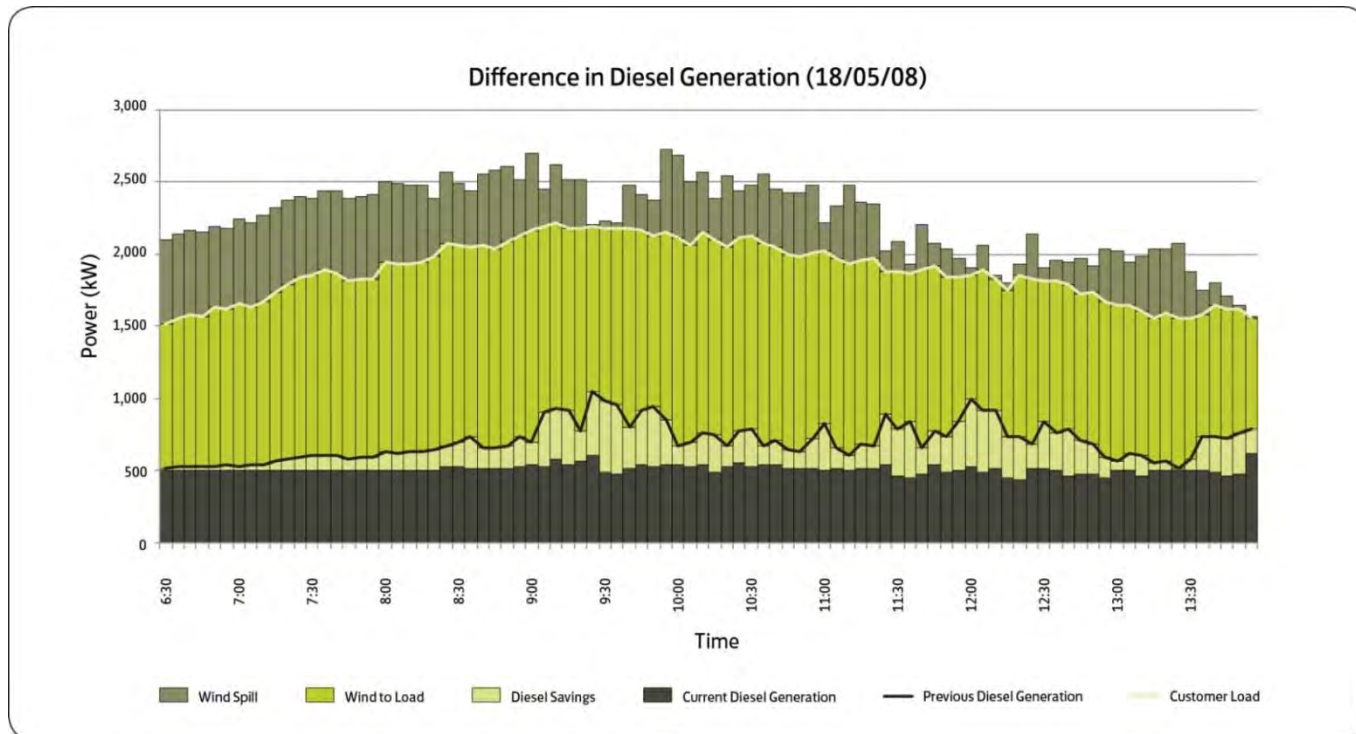


- Resistive elements artificially increase the load: convert excess to heat
- Load balance is maintained (dynamically by resistors) – fast /accurate
- More RE is utilised – more diesel savings
- Diesel generators are protected

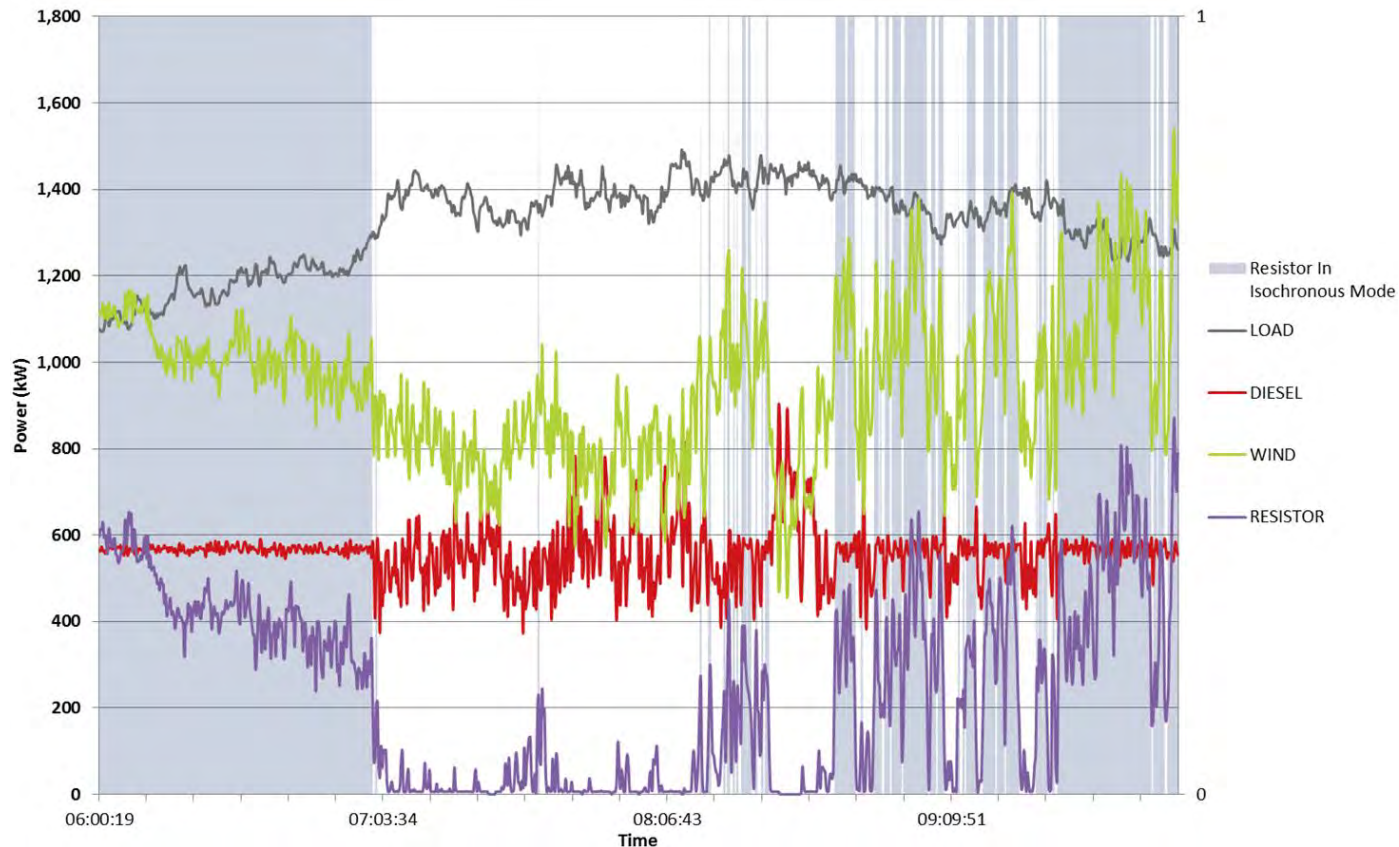
Dynamic resistor

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



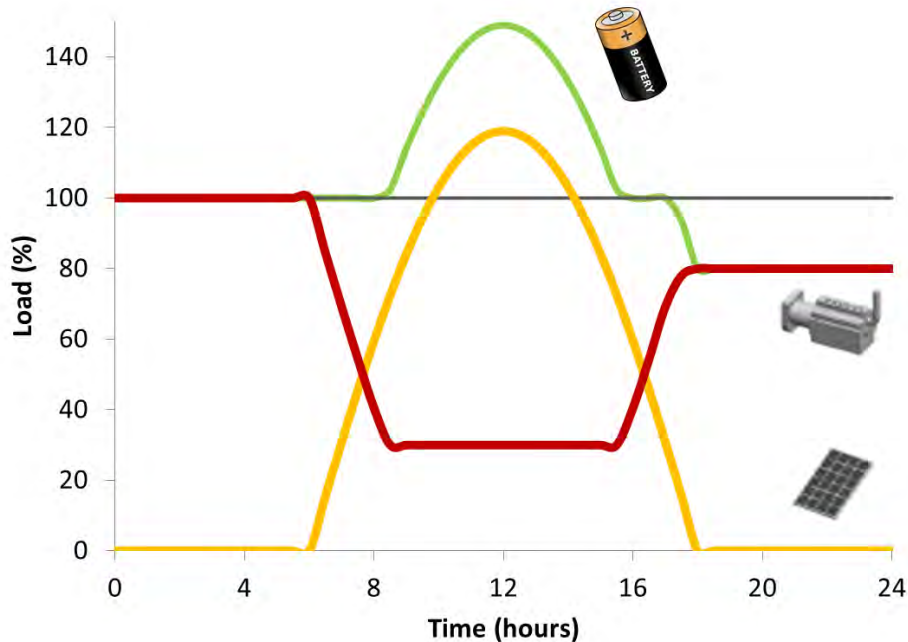
Dynamic resistor operation



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

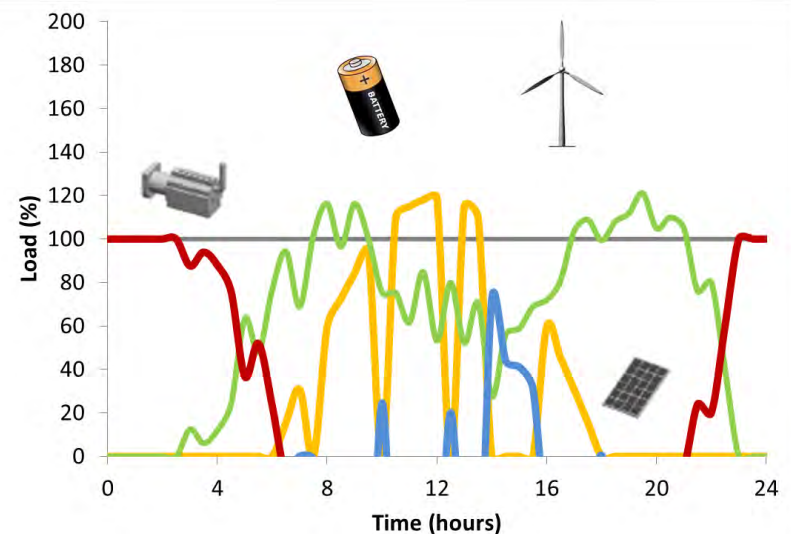


King Island flywheel – supports system without diesel generation

Having to operate diesel generation is key barrier to RE utilisation

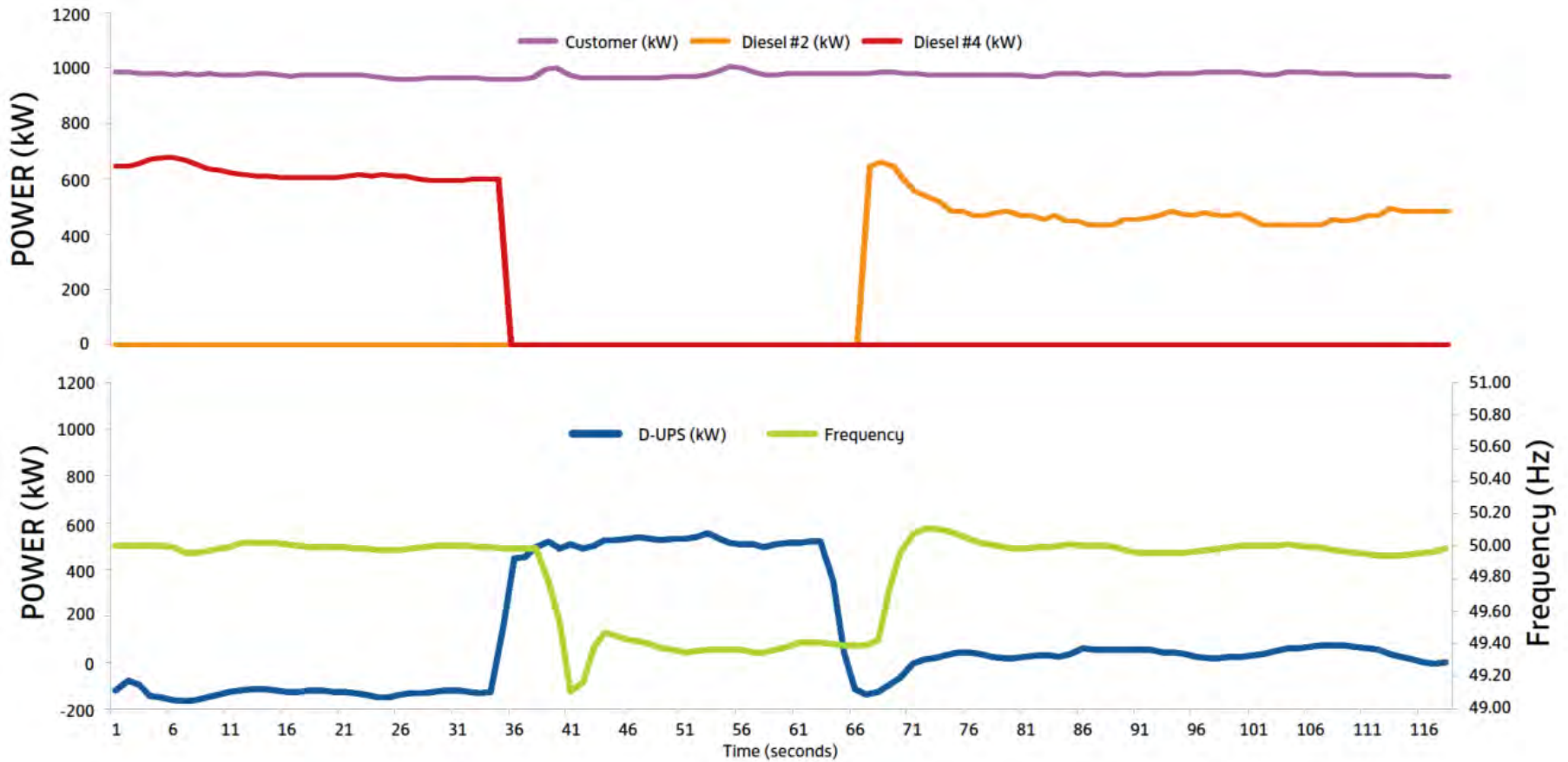
100% penetration systems require:

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



D-UPS provides system security

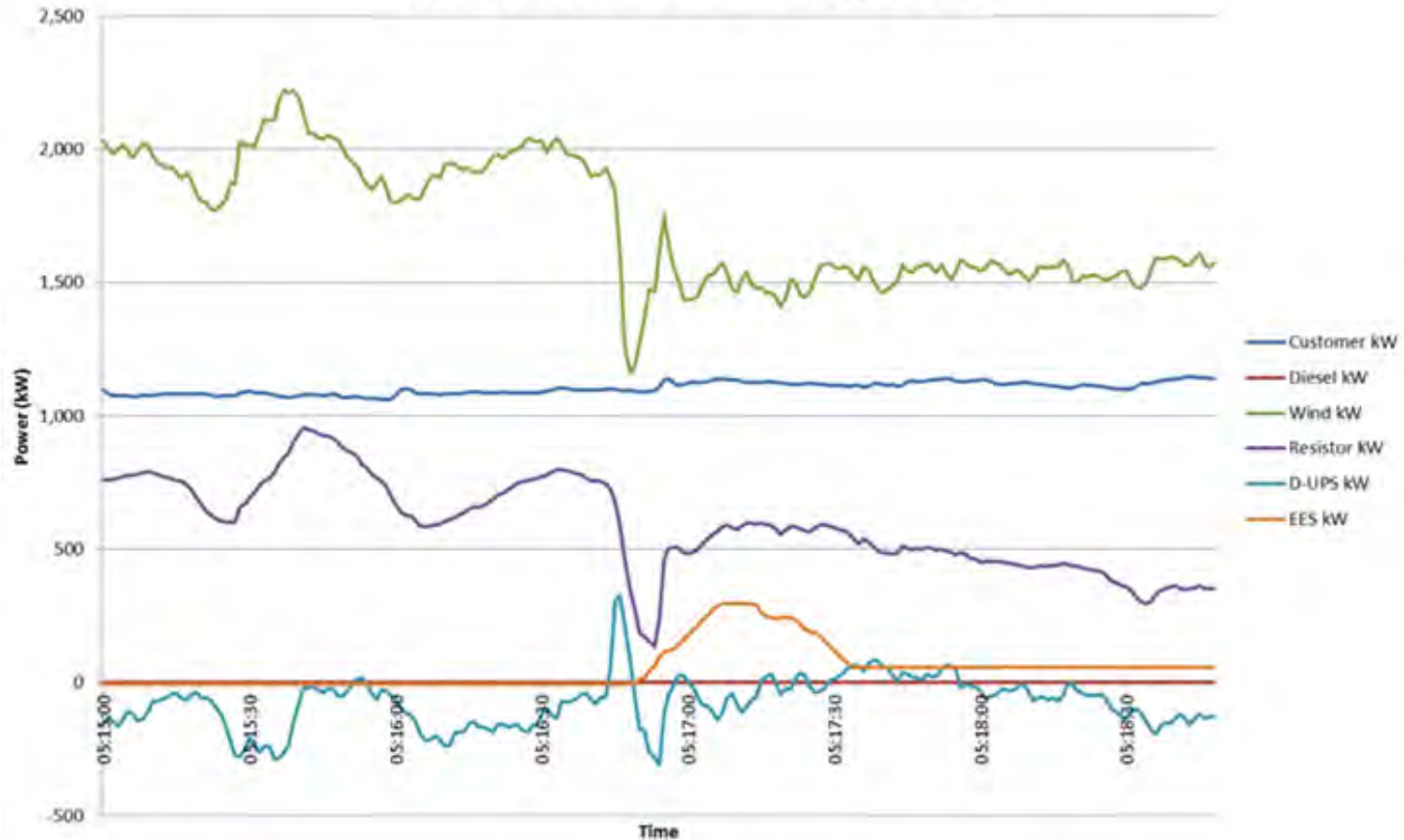
“catches” system when diesel fails (as example)



Enabling systems integrated as one

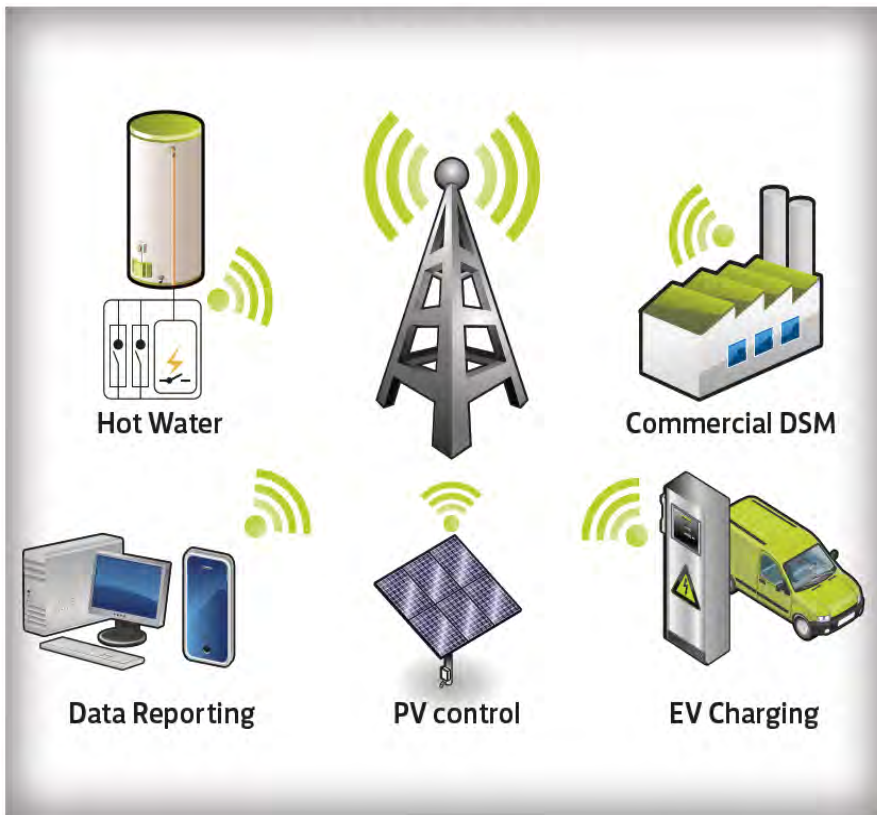
Highly secure, stable system – supports renewables

System Response to WTG trip during ZDO



2014 - Demand management

Further optimise RE utilisation by altering demand to match available RE generation (another option)

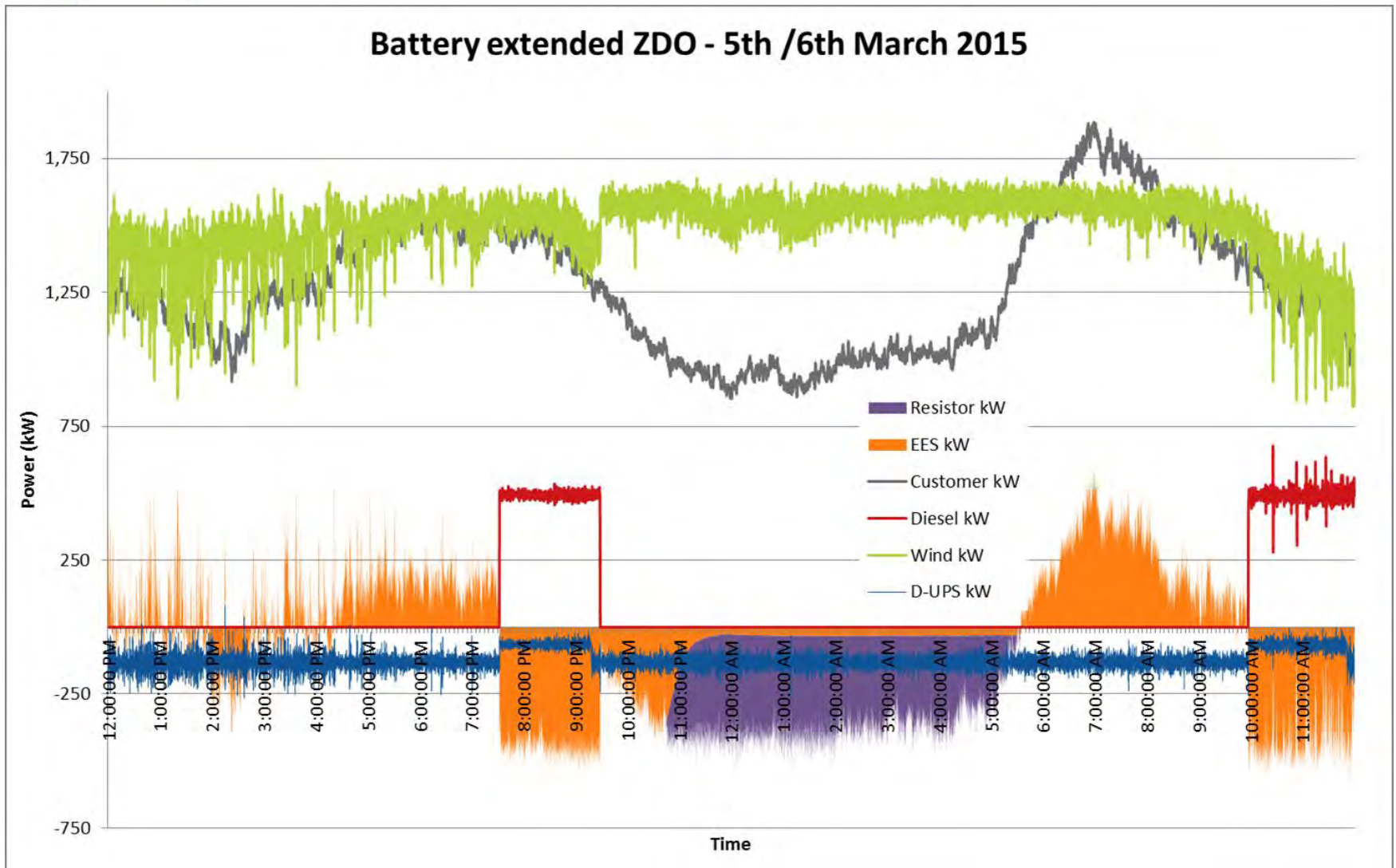


- Aggregates controllable customer load to help balance demand / supply during high RE contribution and variation.
- Fast load shedding , smart EV charging, smart solar PV switching
- Monitoring customer load and providing data to customers via smart phone app.



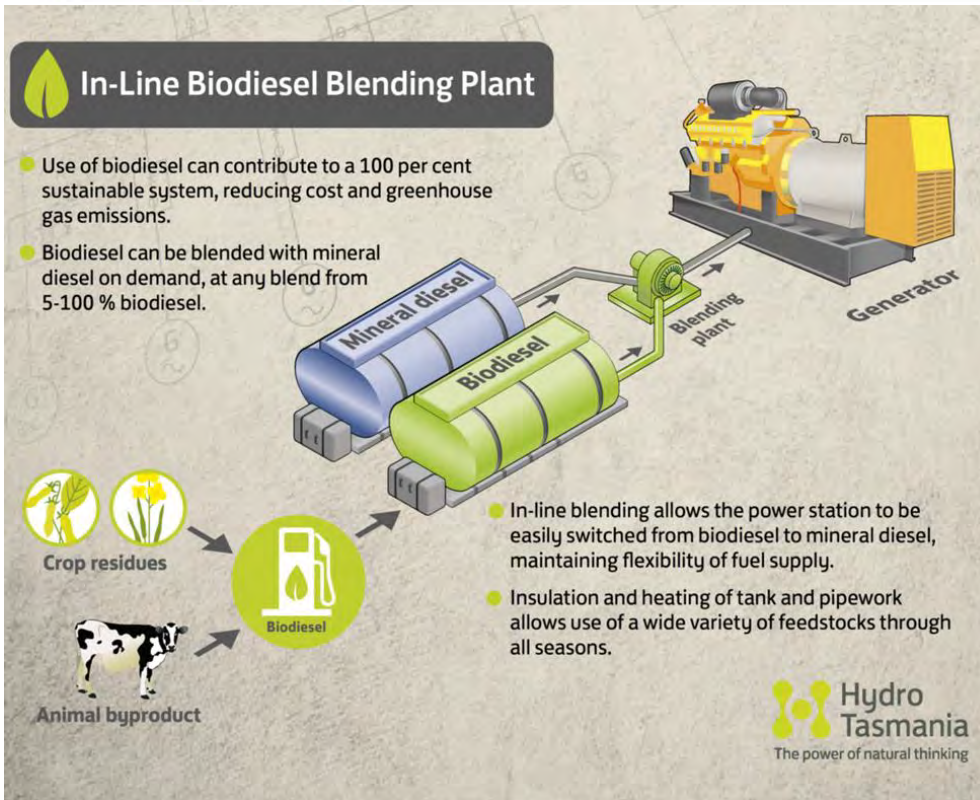
2015 – King Island System Operation

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

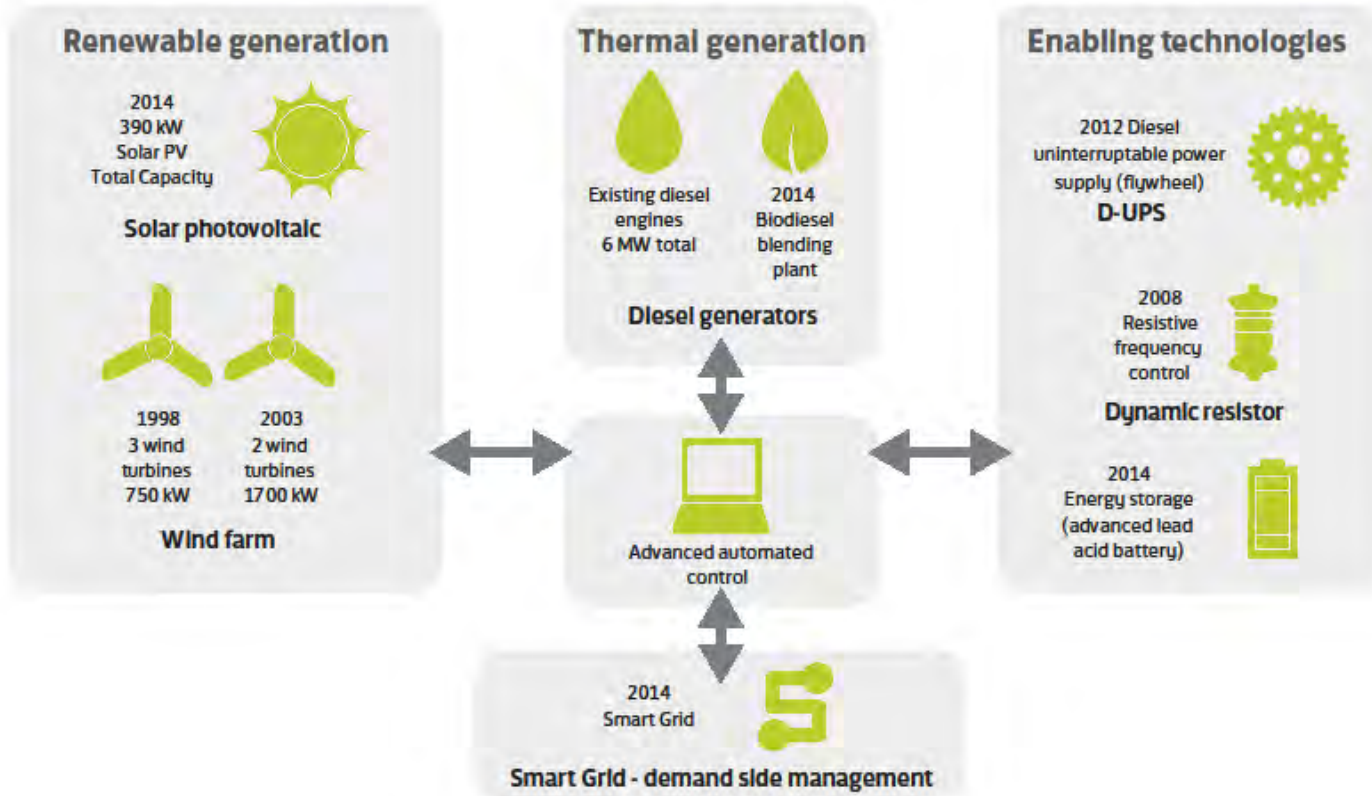


2015 - King Island System

Proven, robust, reliable MW class hybrid system
Result of planned, coordinated activity

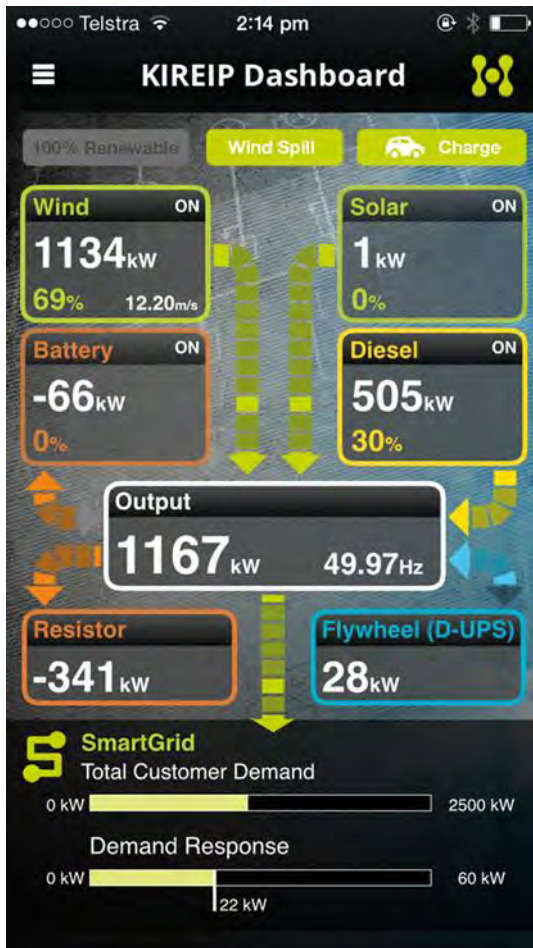
> \$24m in diesel savings (>\$2m per annum)

> 800 hrs of diesel off operation



King Island app & web site – real time data

www.kingislandrenewableenergy.com.au



Hydro Tasmania
The power of natural thinking

King Island Renewable Energy Integration Project

Project Information | History | Hybrid Off-Grid Power Systems | News | King Island Community | Links | App | Contact

Nearly 100 years ago Hydro Tasmania embarked on a clean energy journey, becoming one of Australia's leaders in renewable energy development.

Today, we continue our proud history of clean energy with the King Island Renewable Energy Integration Project (KIREIP).

[Find out about King Island's energy journey here >>](#)

Recently completed, KIREIP, has one main goal – increase renewable energy generation and reduce dependence on fossil fuels. Ideally, renewables will provide over 65% of the annual energy demand and when conditions allow, 100% renewable energy use.

To achieve this, the project brought together a portfolio of new and existing technologies. KIREIP will also reduce emissions and ensure the quality and reliability of power supply on the island. [See the details of the project >](#)

KIREIP gives a glimpse of the possible future of renewable energy – a way renewable energy can work with enabling and storage technologies in a hybrid off-grid power system. The project will also contribute to the development of renewable energy for the wider Australian National Electricity Market.

[Find out more about off-grid systems >](#)

Live data - King Island Advanced Hybrid Power Station

Source	Status	Power (kW)	Percentage
Wind	ON	574	40%
Solar	OFF	0	0%
Battery	OFF	-6	0%
Diesel	ON	865	60%

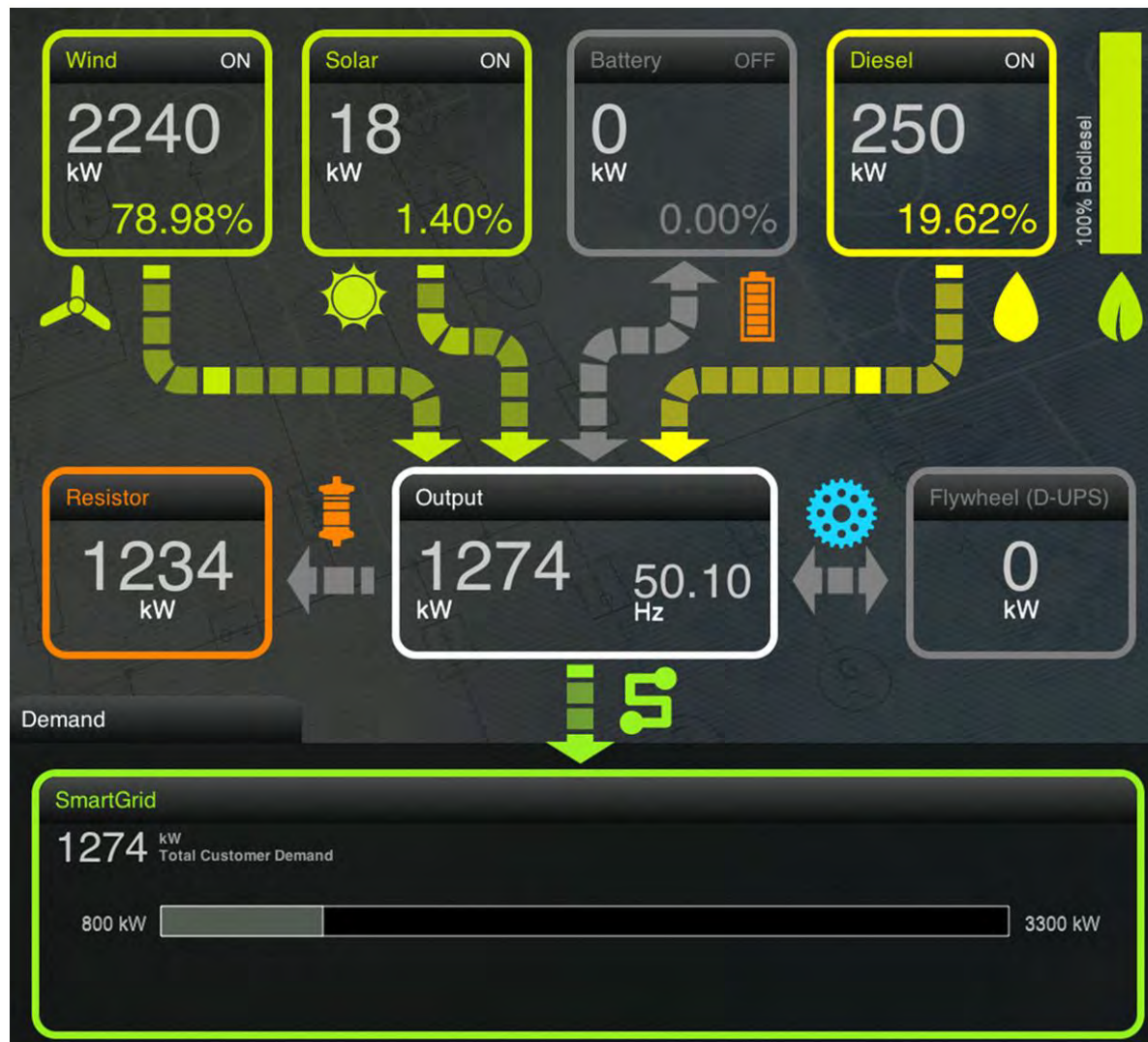
Output: 1433 kW, 49.98 Hz

Resistor: 0 kW

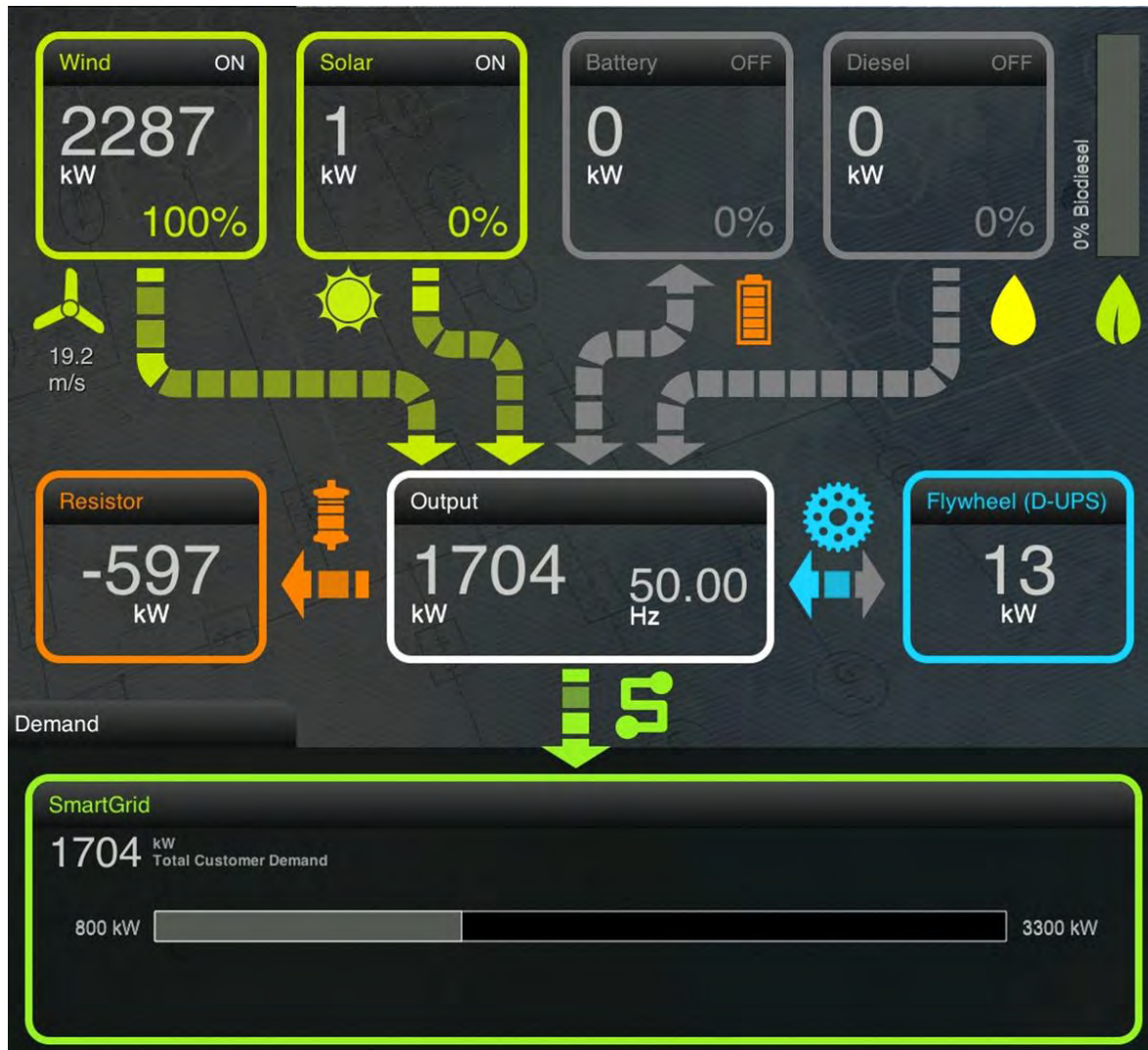
Flywheel (D-UPS): -54 kW

SmartGrid
Total Customer Demand: 0 kW to 3500 kW (1433 kW shown)
Demand Response: 0 kW to 100 kW

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

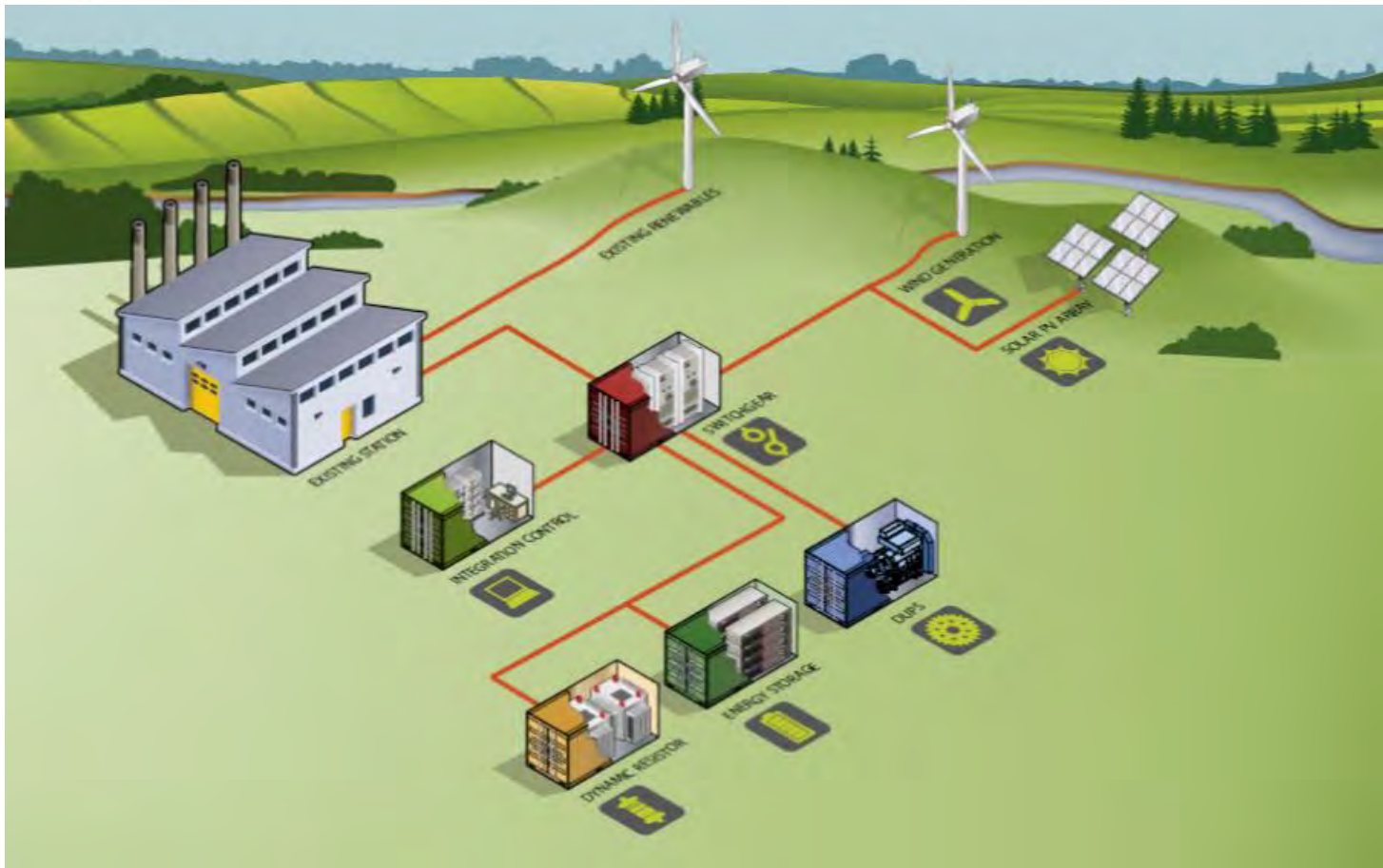
Integration activities traditionally costly and time consuming



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:

Hybrid Off-Grid Solutions

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“KIREIP” iPhone app