



## Renewable Energy Integration into Island Grids King Island Case Study

Simon Gamble  
Manager Small Renewable Asset Development

# Hydro Tasmania

## Overview



- Government Business Enterprise
- Australia's largest clean energy producer:
  - \$5.1 billion worth of assets,
  - 2,281 MW of hydro-electric capacity in Tasmania,
  - 45% of Australia's renewable energy generation.
- Over 900 employees
  - 350 strong consulting business *Entura*.
- Revenue earned through trading electricity and energy products in the National Electricity Market.
- Electricity retail business *Momentum*
- Other assets - Bass Strait Islands.

# Hydro Tasmania

## Remote Area Power Systems (RAPS) Capability



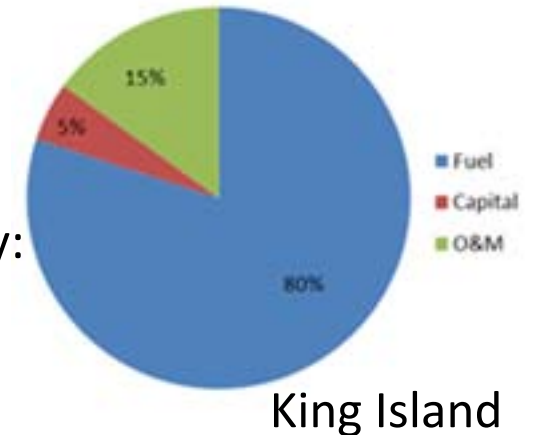
Hydro Tasmania – significant expertise in RAPS:

- Government utility responsible for generation, distribution and retail in the Bass Strait
- Developer, Owner and Operator of world leading RAPS on King Island
- Leading consultant to Multi-lateral Agencies and Utilities on RAPS design
  - Pitcairn, Chatham, Cape Barren
- Suite of mature RAPS products
  - Control systems
  - Integration of enablers (eg Storage)
  - Renewable Energy (RE) technologies
    - Wind, PV, Hydro, Biodiesel

# Hybrid Renewable Energy RAPS

## Market Drivers

- Most islands rely on small to medium diesel based power supplies
  - Reliable, Low capital cost, mature, simple ➤ HIGH COST
- Demand for Hybrid Renewable Energy based RAPS driven by:
  1. REDUCTION IN UNIT COST by displacing diesel
  2. Improving services, reducing GHG



- Adding Renewable Energy is challenging, adds complexity
  - Managing variability, intermittency – requires advanced control, enablers
- Hybrid RE RAPS development is now commercially attractive:
  - Increasing maturity and cost competitiveness of RE technologies;
  - Sustained high oil (diesel) prices – recovery post GFC;
  - Government support – policies and funding;

# King Island

## Renewable Energy Integration into an Island Grid

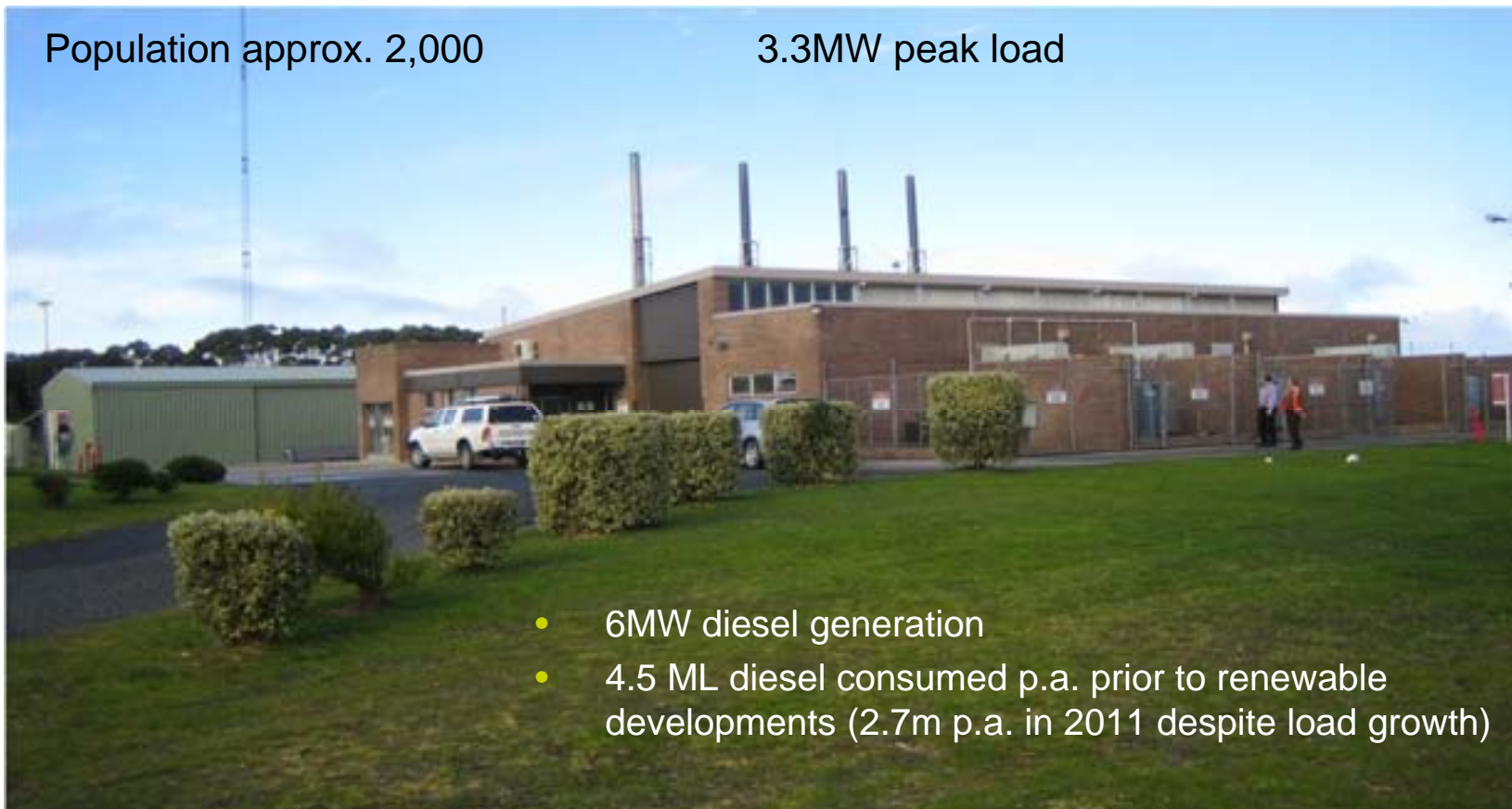


# King Island

## Achievements to Date

Population approx. 2,000

3.3MW peak load



- 6MW diesel generation
- 4.5 ML diesel consumed p.a. prior to renewable developments (2.7m p.a. in 2011 despite load growth)

1998 - first wind farm  
15% reduction in diesel



2003 – 2<sup>nd</sup> wind farm  
33% reduction in diesel  
(with control and VRB)





# 2003: 800kWh Battery Project

## Vanadium Redox Battery (VRB)



# 2008: 100kW Solar PV

## King Island Solar Pty Ltd

6 dual axis tracking panels totalling 100kW (contributes ~1% of supply)



# 2010: Dynamic Resistive Frequency Controller (DRFC)

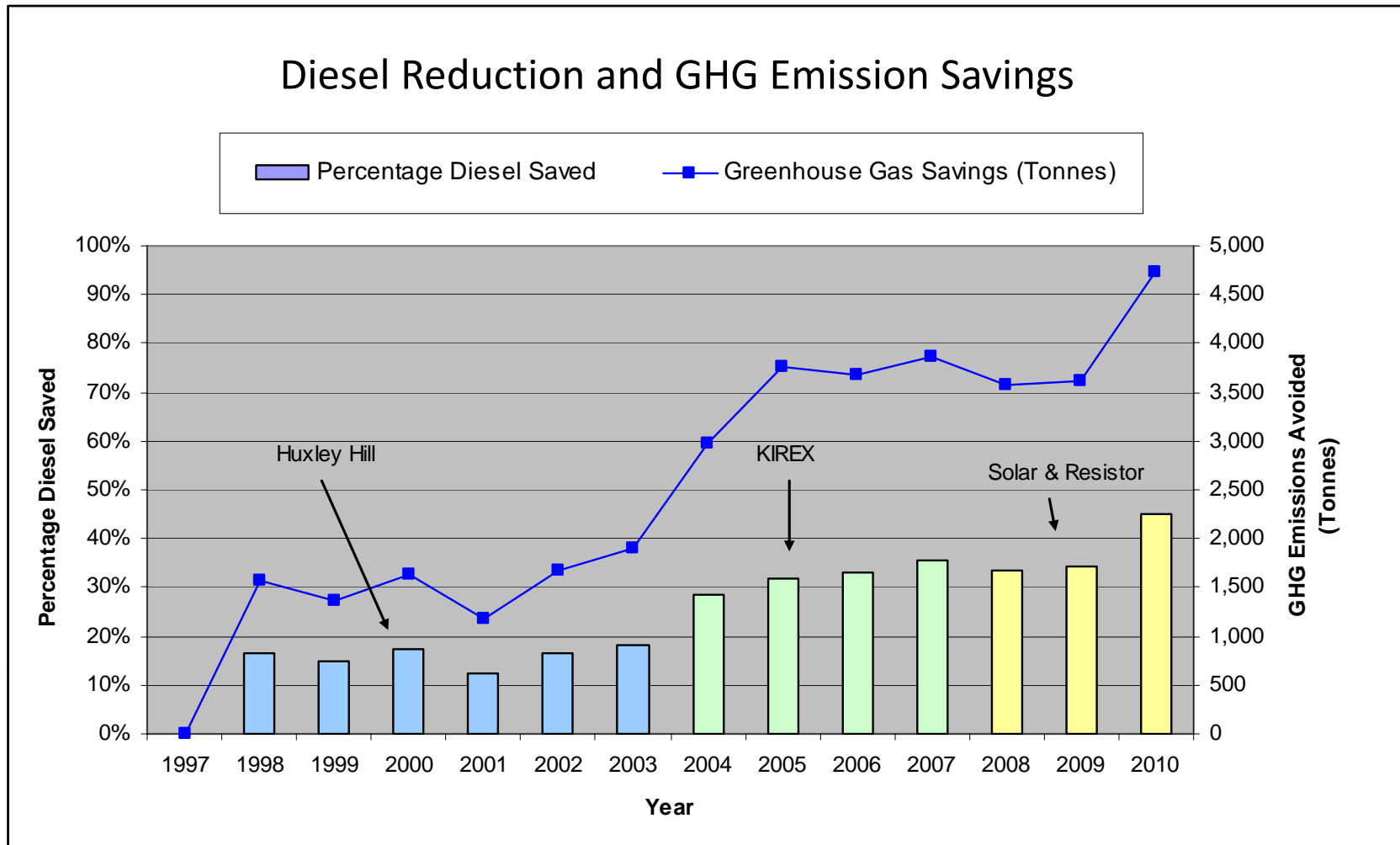
- Resistor converts wind spill to raise / lower reserve
- Allows diesels to generate at minimum load
- Controls system frequency



# King Island

## Achievements to Date

### 45% Diesel and CO2 reduction per annum

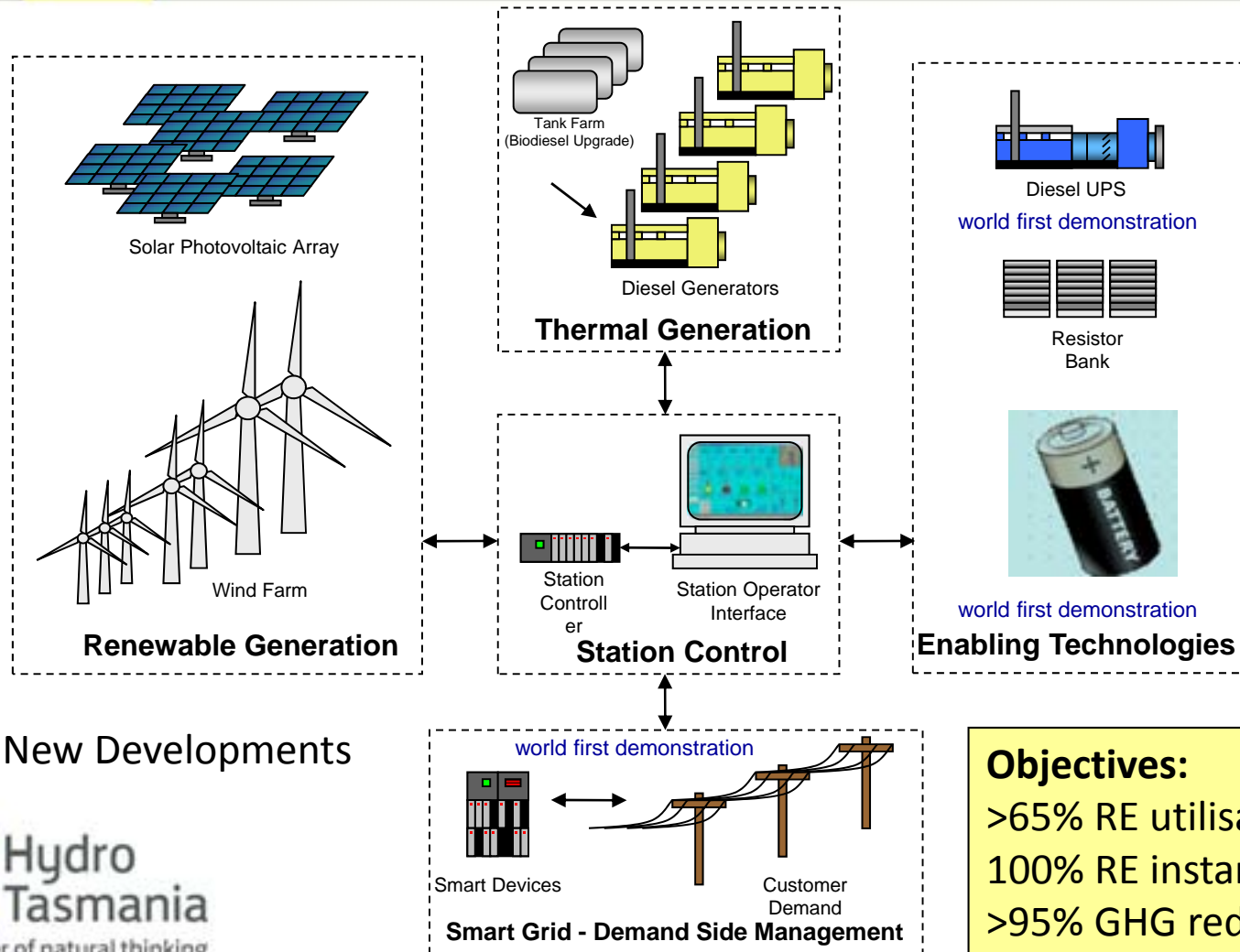


# King Island Current Projects

## KIREIP: 2010 – 2013



Australian Government  
Department of Resources  
Energy and Tourism



New Developments

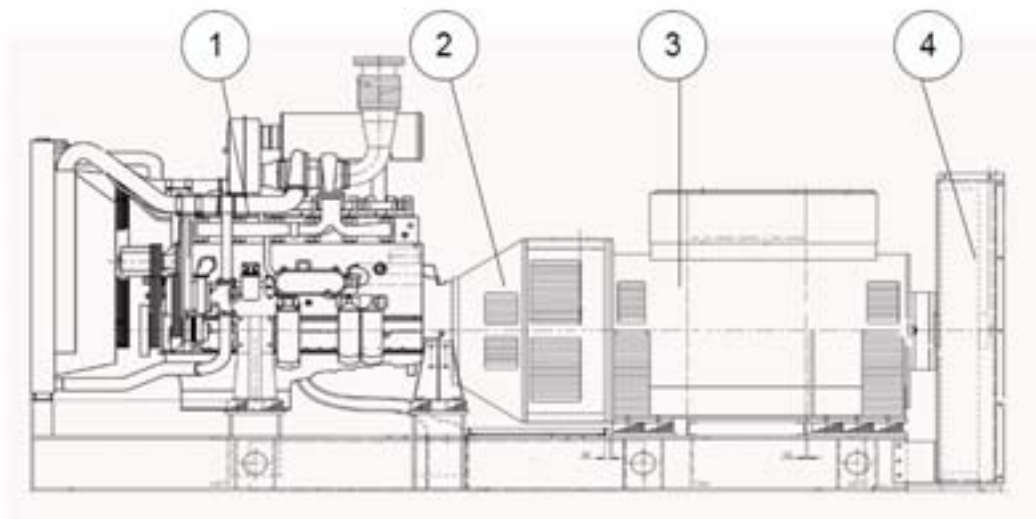


**Objectives:**  
>65% RE utilisation  
100% RE instantaneous  
>95% GHG reduction

# KIREIP : Diesel UPS

## Mid 2012 Completion

- Provides functionality to support the further addition of renewable energy and energy storage
- Integrated flywheel and generator unit
- D-UPS (combined with DRFC) provides the functionality of conventional diesels without the continuous fuel cost - Zero Diesel Operation (ZDO)



1. Diesel engine
2. Electromagnetic Clutch
3. Synchronous Motor/Clutch
4. Flywheel

# KIREIP: Diesel UPS

Physically installed May 2012



# KIREIP: New Energy Storage Role on King Island

- Existing VRB is no longer operational – need to replace
- New battery will store energy when there is an excess of wind, release energy when there is a shortfall, instead of using diesel generators :
  - Sustain ZDO
  - Load shifting





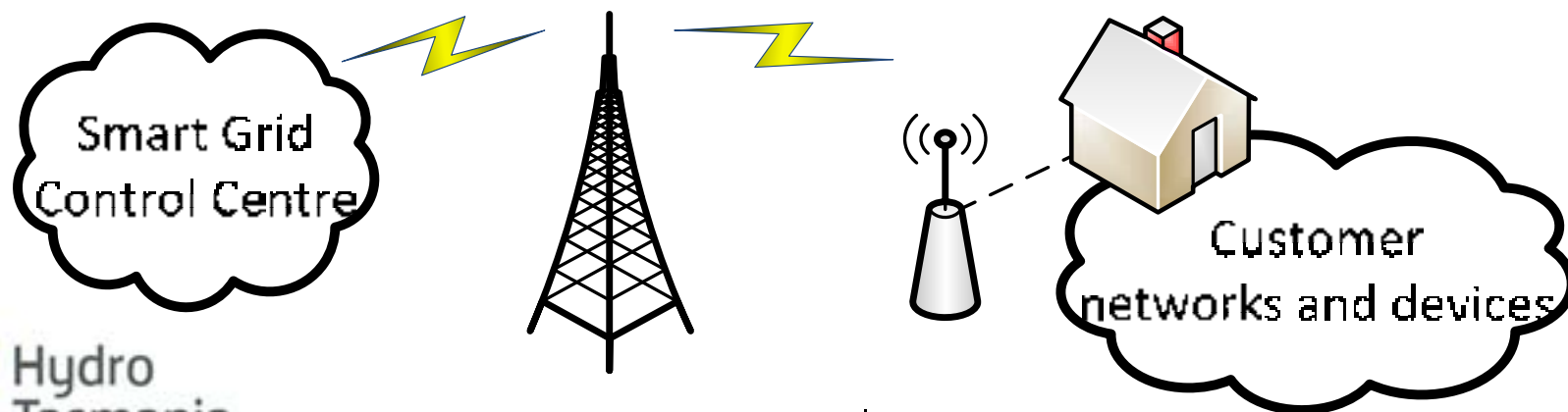
# KIREIP: New Energy Storage Modular Options (examples)



# KIREIP: Smart Grid

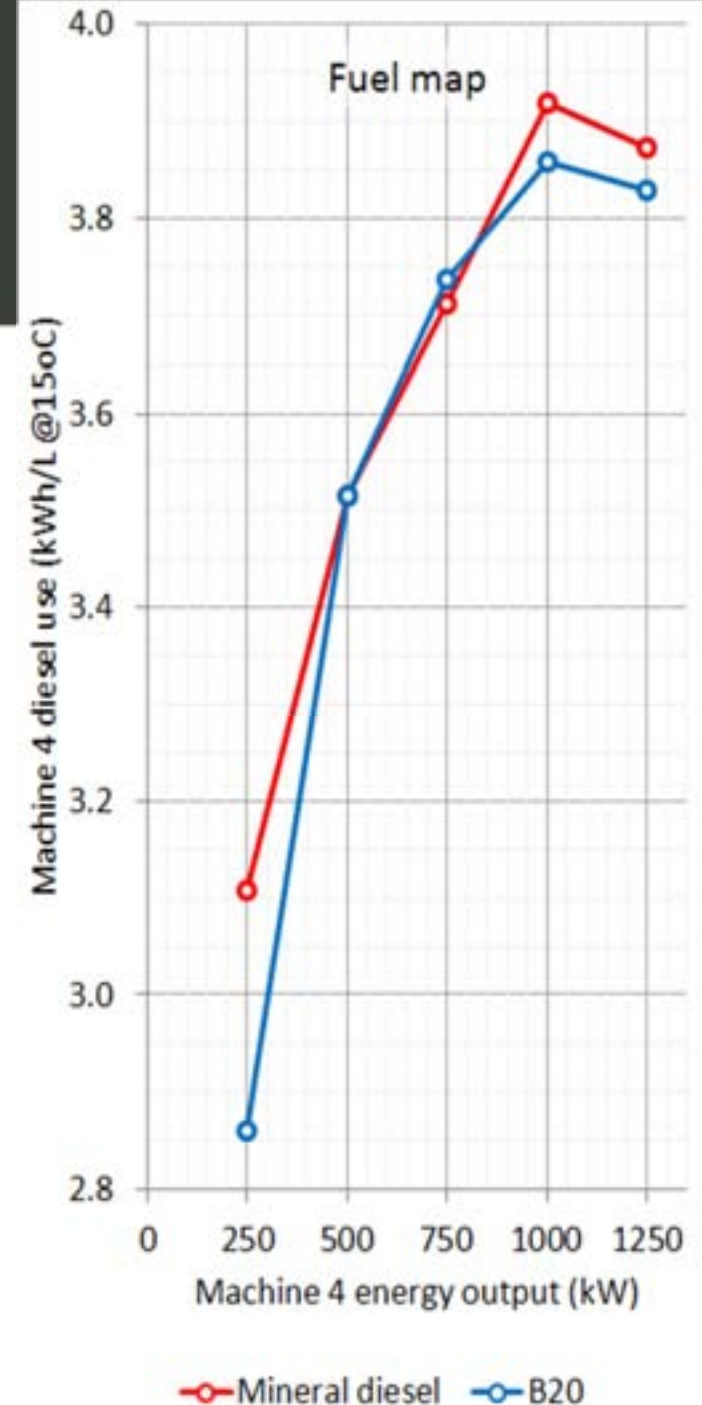
## Assisting RE Integration via Demand Response

- Assist with balancing generation (supply) with customer use (demand)
- Work with customers and community to introduce ability to alter power use
  - Alter load to better match available renewable energy
    - Rapid and short-term – eg reduce hot water heater demand for a few minutes when wind drops;
    - Longer – eg increase demand when an excess of wind energy;



# KIREIP : Biodiesel Trial Progress

- To Identify show stoppers
  - Engine damage
  - Machine de-rating / reduced response
- To Identify equipment modifications
  - Fuel filtration, Fuel heating
- Test the supply chain
- Investigate licensing and accreditations
- Test economics



# KIREIP: Community Engagement

Community Info Night (31<sup>st</sup> Oct 2011)



Smart Grid Workshop (12<sup>th</sup> Dec)





Nearly 100 years ago Hydro Tasmania embarked on a clean energy journey, establishing one of Australia's earliest in renewable energy developments. 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 >

The next step, 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% instantaneous renewable energy generation.

To achieve this, the project brings together a portfolio of new and existing technologies to increase renewable energy use on King Island. KIREIP will also deliver reduced 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 mix of renewable energy can work with energy storage technologies in a Stand Alone Power System (SAPS). The project will also contribute to the development of renewable energy for the wider Australian National Electricity Market. Find out more about SAPS >

KIREIP is an initiative of Hydro Tasmania and is being developed with the assistance of the Australian Government's Renewable Energy Clean Transition Program and the Tasmanian Government.

Combined  
Renewables

1078 kW

Customer  
Load

2309 kW

Wind Speed  
20.6 kts

Wind  
1049 kW

Solar  
30 kW

Resistor Load  
0 kW

Diesel Generation  
1202 kW

Station Load  
2266 kW

Station Power Usage  
43 kW

Estimated Fuel Consumption  
330 litres p/h

As at 11:00 AM (AEST) 2015



View a diagram representation of our existing system and proposed new developments >

#### Contact

Post Box  
King Island Advanced Hybrid Power Station  
GPO Box 35, Hobart, Tasmania 7501, Australia  
Phone: [+61 8 9333 3333](tel:+61893333333)  
Email: [kireip@hydro.tas.gov.au](mailto:kireip@hydro.tas.gov.au)

View Staff Contacts List >

#### Latest News

- [Welcome to KIREIP >](#)
- [New & Stand Alone Works Commence >](#)
- [King Island Renewable Energy Integration Project Officially Launched >](#)

[www.kireip.com.au](http://www.kireip.com.au)

# Conclusions:

## Renewable Energy Integration into Island Grids

- Hydro Tasmania has proven that renewable energy technologies can reduce cost of island energy supply by reducing the consumption of diesel fuel
  - Renewable Energy Integration is KEY
- “Off the Shelf” solutions available today – deliver up to 30% diesel savings
- Next generation of solutions are now being commercialised (>65% savings)
- World leading projects such as King Island will demonstrate pathway to full Renewable Energy based systems – to eliminate dependence on diesel fuel
- The King Island showcase can assist island asset managers better understand solutions that are available – come and visit!
- Hydro Tasmania can assist with advisory services (Entura), training and implementation of world leading renewable energy based RAPS

## Further information:

Simon Gamble

Mgr Small Renewable Asset Development

Hydro Tasmania

[simon.gamble@hydro.com.au](mailto:simon.gamble@hydro.com.au)