Preparing for 100 % Renewable Energy

Pacific Power Association Conference 2017

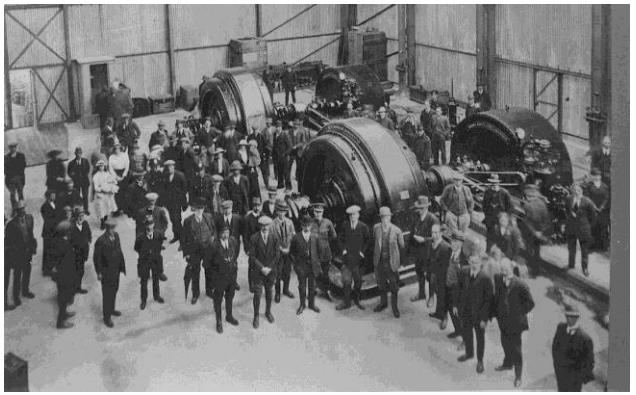
Who we are

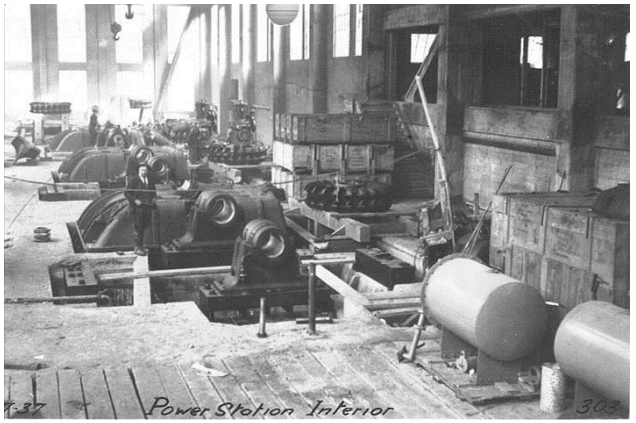
GBE owned by people of Tasmanian

Turned 100 in 2014

Australia's largest Clean Energy producer

- >2,200 MW of hydro generation
  - 30 Powerstations, 59 major dams
- Construction and part owner of large windfarms
- Owner, Operator, Retailer of Hybrid Power Systems
- Advice, design and project implementation in Pacific





Our Brands

Hydro Tasmania

entura
Hydro Tasmania

momentum
energy

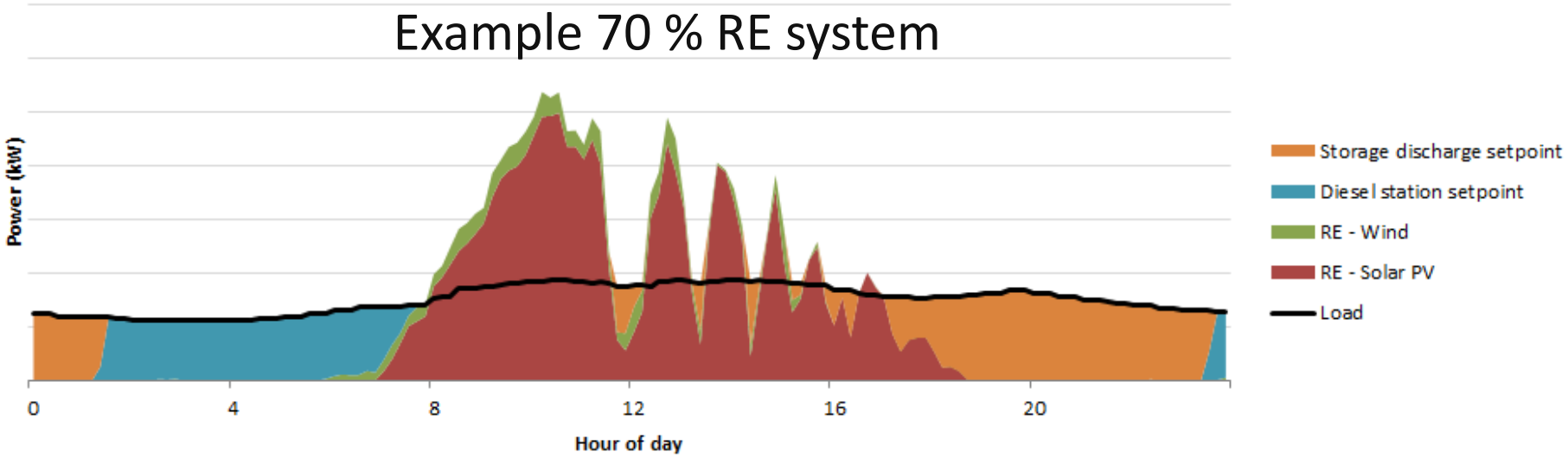
What does 100 % RE contribution look like?

All energy must come from renewables

Typically achieve 40 % to 70 % RE, then rest with biofuels

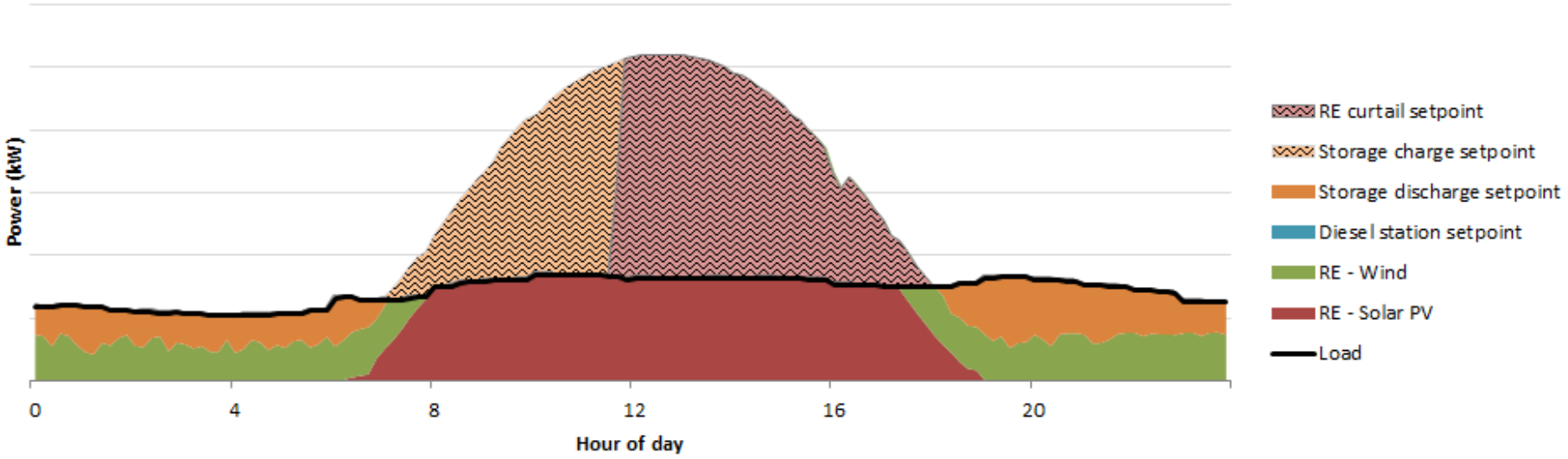
Optimal system very situation dependent on:

- Wind and solar mix
- Access to hydro and biofuels
- Commercial realities



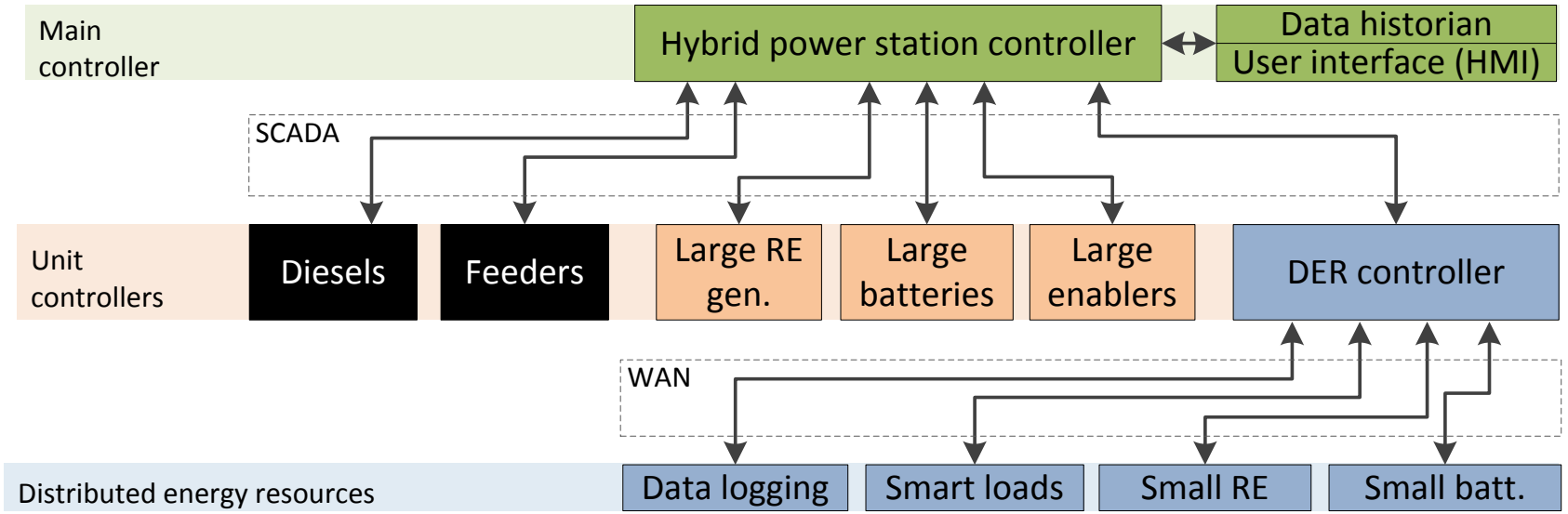
Dealing with excess RE energy

Excess energy goes to batteries	→	What if they are full or faulty?
Absorb at power station	→	How much did you pay for this energy?
	→	Will feeders overload?
Curtail at source	→	How fast is the control path?
	→	What are the commercial solutions?



Specifying a control system

- Less control coordination = more enabler hardware
- Quality control system cost << RE generator cost



- Fast and reliable SCADA to link unit controllers
- Wide Area Network (e.g. 4G) to control & monitor DER

Enablers

Supply & demand must balance at millisecond resolution, during:

- Normal operation → RE and load ramping
- Contingencies → RE, feeder and enabler trips
- Short circuit → Protection scheme operation

Enablers must replicate **ALL** diesel generator functions for 100 % RE to be possible

Type	Examples	Strength	Weakness
Rotating generators	Diesel UPS	• Inertia • Operates grid protection scheme • Simple	• Losses
Power electronics	Battery	• Configurable grid support • Large energy storage	• Poor 'inertia' during short circuit • Zero diesel not proven for large grids
Controllable loads	Resistor	• Easily sink excess energy • Low cost hardware	• Surplus energy must be cheap

Energy storage

Why?	→	Value add to RE spill, be clear on role
Roles?	→	Grid control, replace some diesel functions
	→	Energy shifting
	→	Power electronics distributed grid support
Where?	→	Some at power station, rest at RE generation
Life?	→	Calendar life often short, aim to use all of cycle life
	→	Roles change at different % RE with new enablers
From who?	→	Know what you need, have realistic expectations
	→	New technology procurement is DIFFERENT
	→	Buy something that already works. Test it.
O&M?	→	Need expertise to resolve issues
	→	What happens at cell EOL?

The path to 100% RE

Large grids are a few steps back on the same journey

Good solutions are mindful of:

- Limit uncontrolled generation
- Minimise transitional equipment → obsolete
- Connection standards embrace technology capabilities
- Avoid complex / unproven solutions → high O&M
- Highly targeted incentives only
- New revenue structures to support LCOE solutions
- Balance of private/public ownership and central/de-central config.
- Customer options: embedded networks, batteries, smart loads, EVs
- Community and customer impacts

Ultimately want **happy customers that stay on the grid**!

King Island Renewable Energy Integration Project

- HT EPC
- 100% RE Penetration
- 65% RE Contribution
- Increased System Reliability
- Sub 1 second DSM aggregation
- Happy Operators!
- Successful Customer Engagement
- Test Bed

2.45 MW Wind, 400 kW PV

3 MW / 1.6 MWh BESS

3 MW Dynamic Resistor

2 x 1 MVA D-UPS (Flywheel)

100% Biodiesel Trial

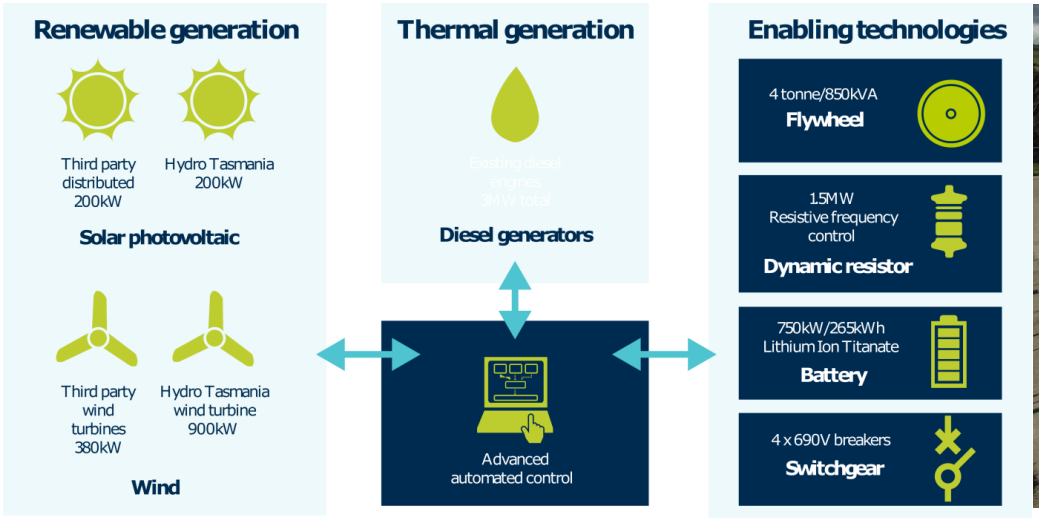
DSM Smart Grid

Hybrid Controller

http://www.kireip.com.au/

Flinders Island Hybrid Energy Hub

Hydro Tasmania

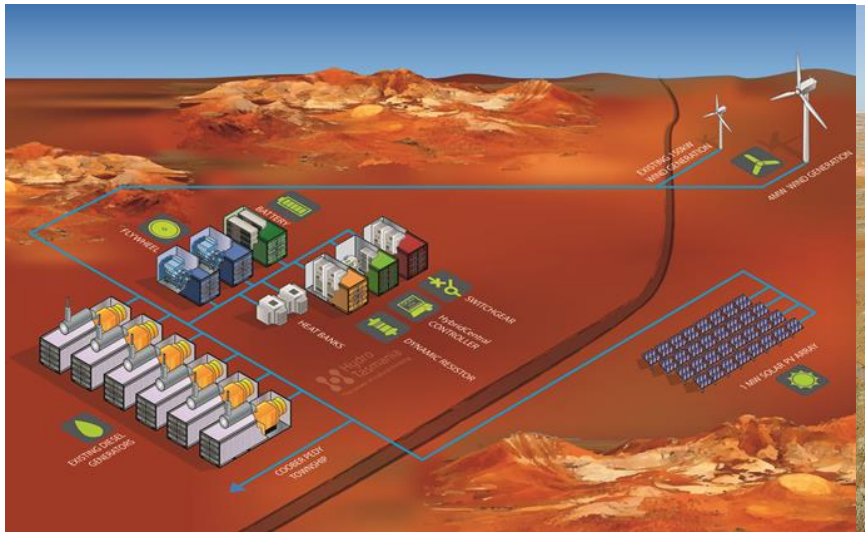


Scalable modular systems capable of low cost rapid deployment

- HT EPC
- Modular Solution
- Test off site
- Strong Community Engagement
- Whole of system Hybrid Control Upgrade
- Undergoing Final Commissioning
- 100% RE Penetration
- 60% RE Contribution

Australian Government
Australian Renewable Energy Agency

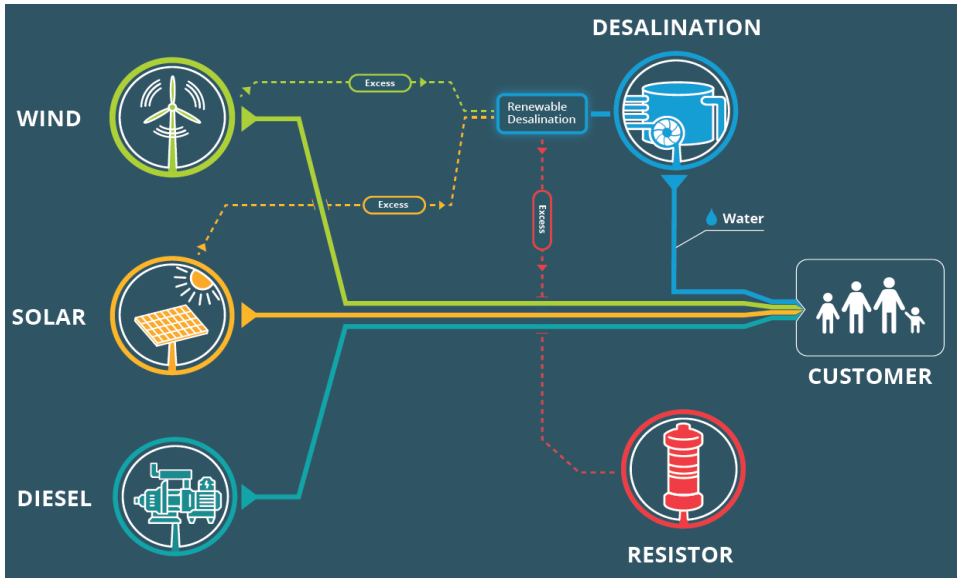
Coober Pedy Renewable Hybrid Project

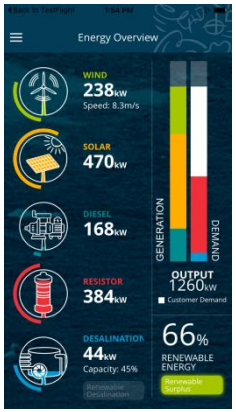


- **HT Design, Owners Eng, Supply of**
  - D-UPS, Dynamic Resistor, LV-HV Switchgear, Hybrid Control
- **70% RE Contribution target**
- **100% Penetration**
- **Hybrid Control 'talks to' Existing Diesel Control**
- **Multiple Party Interfacing – Physical and Control**

Rottnest Island Water Renewable Energy Nexus

Hydro Tasmania





- HT EPC
- Finalisation activities underway
- 45% RE Contribution
- Integrates Desal as Energy Storage
- Replace Hybrid Control & Diesel Control
- Extensive Training
- Operator Remote Interface
- Education App

Key points

- Planning is critical, ‘roadmaps’ are a great tool
- Consider the Whole of system, not just individual pieces
- Invest in the right equipment that works, proven, robust, simple
- Training and support must be part of the scope, projects don’t finish at commissioning.
- Implement in sensible steps, with aligned procurement method
- Build backbone to simplify private investment
- Set expectation of Private Sector
- Engage stakeholders early and often.

IPS Connect

Thank You

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