ENERGYANDMINES
AUSTRALIAVIRTUALSUMMIT
AUGUST 4-6, 2020
RENEWABLESFORMINES

entura

THE BALANCING ACT FOR OFF-GRID RENEWABLE SOLUTIONS:

What over 20 years of designing and operating hybrid systems has taught us

Akhil Pai & Ray Massie

2020

WE OWN. WE OPERATE. WE CONSULT.

THE HYDRO GROUP

Hydro Tasmania

Australia's largest renewable energy producer and water manager, operating for more than 100 years
Government Business Enterprise, owned by the State of Tasmania.

- $6.0 billion worth of assets
- 2 653 MW of hydropower installed capacity
- Produces 9 000 GWh of clean renewable electricity from hydropower each year
- Part-own 300 MW of wind capacity in Tasmania

Generates electricity from renewable sources and trades on the National Electricity Market

entura

One of the world's most experienced specialist power and water consulting firms
Partners with clients to deliver practical and commercially sound solutions across the whole lifecycle of power and water assets
Consulting services covering every aspect of major power and water projects, from strategy, planning, design and construction through to operation, maintenance, risk management and training

momentum energy

A growing gas and electricity retailer dedicated to making energy simple for customers. Servicing 220,000 residential and small businesses sites and 6,000 commercial sites across VIC, SA, NSW, ACT and QLD. Ranked top Australian gas and electricity supplier in 2018 by Canstar Blue

WHAT MAKES US UNIQUE IN THE POWER BUSINESS?

- One of the world's most experienced specialist power and water consulting firms
- Part of the Hydro Group - backed by more than 100 years of creating energy and maintaining power and water assets
- Services covering every aspect of major power and water projects, from strategy, planning, design and construction through to operation, maintenance, risk management and training
- Over 230 staff; expanding business opportunities nationally and internationally

- Remote area power systems
- Hybrid Control Systems
- Wind power
- Solar power
- Hydropower
- Pumped storage hydropower

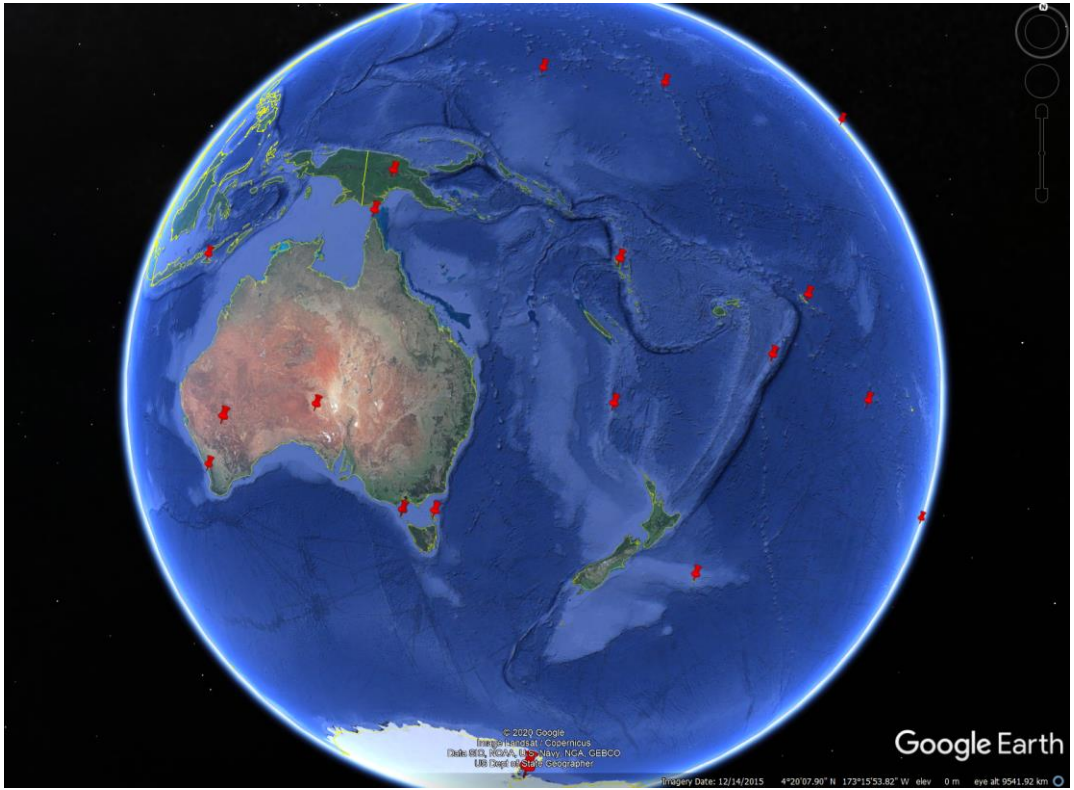
- Substations
- Transmission and distribution
- Power systems
- Testing and commissioning
- Automation and SCADA
- Generator connection

- Dams
- Water infrastructure, planning and optimisation
- Supply infrastructure
- Flood management

entura

WE OWN. WE OPERATE. WE CONSULT.

SOME OF ENTURA HYBRID PROJECT ACTIVITY



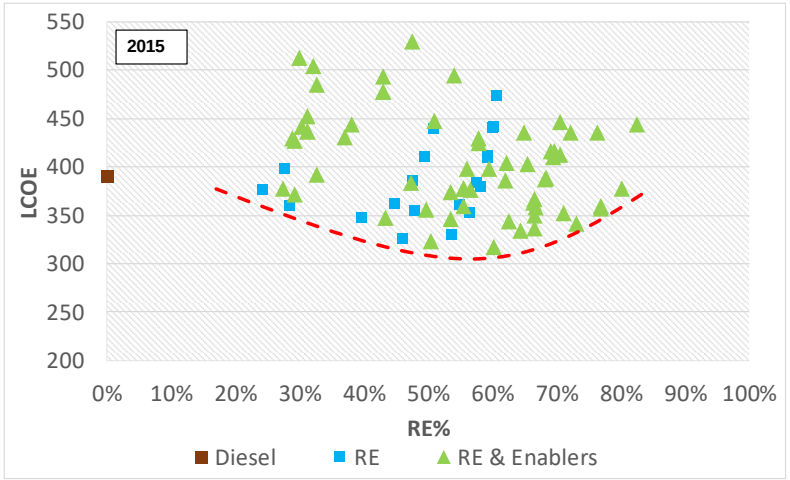
Including

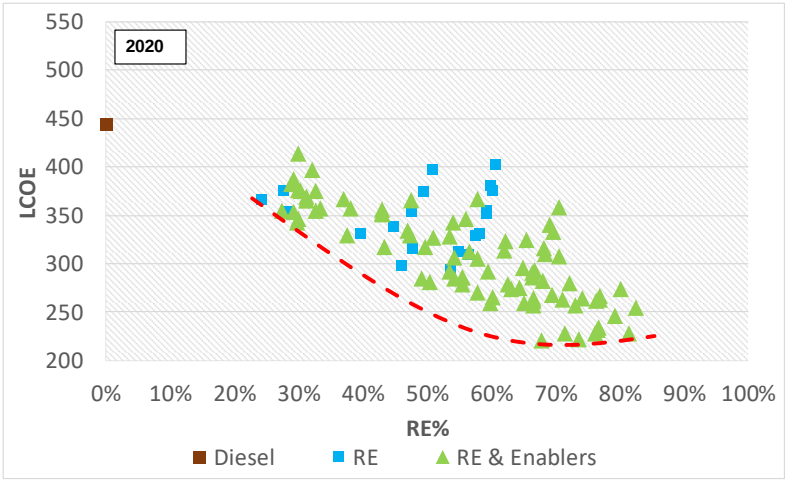
- King Island
- Flinders Island
- Coober Pedy
- Rottnest Island
- Agnew Gold Mine
- Antarctica
- Indonesia
- Pacific
- PNG

entura

WE OWN. WE OPERATE. WE CONSULT.

WHY ALL THE HYBRID POWER INTEREST





Demonstration based projects & Grants

Private Sector Commercial Interest

entura

WE OWN. WE OPERATE. WE CONSULT.

SO IT'S EASY NOW THEN? YES.... and NO.

New Player Knowledge Gap

- Mining Industry earlier on learning curve compared to Power Utilities but with arguably a smaller risk appetite
- Increasing number of IPP & Financer parties without necessarily 'runs on the board'.
- Supplier interest increasing but without the experience full integration understanding.
- All good for competition, but differing levels of knowledge.
- 'Traps' still for new and existing players contractually & technically particularly with multiple counter parties

Technical Challenges still

- Gas engine response times and operational levels differing to diesel, largely used to date
- Multiple suppliers not familiar with hybrid integration challenges - technical as well as contractual gaps
- Operational experience predominately in traditional thermal plant only across industry – now multiple elements
- Project are still case by case, but approaches merging.

The Key - Integration Integration Integration!

- Need overarching view of hybrid system approach, individual suppliers wont necessarily have.
- Early intervention - Understand what's coming.
- Early Integration view in planning right through to operation - can help bring understanding of options and outcomes

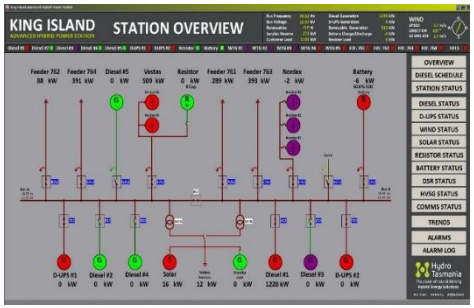
TECHNOLOGY MIX INTEGRATION

- RE can provide cheaper real (kW) power, **not all of the system reliability** requirements alone
- Hybrids rely on the **careful integration of renewable energy** through automated control and enabling technologies.
- **Automated control** – speed of response, ability to deal with system complexity, varying system & element states, future changes, operator experience
- **Enabling technologies support RE** - maintain system stability, security and safety, managed through control
- Spend on technology vs level of **acceptable risk** needs to be understood early
- Available RE **resource understood?**
- **Optimisation** through Modelling – Energy, Economic, Power System
- **Legacy System Integration** more challenging and needs careful consideration
- **Coordinated Collaboration** can help significantly – Customer, OEM involvement Critical, Designer, OE, IPP

Power System Requirement	Generators			Enablers			
	Thermal	PV, Wind, Small Hydro	Large Hydro	BESS	Dump load	Dynamic Resistor	Diesel-UPS, SC, Flywheel
Voltage Control	√	√	√	√	X	X	√
Frequency control	√	X	√	√	X	√	X
Real (kW) power	√	√	√	√	X	X	X
Reactive (kVAR) power	√	√	√	√	X	X	√
Inertia	√	X	√	√	X	X	√
Fault currents	√	X	√	√	X	X	√
Spinning reserve	√	√	√	√	√	√	X

Notes

- BESS Inertia 'synthetic'
- BESS fault current significantly lower than synchronous generators
- RE spinning reserve in significantly high RE cases relative to load.

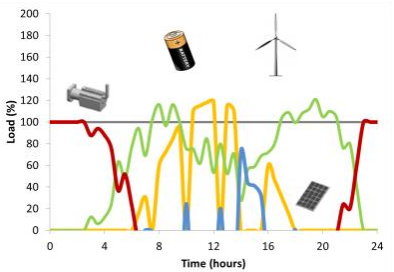


SOME KEY INTEGRATION LESSONS

- Early focus on Ongoing Operating is Critical - include operator experience, contractually
- Test off site & plan for minimum site time - FAT
- Knowledge of Suppliers & Customers still growing – allow time.
  - Customer - Understand Need and get Specification and Contract right
  - Supplier – Understand Complexity of Hybrid Need
- Prices decreasing, functionality increasing – nothing truly standard yet.
- Supply chains and Delivery Models still evolving
- Expect change

Factory Acceptance Testing (FAT)

Traditional vs modular deployment



KI - 2004
0.2 MW / 0.8 MWh

Vanadium Redox

KI - 2014
3 MW / 1.5 MWh

Advanced Lead Acid

FI - 2016
0.75 MW / 0.3 MWh

Lithium Titanate

entura

WE OWN. WE OPERATE. WE CONSULT.

THANK YOU

Join us at our panel session:

PPA Toolkit: A Step-by-Step Guide for Mines Considering Renewables

5th August 2020, AWST 1:00-1:50

CONTACTS

Ray Massie – Specialist Hybrid Energy Solutions
E: ray.massie@entura.com.au

Akhil Pai – Business Development Manager, Power
E: akhil.pai@entura.com.au

entura

WE OWN. WE OPERATE. WE CONSULT.

ADDITIONAL PDF VERSION MATERIAL

KING ISLAND RENEWABLE ENERGY INTEGRATION PROJECT

- HT/Entura Design & Build
- Test Bed
- Advanced Hybrid Control
- 100% RE Penetration over 12,000+hr
- **Record = 137.5hr continuous ZDO**
- 50+% RE Contribution
- Increased System Reliability
- Sub 1 second DSM aggregation
- Successful Customer Engagement

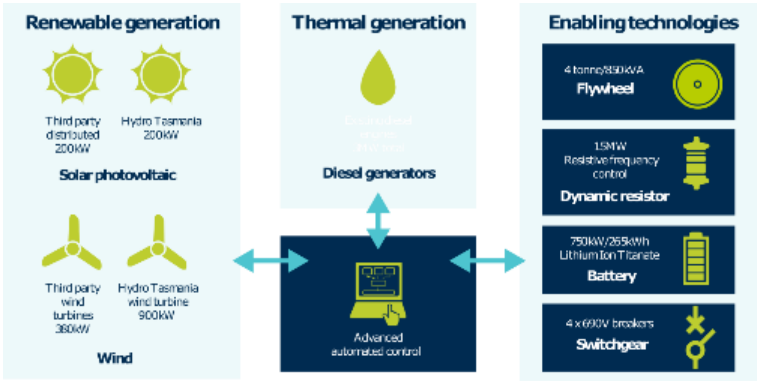
Population ~1300, 2.5MW peak load, 12GWh pa, 450km of 11kV distribution

6MW diesel
2.45MW Wind, 400kW PV
3MW Dynamic Resistor
2 x 1MVA Diesel-UPS (Flywheel)
3MW/1.6MWh BESS
Biodiesel Trial
DSM Smart Grid
Hybrid Controller

entura

WE OWN. WE OPERATE. WE CONSULT.

FLINDERS ISLAND HYBRID ENERGY HUB



Scalable modular systems capable of low cost rapid deployment

Population 600

- 1.3MW peak load, 6.7GWh pa
- 3MW diesel, >200km of 11kV
- HT Design & Build
- Modular Solution
- Test off site
- Strong Community Engagement
- Whole of system Hybrid Control Upgrade
- 100% RE Penetration
- 60% RE Contribution

Record 112 hours continuous Diesel Off

entura

Australian Government
Australian Renewable Energy Agency
ARENA

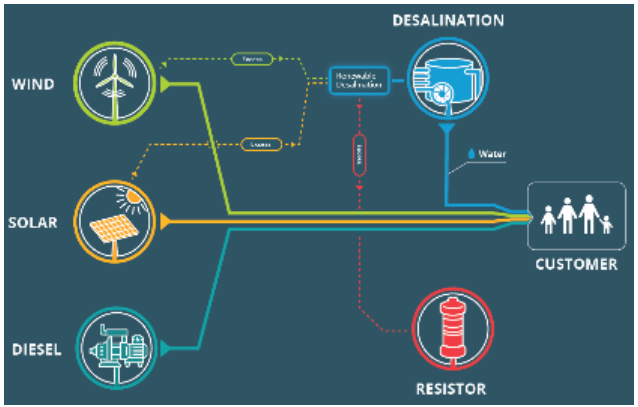
WE OWN. WE OPERATE. WE CONSULT.

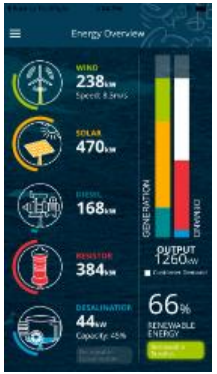
FLINDERS ISLAND HYBRID ENERGY HUB

entura

WE OWN. WE OPERATE. WE CONSULT.

ROTTNEST ISLAND WATER RENEWABLE ENERGY NEXUS





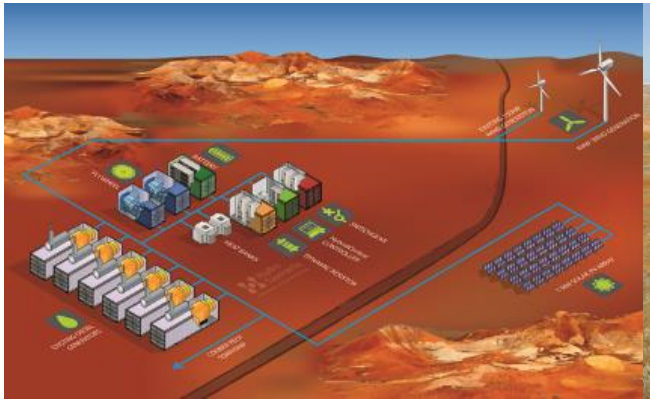
- HT EPC
- Integrates Desalination as Energy Storage
- 45% RE Contribution
- 95% Penetrations with LLD
- New Hybrid Control & Diesel Control
- Extensive Training
- Operator Remote Interface
- Education App

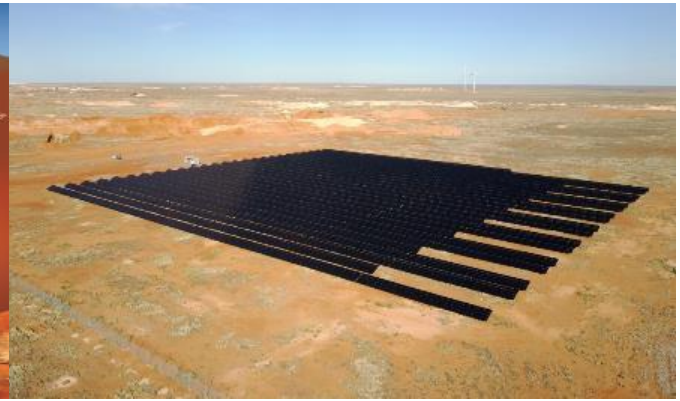
Australian Government
Australian Renewable Energy Agency
ARENA
ROTTNEST IS

entura

WE OWN. WE OPERATE. WE CONSULT.

COOBER PEDY RENEWABLE HYBRID PROJECT





Population 1,700, 13GWh annual Energy,
3MW max, 1.4MW ave
8 x 490kW diesels

- HT/Entura 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

Australian Government
Australian Renewable Energy Agency

ARENA

Energy Developments

entura

WE OWN. WE OPERATE. WE CONSULT.

AGNEW GOLD MINE IN WEST AUSTRALIA

Hybrid System:

- **18MW Wind farm**
- **4MW Solar PV**
  - With Forecasting
- **13 MW / 4 MWh BESS**
- **16 MW Gas Engines**
- **3 MW Diesel Engines**
- **HT/Entura undertaking Integration & Hybrid Control System**
- **50-60% RE Contribution target**

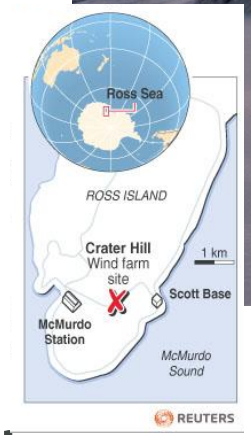
Gold Fields

eDL

entura

WE OWN. WE OPERATE. WE CONSULT.

ROSS ISLAND - ANTARCTICA



entura

WE OWN. WE OPERATE. WE CONSULT.