





## **About Optimal**

### **Engineering capability**

- Optimal is a unique team of dedicated energy professionals who deliver advanced turnkey power generation, combined heat & power and hybrid solutions to industry.
- As the South Pacific regional distributor for Capstone Turbine Corporation, we deliver on-site energy solutions that are cleaner, cheaper and more reliable to a diverse range of industries across Australia, New Zealand and the South Pacific.
- ➡ Head Quartered in Mulgrave VIC, we are a privately owned company with an annual revenue of over \$25 M





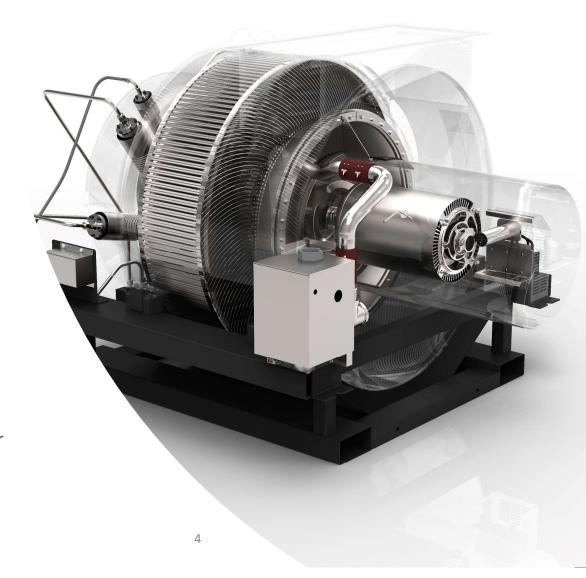
### **About Optimal**

### **Capability**

- Process, chemical, mechanical and electrical engineering team members allow Optimal to integrate combined technologies including;
  - Biogas Anerobic Digesters (Covered Lagoon, Stirred and Fixed Film)
  - Biogas to Biomethane Upgrading Equipment (CO2 and contaminant removal)
  - Biomethane Compression Equipment
  - Microturbine Power Generation Systems
  - Heat Recovery Systems (steam, hot water, drying)
  - Absorption Chilling
  - Renewables (Solar PV, Wind, Hydrogen)
  - Energy Storage (battery & capacitor systems)

### Technology Overview

- Solution based on the Capstone Turbine C200S Technology Platform, 200 kW power generation
- Only one moving part
- No oils, coolants or lubricants
- Clean, Quiet and ultra low emission power
- Highly efficient combined heat & power
- Modular & scalable
- High quality inverter based power
- Low maintenance
- Clean exhaust (18% O<sub>2</sub>) ideal combustion or drying air



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## The C200S Package

The 200S Capstone Turbine system comes installed in an rugged outdoor rated enclosure, complete with everything you need for plug and play power generation

- ✓ Microturbine Generator
- ✓ Power Electronics
- ✓ Protection Relays
- ✓ Onboard Gas Boosting
- ✓ Noise Attenuation



Capstone Turbine Corporation's patented technology delivers hassle free efficient power, and avoids

- x Exhaust Clean Up (SCR)
- **x** Vibration Attenuation
- **X** Oil Bunding & Storage
- **x** Cooling Towers
- x Acoustic Enclosures
- x Synchronising Systems
- x Fault Current Protection



# The C200S: 200 kW of power plus: Combined Heating, Cooling & Power

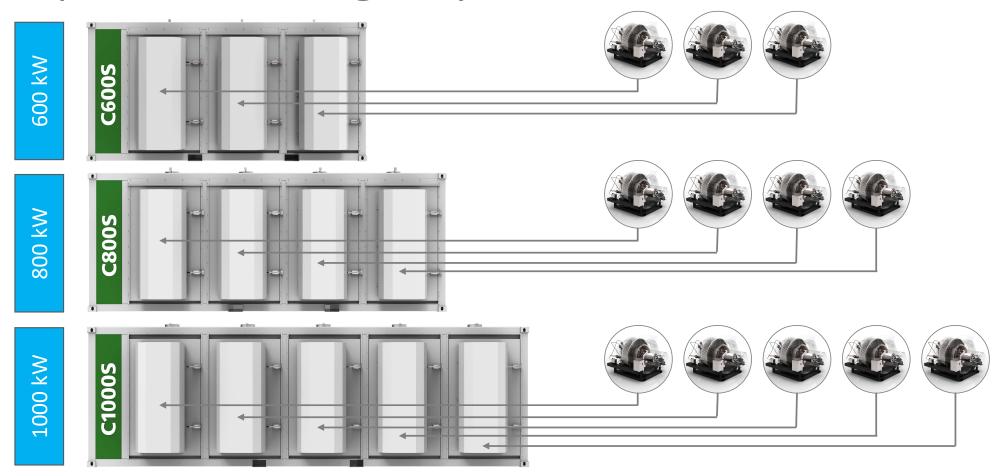








# **Expandable Packaged Systems**



Revision 0

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>480
INSTALLED
TURBINES IN

AUSTRALIA



24/7
NATIONAL
SERVICE



>30 MW OF INSTALLED CAPACITY



>65
DIFFERENT LOCATIONS



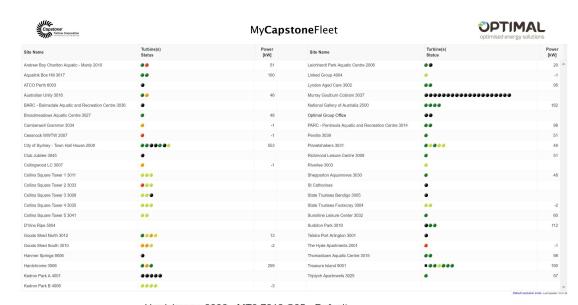


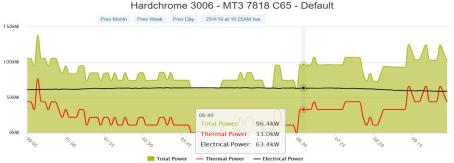


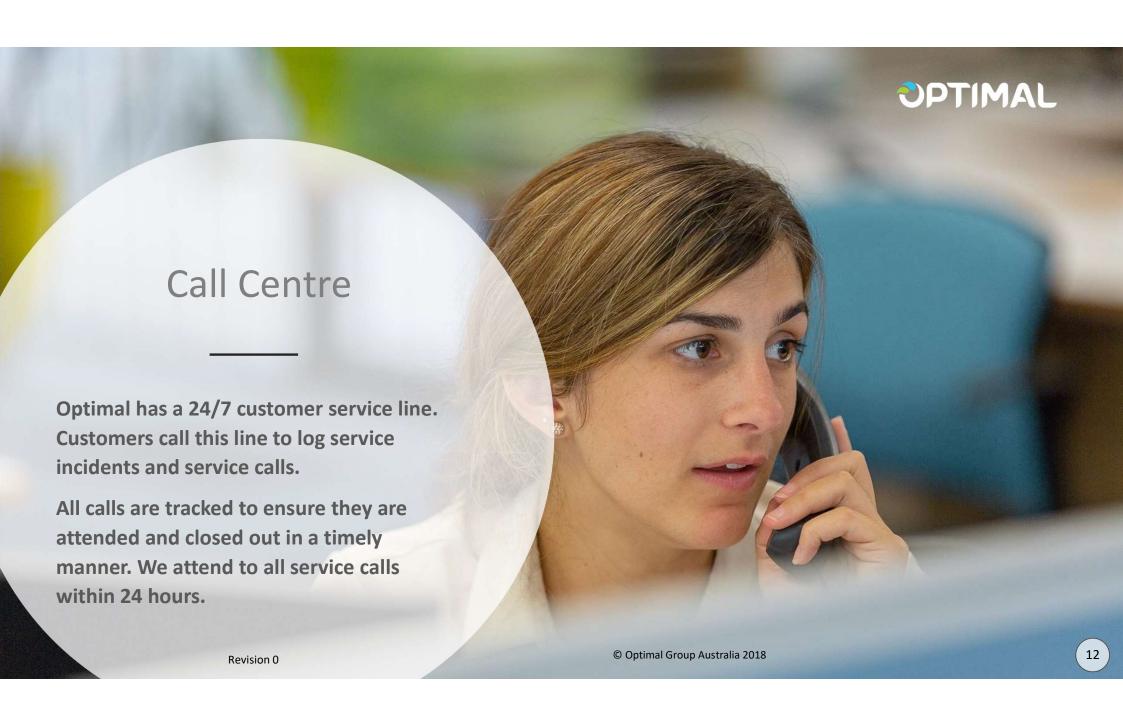


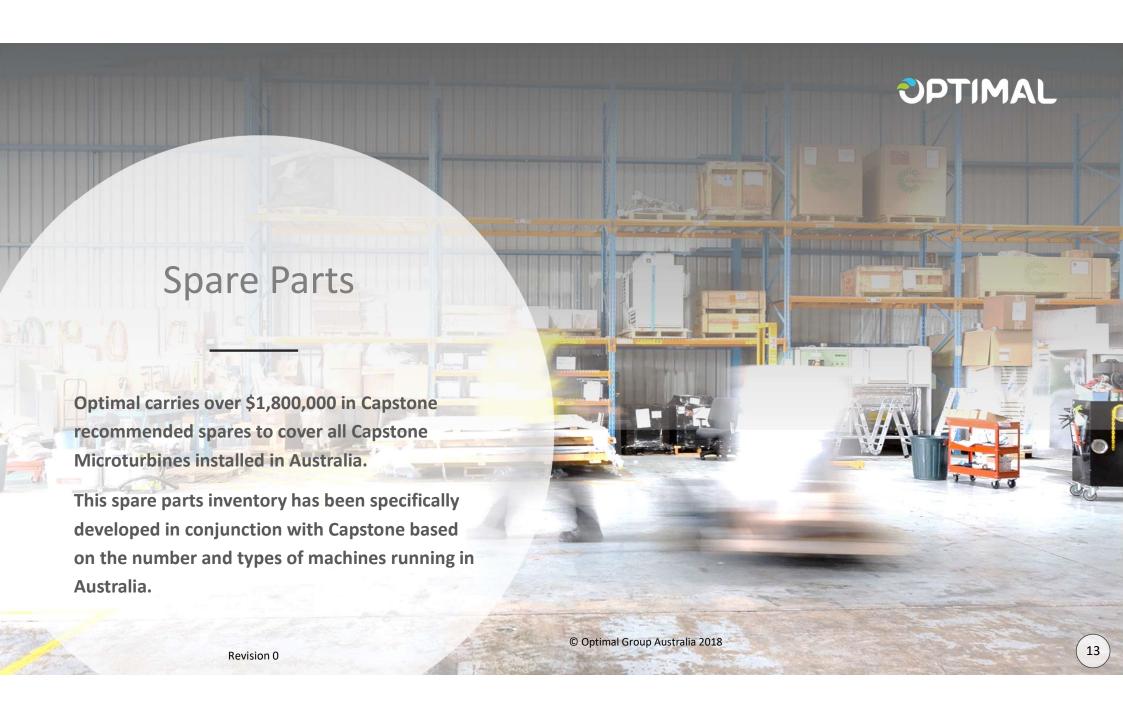
### MyCapstoneFleet Software Package

- Scope
   On-line real time Health & Usage Monitoring System (HUMS) and Computer Aided Maintenance Management Module System (CAMMS) specific for Capstone Microturbine based energy solutions.
- Partners
  Arvio
- Status Current
- Market Potential
   Deployment into over 90+ Capstone
   Distributors.











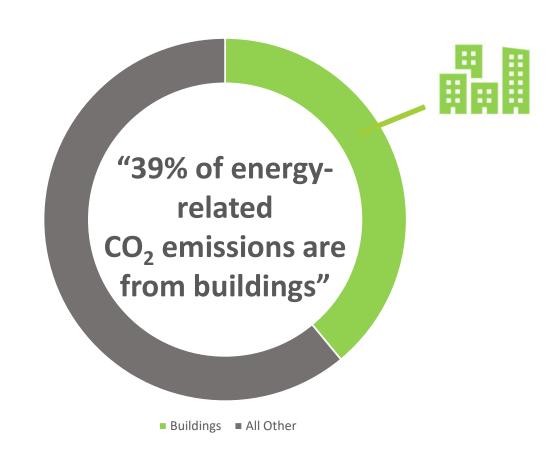




Opportunity

Huge market potential

Strong drivers



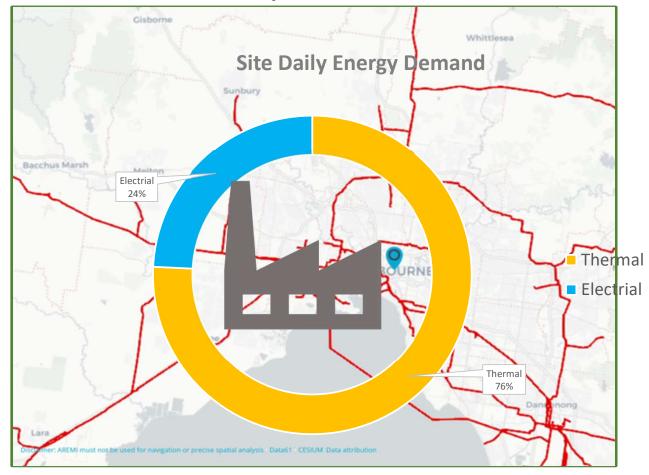


# Industrial energy use is often majority thermal, increasing difficultly for decarbonise



Limitations for fuel switching

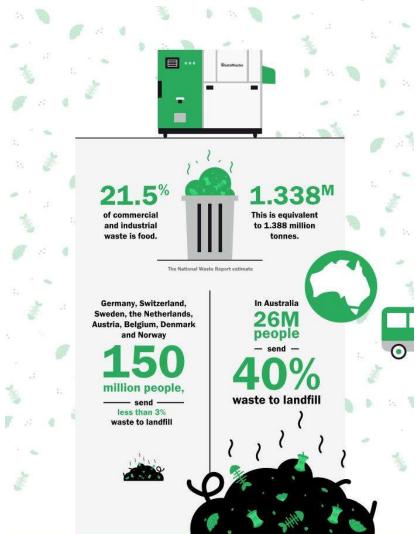
Gas network can support constrained grid







Food waste is an enormous issue



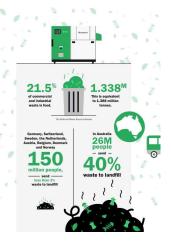
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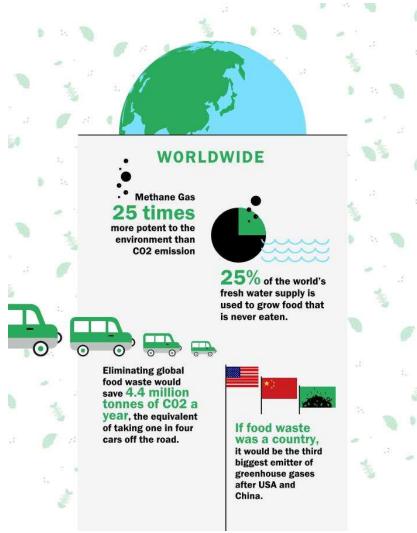


Opportunity

Food waste is an enormous issue

Putrescible waste \$350/t, vs \$150/t dry waste



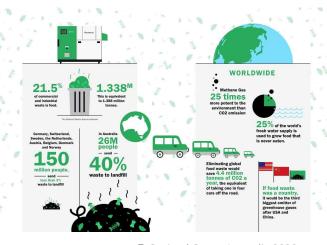




Opportunity

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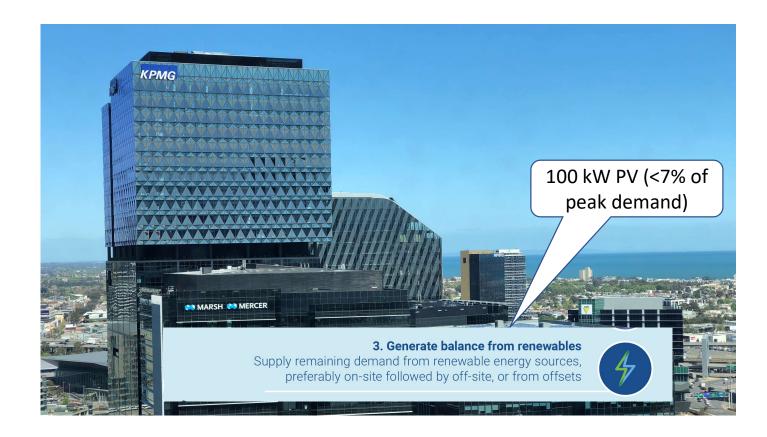
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## Why are we here?

Opportunity

Limited capacity for onsite renewables

Incentives towards onsite generation

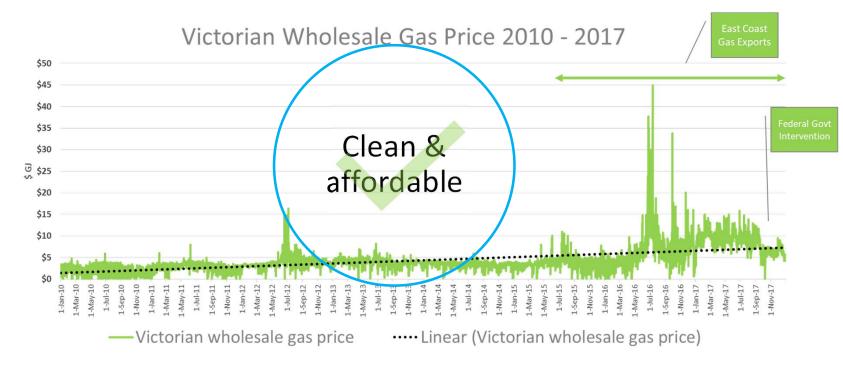




Opportunity

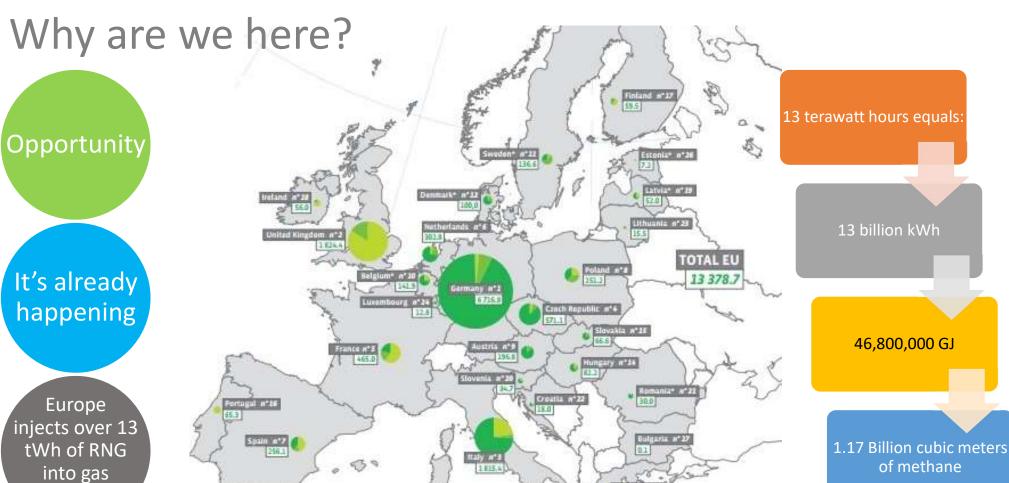
Market price point supports biomethane

Biogas is a zero carbon solution



### **Biomethane is Renewable Natural Gas (RNG)**





Revision 0

network

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# Summary of turbine flexibility benefits for biogas



	Option 1	Option 2
Technology	Capstone Microturbine	Reciprocating Gas Engine
Electrical Efficiency (LHV)	33%	44%
Installed Generation Capacity	1,000 kW	1,000 kW
Minimum Part Load	10%	50%
Minimum Methane Content	55%	60%
Maximum Methane Content	85%	70%

Options compare generator technologies with average biogas yield of 500 m3/hr

Charts show the potential to generate power from each technology during these variations









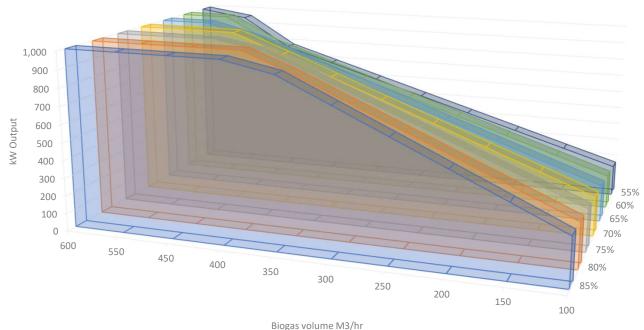
# Summary of turbine flexibility benefits for biogas





Turbine sized on an average biogas yield of 500 m3/hr, with an average methane content of 65%

#### Turbine Power Output with variation of energy content and biogas volume









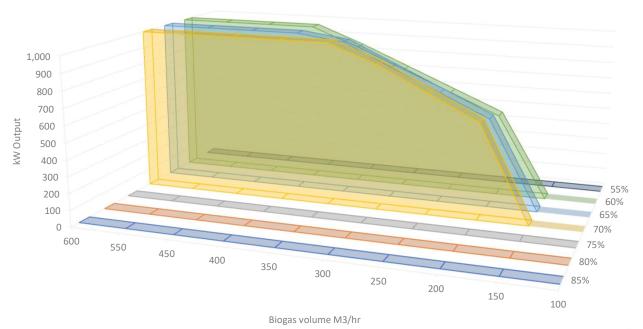
# Summary of turbine flexibility benefits for biogas





Engine sized to matched turbine installed size of 1 MW

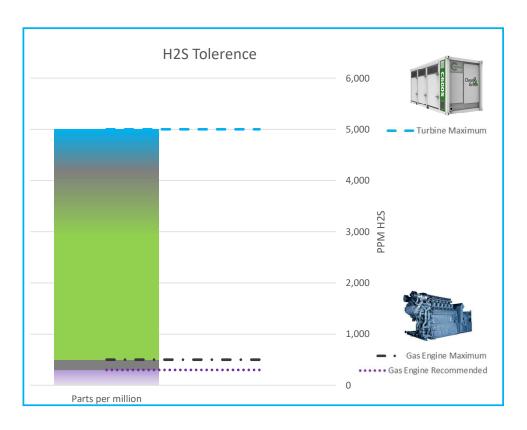
Matched Engine Size Power Output with variation of energy content and biogas volume







# Benefit 1: Fuel Gas Flexibility: Quantity

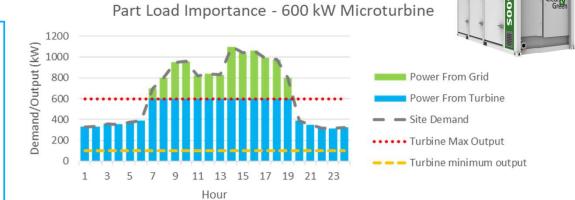


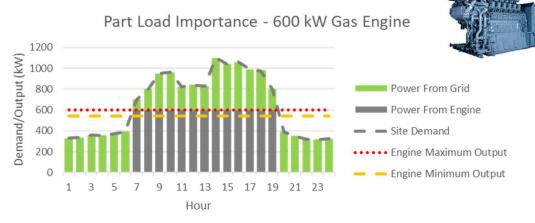




# Benefit 2: Partial Load Flexibility: Load Following

- Partial load capacity / changes in gas quality
- Varying site demand
- Partial load capability



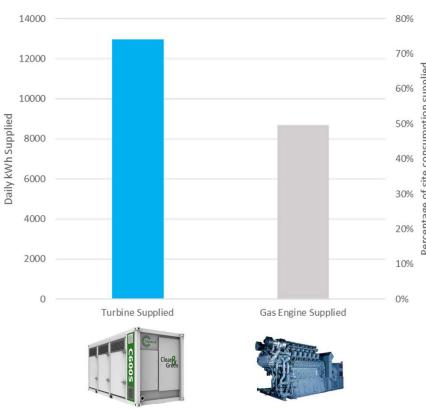




# Benefit 3: Partial Load Flexibility: 600 kW compare

- Partial load improves availability
- Increased benefits
- Engine has low partial load ability



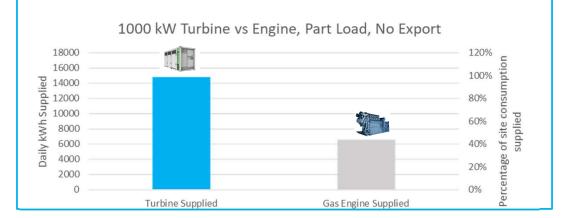


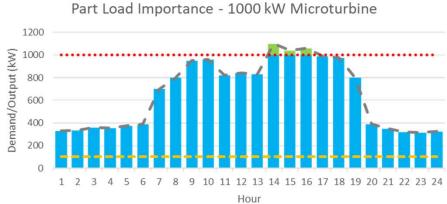


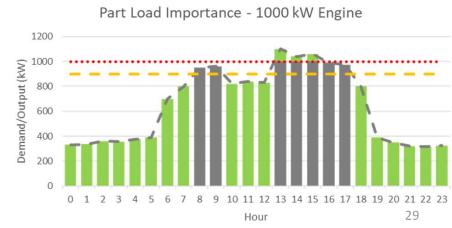
# Benefit 4: Partial Load Flexibility: No Export Biogas storage



Minimum load of single turbine





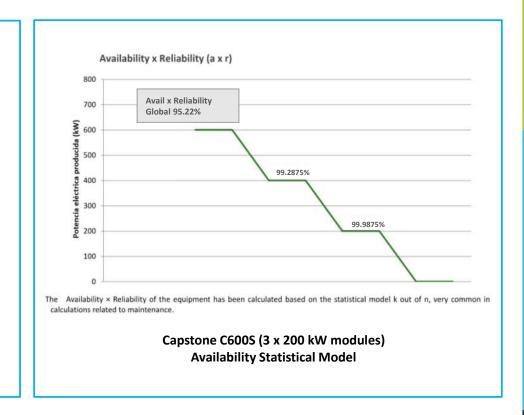


Revision 0



# Benefit 5: Availability & Reliability

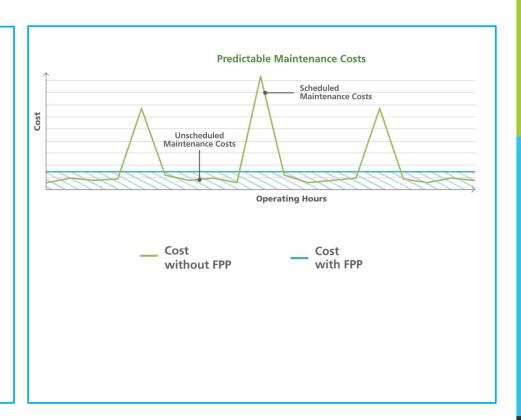
- low scheduled service intervals
- Isolated for maintenance
- Availability is key financial indicator





# Benefit 6: True, Fixed Lifecycle Costs

- Fixed total cost of ownership
- Fully inclusive >20 years
- All parts and labour



Revision 0 31

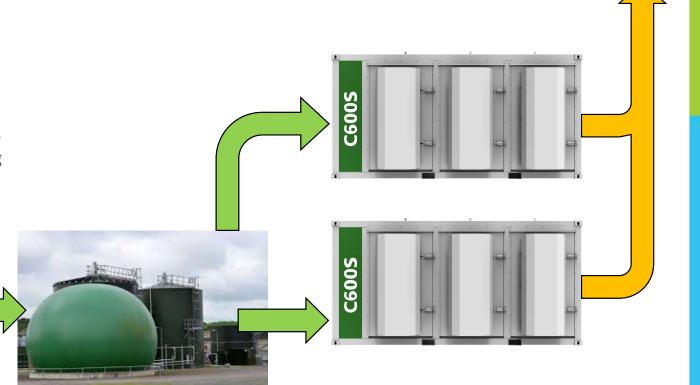


### **Typical Biogas Project**

New digester taking solid potato waste will produce biogas, complemented by the existing biogas produced by CAL (covered anerobic lagoon).

Optimal are supplying 1,200 kW of Capstone Microturbines to provide onsite power using the biogas generated from both sources, 6 x 200 kW modules provide excellent scaling and redundancy.



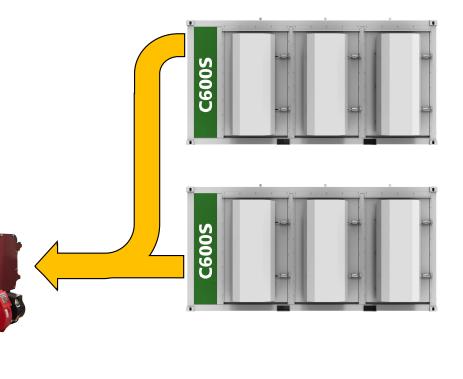




### **McCain Biogas Project**

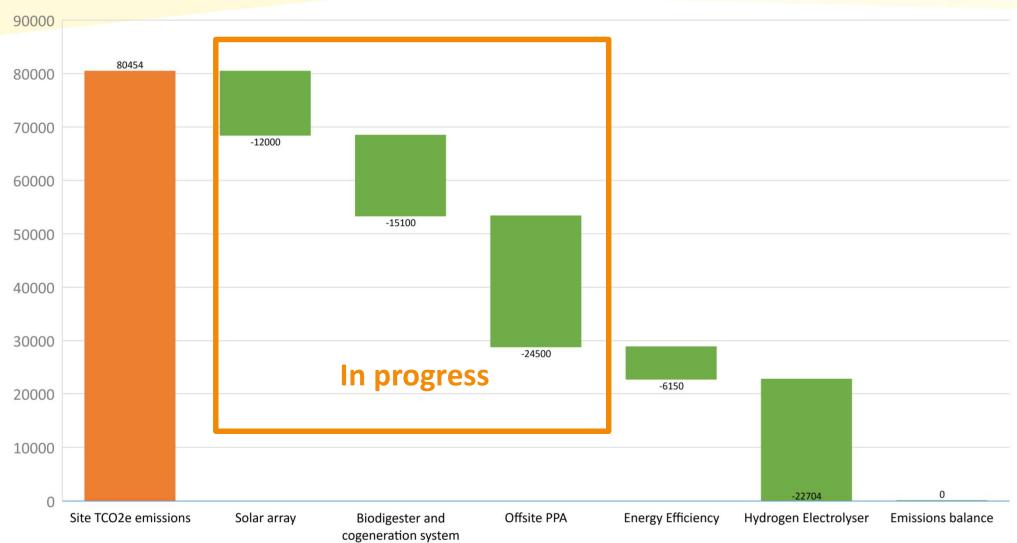
2,340 kW of clean, oxygen rich exhaust heat, produced during power generation is utilised by the boiler as combustion air, reducing natural gas consumption.

Turbine with exhaust to burner combined heat and power uses over 90% of the energy in the biogas.



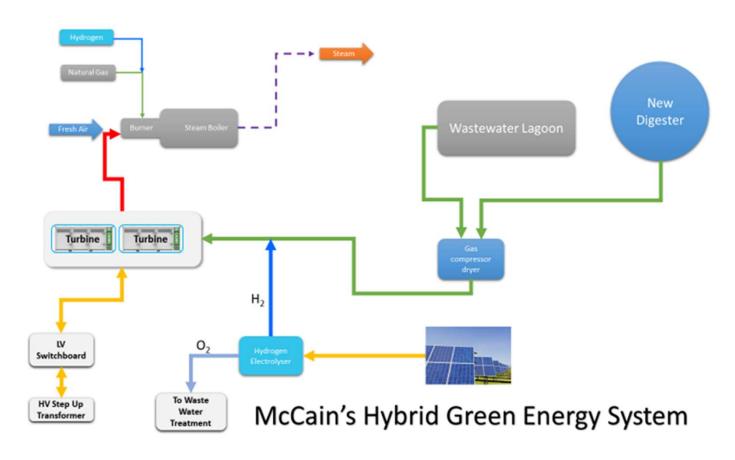
# McCain Ballarat 5 Yr Carbon roadmap - Carbon free plant.







## The Future Energy Roadmap



### What makes this project so compelling?



- Large manufacturing site committed to being CO2 free
- Large, relatively constant heat load
- Close proximity to Oxygen offtaker
- Aligned with municipalities carbon neutral strategy
- Alignment with current site activities around waste to energy and CO2 reductions

### **Key Success Factors**



- Upfront costs of feasibility study
- Access to low cost electricity
- Access to low cost water
- Offtake agreement for Oxygen
- CAPEX support



### **Green Gas – Starts with waste management**

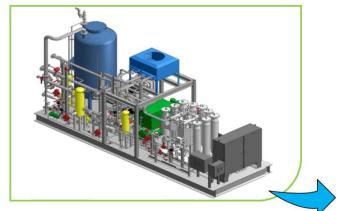
### Repurposing organic landfill waste

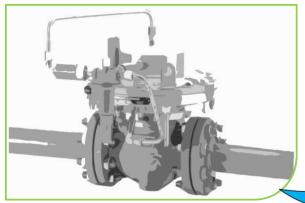
### Wastemaster Pacific – A partnership between Optimal and Green Eco technologies

- Waste generated on-site is diverted to bio-digestion
- Residue from process retains full energy content
- Adding to digester improves methane production
- Waste generated on site diverted to bio-digestion (zero waste)
   and returned as biomethane (for zero carbon power & heat)











#### **Biogas to Bio-Methane Upgrade**

Biogas is cleaned, dried and purified into Biomethane  $\& CO_2$  – both have commercial applications.

#### **Gas Distribution**

Biomethane (Green Gas) is metered and injected into the gas pipeline. Option for hydrogen to be injected.

### Decarbonizing the gas pipeline

Green Gas is Carbon neutral The fuel switch to Green Gas will facilitate compliance with Net Zero objectives.

Revision 0 39

### **Green Gas – Additional options**



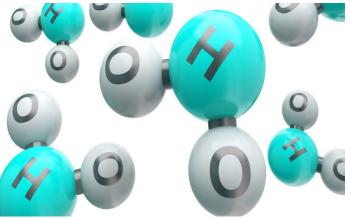
#### **Energy crops**

- Conventional crops like Sugar beet or starch crops like Maize or wheat
- Excellent for co-digestion
- Energy crops absorb carbon dioxide and release oxygen
- Proven technology across Europe.
- Co-digestion improves methane potential

#### **Hydrogen**

- Electrolysers produce H<sub>2</sub> and O<sub>2</sub> from water using electricity
- Can be powered by behind the meter PV, or utility power
- Renewable H<sub>2</sub> can be produced and blended into the gas network
- Waste water is a potential feed stock for electrolyser





### **Green Gas – Additional options**



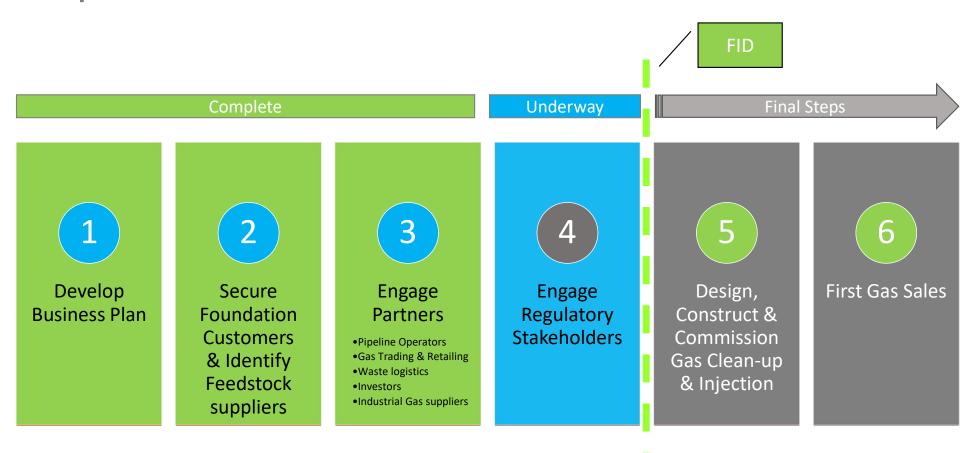
### CO<sub>2</sub>

- CO<sub>2</sub> is removed during biogas treatment
- Revenue source for industrial gas sales
- Potential to co-locate greenhouse facilities
- Can be potentially use to produce additional methane (CH<sub>4</sub>)
  - Returned via dissolving into substrate
  - Potential to produce synthetic Green Gas





### Steps to deliver Green Gas to Market



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