

Bluebox Energy Ltd
Approaching zero-net carbon



Portsmouth City Council pitching event

16th January 2020

Report contains confidential information. Any disclosure should be governed by current non-disclosure agreements.



Q: What is the problem you are aiming to solve?

A: Helping to reach “Net-zero greenhouse gases emissions by 2050”

To fight global warming, the UK have set this ambitious challenge, backed by core options defined by the “Committee on Climate Change”. Bluebox Energy addresses the following:

Challenges

Power: Cleaner and more efficient energy supplies to substitute current centralized natural gas power plants

Low-carbon electricity must quadruple its supply

Industry: Decarbonization of electricity and heat

Thermal energy production accounts for ~ 50% of energy consumption in Europe

Buildings: All heat in buildings to be decarbonised

Heating accounts for 37% of UK CO₂ emissions
Heating for buildings responsible for ~ 20%

Greenhouse Gases Removal: The deployment of BECCS solutions is a key enabler in meeting the net-zero greenhouse gases emissions challenge

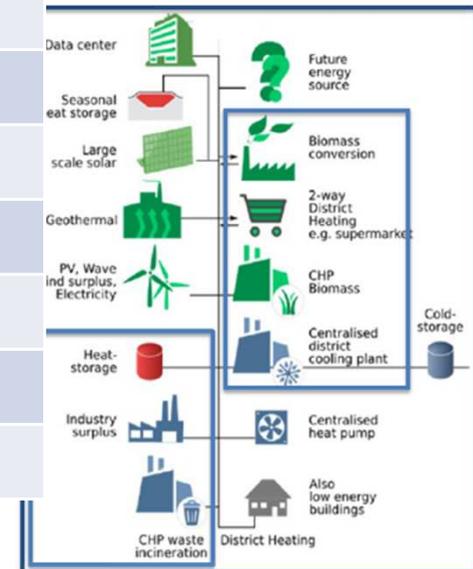
Negative emissions technologies are needed to meet CO₂ emissions targets



Q: What is the problem you are aiming to solve?
A: Low / zero carbon energy options



	Social impact	Cost of energy	CoGen compatibility	Susceptibility to weather
Waste to energy – large scale	High	Low	No	No
Waste to energy – medium scale	Med	Med	Yes	No
Biomass – Large scale	High	Low	Needs a large DHN	No
Biomass – Medium scale	Low	Med	Yes	No
PV - Domestic	Low	High	No	Yes
PV – Large scale	Med	Low	No	Yes
PV - Floating	Low	Low-Med	No	Yes
PV + Battery energy storage	Low	High	No	No
Wind – Urban	Low	High	No	Yes
Wind – Large scale	Med	Low	No	Yes
Wind – Off-shore	Low	Low	No	Yes
EV charging	V .Low	N/A	No	No





Q: What is your innovative solution?

A: Bluebox Energy approach to net-zero CO2 challenge

Solutions

Consulting services:

From technology market screening to complete solution assessment and modelling BBE gives deep insights for better LAES development

Complete Power & CHP systems: Low risk, proven Heat & Power Co-generation from Biomass and Waste

De-carbonization modules: Our Hot Air Turbine modules recover high grade heat and turn it into electricity or electricity and heat, ideal for thermal energy production (District Heating Networks) and industry processes

Bio Energy Carbon Capture & Storage: A CHP pyrolysis plant demonstrator with Carbon Capture & Storage. Up to 60% CO2 capture with Biochar or Activated Carbon as a by-product



Innovation award to Innergy – Bio-Bloc
Power and heat biomass & waste”
Expobiomasa, Valladolid 2019



BBE solutions part of the 2019 IEA
“Best practise report on decentralized biomass fired CHP plants and status of biomass fired small- and micro scale CHP technologies”



2018 regional finalists of the Shell Springboard competition



BBE HAT solution part of the
“Swiss Cleantech report 2017”
A decentralised, CO2-neutral supply of Power and Heat for municipalities and local districts



Q: So, what are your innovative solutions?

A: Low risk solutions for decentralised, decarbonised Heat & Power generation

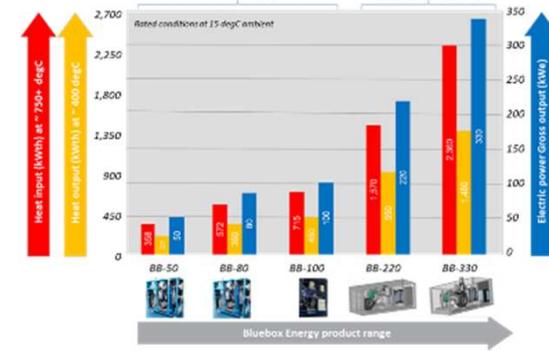
Commercially available

Schmid Energy HLT-100 Compact - CHP Biomass boilers



- Deployment in Switzerland, with advanced discussions in Netherlands, Japan and France
- 100kWe & 465kWth Power output. Unit in 24/7, unmanned operation since Oct' 2017. Runs on untreated wood chips M55

Bluebox Energy HAT systems for Heat Energy recovery



- Worldwide deployment started (US, Australia, Japan, Europe)
- 50 - 330 kWe, 200-1500 kWth (heat)
- Available for Solar, Biomass, Waste or industrial solutions

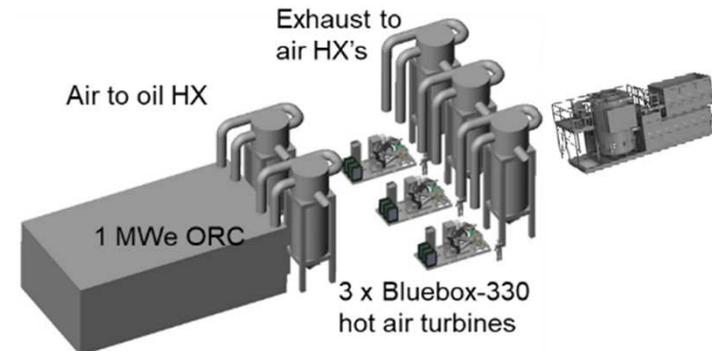
Ready for deployment

CPP800 – CHP Biomass pyrolysis plant with BECCS



- Demonstrator installed at Gerber Logistics, a Swiss agricultural greenhouse, where it produces Power, Heat and Biochar.
- 50kWe and ~200kWth Power output.
- 24/7 operation expected Q3 2020

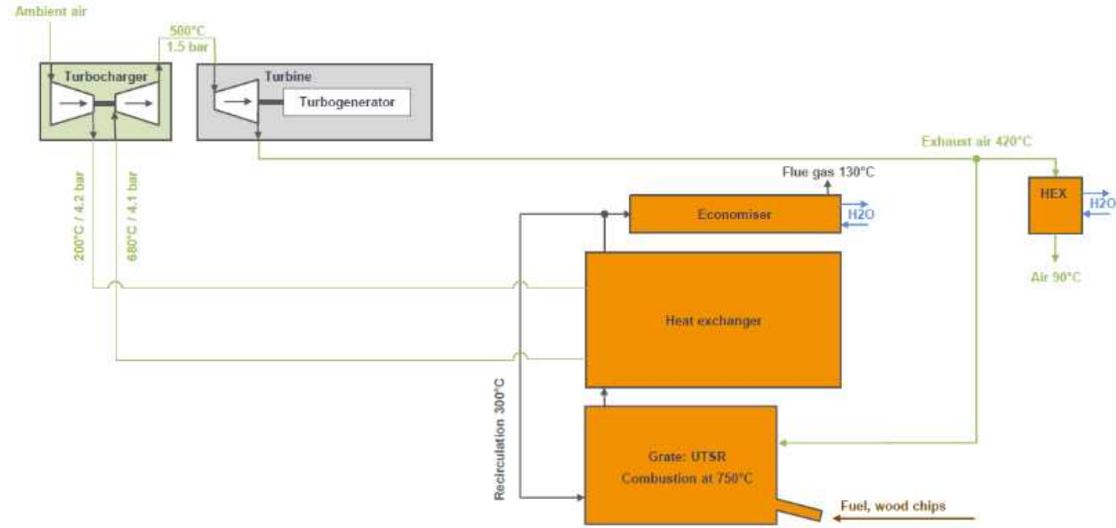
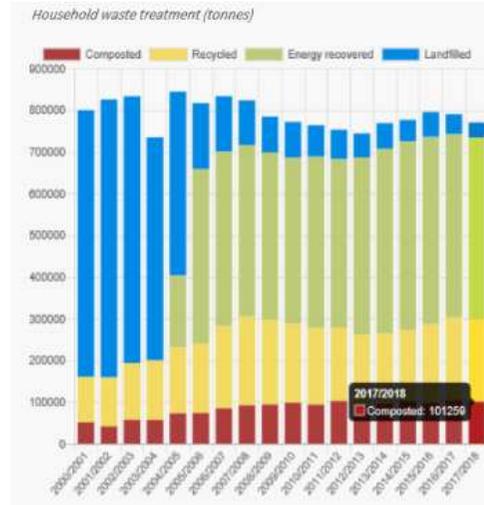
BBE Combined Cycle Plant – 1.9 MWe Power (>26% η) from Waste and Biomass



- Waste and Biomass
- 3-off BBE-330 HAT recover the high-grade heat and couples to a 1MWe ORC for increased efficiency



Case study: The HLT-100 Compact CHP solution applied to the Hampshire County Council composted Waste



HLT-100 key features:

- Low risk, fully proven, decentralised, near-zero CO2 solution
- Environmentally friendly (working medium is air)
- Ideal base load solution for small and medium size DHN
- 100kWe and 465kWth Power output per unit
- 24/7 unmanned operation, Low maintenance
- Designed to run on low cost, untreated natural wood chips
 - Significant positive impact on the solution's economics
 - M35 –M55 content, No pre-treatment required
- Ultra-low particulates emissions using the latest electrostatic precipitators, meeting current Swiss requirements

Facts:

- According to the Project Integra data, the Hampshire County Council processes about 100,000 tonnes/a of composted waste per annum
- Assuming that 10% (10,000 tonnes) of this waste can be turned into M50 Wood Chips
- At rated power, HLT-100 uses 370kg/h (eq. to 2,500 t/a) of wood chips
 - The Hampshire City Council could therefore run 4-off HLT-100 units, generating:
 - **2.8 GWh p.a. of decarbonised electricity**
 - **13 GWh p.a. of decarbonised heat**
 - **Saving 3,584 tonnes of CO2**



Q: What is the business opportunity?

A: Providing cost efficient, low risk, decentralised, CO2-neutral solutions

**System
price est.**

Customer's needs

Business opportunities

<p>Analysis and objective assessment of the best solutions to reach decarbonisation objectives</p>		<p>Consulting services</p>		
<p>Generation of decarbonised electricity only</p>		<p>Combined Cycle: Annual CO2 savings:</p>	<p>1.9MWe 3,700 tonnes</p>	<p>< £6.5M</p>
<p>Generation of decarbonised Heat & Electricity</p>		<p>Combined cycle: Annual CO2 savings:</p>	<p>1.9MWe + 4.1MWth 9,900 tonnes</p>	<p>< £6.5M</p>
<p>Generation of decarbonised Heat & Electricity + BECCS (For demonstration / communication purpose?)</p>		<p>Single cycle: Annual CO2 savings:</p>	<p>800kWe + 3.2MWth 6,400 tonnes</p>	<p>< £4.0M</p>
		<p>HLT-100 Compact: Annual CO2 savings:</p>	<p>100kWe + 465kWth 900 tonnes</p>	<p>< £1.2M</p>
		<p>Single Cycle: Annual CO2 savings:</p>	<p>80kWe + ~300kWth 2,000 tonnes (est)</p>	<p>< £1.2M</p>

* Based on 7000 operating hours /annum, 0.28 kg CO2 / kWhe, 0.215 kg/kWth and using a renewable fuel



Q: Do you have an IP or a need for an IP? (Does it need protecting / Can you protect it?)

A: Bluebox Energy IP considerations

Patent consideration:

At present, Bluebox Energy has no patents filed or granted. However, with appropriate funding in place, we will seek to file three patents:

- Thermodynamic matching
- Starting algorithms
- Performance optimisation

Innovation

Our core know-how is based in three areas:

- Ability to match the Brayton hot air turbine to a heat exchanger and heat source (detailed thermodynamic models based on Modelica environment)
- Development of core “life support” systems to prevent system shutdowns and component failure
- Control algorithms that give optimal energy output whilst avoiding overstressing components



Q: What is the market? (Route to market / How will you sell/provide your product/service/process)

A: Our vision for our solutions deployment

- Build market awareness based on achievements to date
 - Keep reference sites operational
 - Communicate success through conferences, workshops and seminars

- Deployment of existing solutions
 - To City councils, Housing developers, Industry
 - UK and export

- Build next set of demonstrators
 - Three opportunities in the pipeline (Cogeneration for Heat to Power applications, Waste to Power, Biomass to Power)

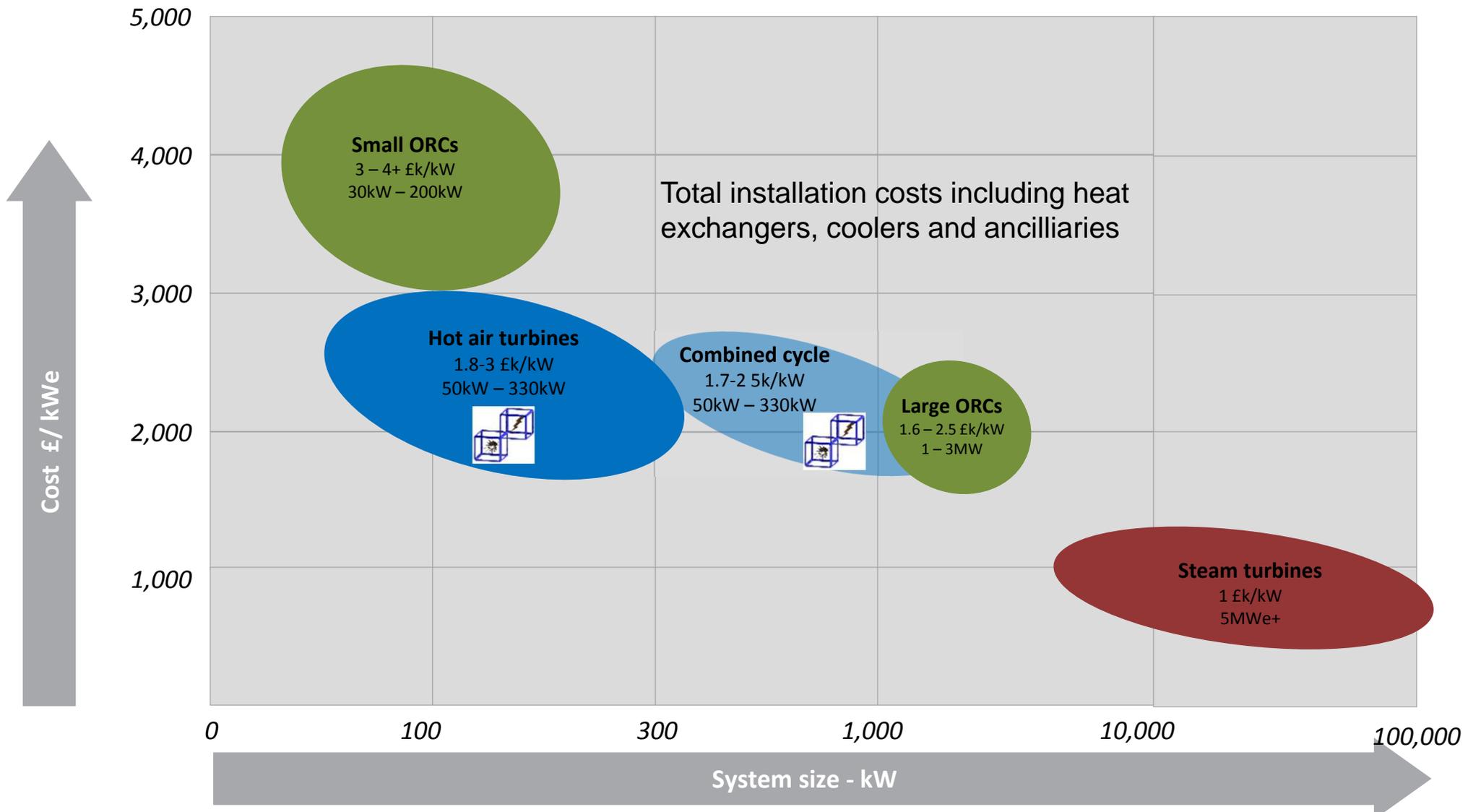
- Add partners to our network (currently 4 non-exclusive)
 - Present partners cover Europe & Switzerland, Australia, South East Asia and the USA
 - On-going discussions with potential partners for Spain and Japan

- Develop the core team
 - From 2 full time employees and 6 consultants
 - Strengthen our sales capacity



Q: Who are your competitors?

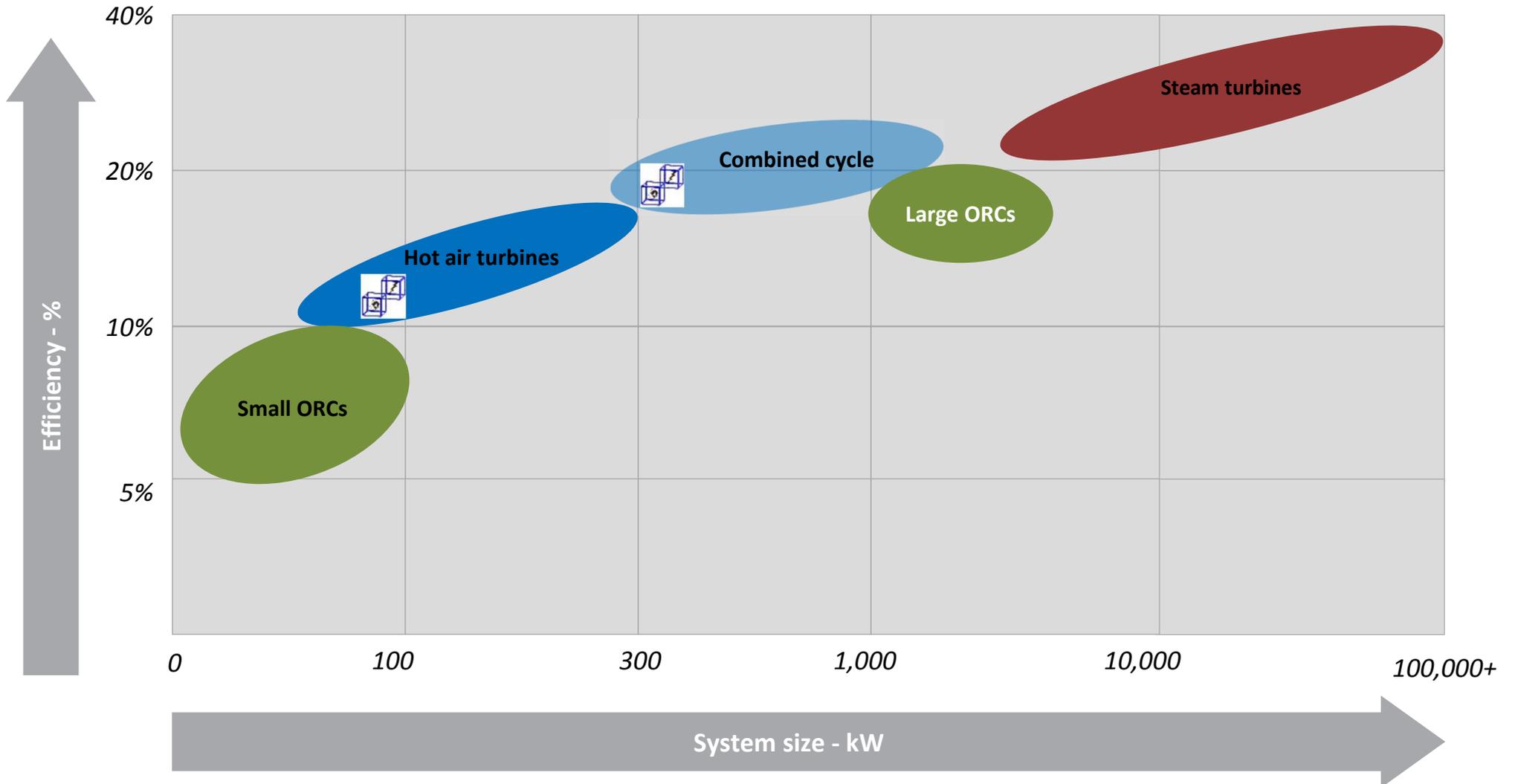
A: Hot Air Turbines Vs alternative technologies – Cost per kWe comparison





Q: Who are your competitors?

A: Hot Air Turbines Vs alternative technologies – Efficiency comparison





Australian Government
Department of Defence
Science and Technology



Thank you...

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