OPTIMAL GROUP

SKY CARBON TO EARTH

A solution to meet your energy needs while removing carbon from the atmosphere

Rainbow Bee Eater

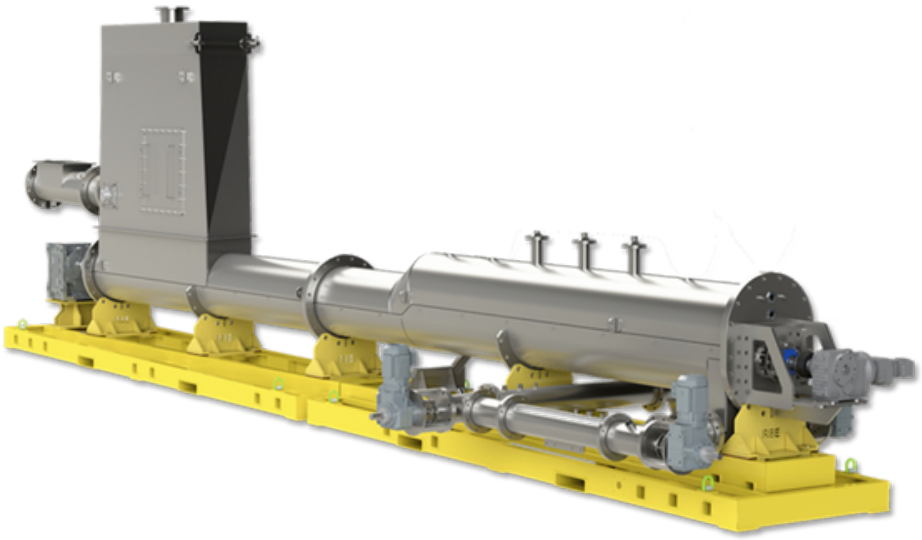
INTRODUCTION

Optimal Group Australia (OGA) delivers end-to-end energy solutions across industries such as commercial, industrial, healthcare, utilities, food and beverage, and oil and gas. With full EPC capabilities and ongoing maintenance, OGA provides reliable, turnkey energy solutions.

Rainbow Bee Eater (RBE) is an Australian company focused on carbon removal through its innovative ECHO$_2$ pyrolysis technology. This process permanently captures carbon and produces a clean, net-zero renewable gas to replace fossil fuels for heat and power.

RBE is the only company globally to have a proven biochar pyrolysis technology, which:

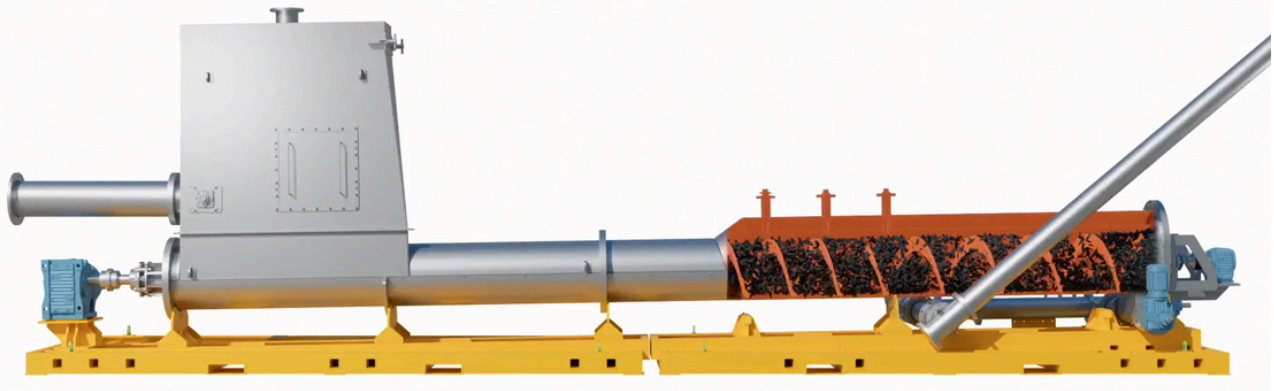
- Delivers the highest in-class biochar yields, while being very high in quality as well
- Produces clean, cool syngas with no chemical cleanup required
- Requires low operator and power input, as well as having high uptime
- Is designed to work on low-quality residues (husks, straw, etc.)
- Is certified Carbon Removal by puro.earth (world's leading platform for carbon removal)
- Is a modular technology and can be scaled to meet each application



$ECHO_2$ PROCESS

$ECHO_2$ by RBE uses a unique pyrolysis process to produce biochar and clean syngas in a single step. Pyrolysis is the thermal decomposition of organic materials at elevated temperatures. This takes place in low or no-oxygen environments. The volatile gases are driven off, and the remaining biomass is decomposed into carbon solids.

Hot and dirty syngas, produced during pyrolysis, is cleaned and cooled within the $ECHO_2$ reactor, utilising a counter-current action which filters the syngas through the feedstock “packed bed”.



This process results in tars and oils, often a hazard and waste by-product of other pyrolysis processes, are instead broken down into additional syngas and biochar fractions, increasing biochar yields, reducing waste, and increasing energy recovery and efficiency.

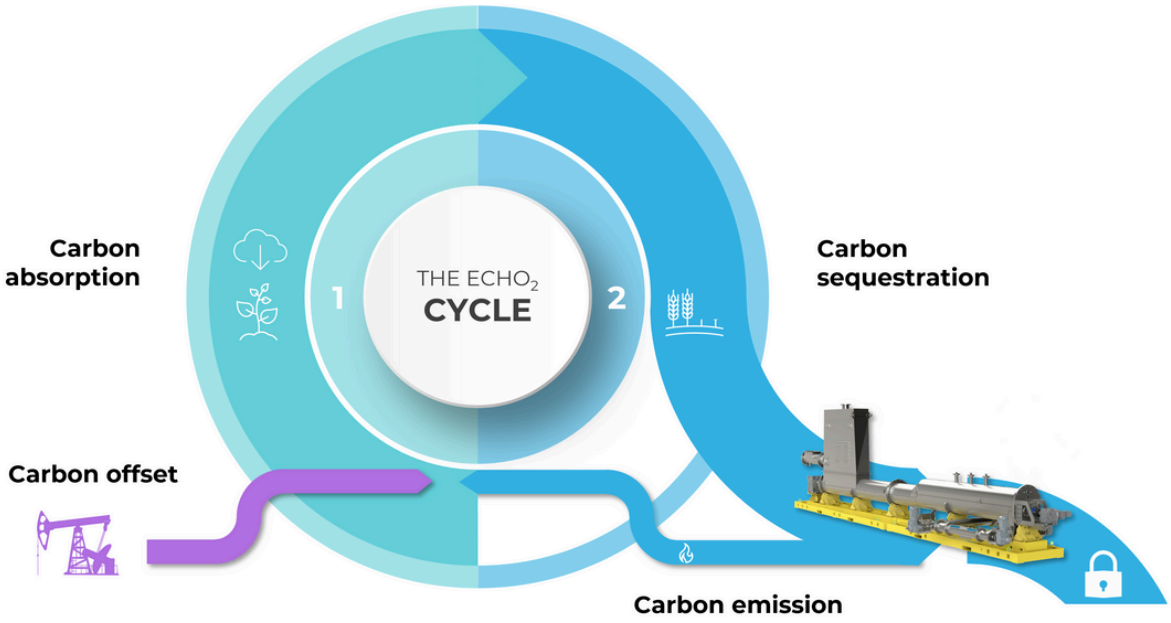
The clean syngas exiting the ECHO2 reactor does not require additional chemical cleanup and can be used to produce heat and power.

Cooling the syngas further recovers a water fraction, Pyroligneous Acid (also known as Wood Vinegar), a natural bio-stimulant with multiple value add applications in agriculture.

ECHO$_2$ CYCLE

Plants take carbon dioxide out of the air as they grow. When crop waste is burned, spread on fields, or buried in landfills, that carbon goes straight back into the atmosphere.

The ECHO$_2$ unit changes the story. It converts leftover plant material into biochar, a solid form of carbon. Added to soil or used in industrial products, biochar locks the carbon away instead of letting it escape as CO_2. Research shows that biochar made under the right conditions can keep carbon out of the atmosphere for thousands—even millions—of years.



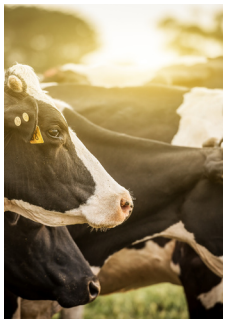
The ECHO$_2$ system also produces clean syngas, a renewable fuel that can be burned for heat or electricity. While the biogenic carbon in this gas does return to the atmosphere when it is used, every unit of syngas replaces a unit of fossil fuel that would have released new CO_2. That swap means the overall process still removes more carbon than it emits, keeping the balance solidly on the carbon-negative side.

ECHO$_2$ APPLICATIONS

BIOCHAR APPLICATIONS

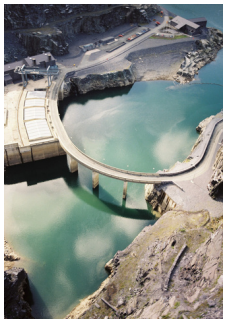
Agriculture soil improver

Land remediation



Farm animal feed

Building materials



Water treatment

SYNGAS APPLICATIONS

Hot water or steam

Glasshouse CO_2 fertigation

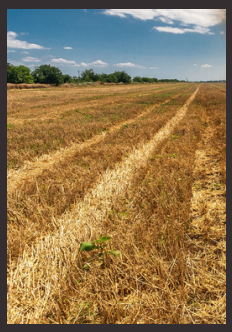
Power generation

Direct drying or kiln

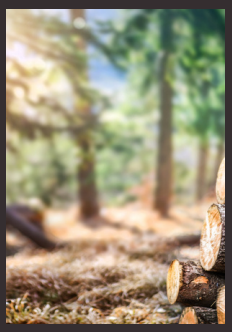
Upgrading to biofuels

BIOMASS & CREDITS

SUITABLE ECHO2 FEEDSTOCKS

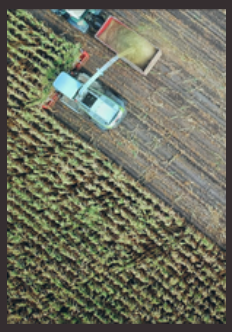


Straw and stubble



Wood products

Nuts, shells and pips



Crop trash and bagasse

Animal bedding

CARBON CREDITS & OFFSETS

RBE's $ECHO_2$ is certified by puro.earth to generate CORCs. $ECHO_2$ biochar yield per tonne of feedstock and price per CORC traded is amongst the highest in the industry. Each dry tonne of biochar generates between 2.5 - 3 CORCs which RBE sells into the international market at more than $200, under a revenue share agreement with $ECHO_2$ project operators.

The syngas produced by $ECHO_2$ is "net zero", meaning additional carbon credits can be recovered when offsetting the use of fossil fuels such as natural gas, LPG, or diesel. These credits can be Federal (e.g., ACCUs) or state-based schemes (e.g., VEEC, ECC), and typically range from $30 to $80 t/$CO_2$e. These credits fully retained by end user.

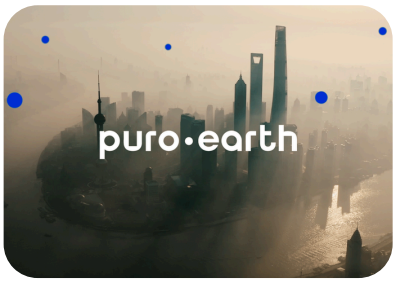
PROJECT DETAILS

Ideal Project

Ideal projects have access to sufficient biomass to support multiple ECHO2 modules. For example, an ECHO2 “6 pack” can process up to around 30,000 t/pa of feedstock (wet) and will produce approximately 120,000 GJ/a of syngas and 20,000 t/pa of biochar (wet).

Ideal applications will also have an annual heat or electricity and heat requirement of 10,000 MWh or more (36,000 GJ/pa), to take advantage of the syngas produced.

Project Facilitation



RBE registers, maintains validation, and markets CORCs, maintaining a value premium on $ECHO_2$ project credits. CORC revenue is shared with the end user.

RBE can also provide additional project facilitation, including feedstock sourcing and contracting, biochar offtake agreements, and assistance in developing potential local wood vinegar markets.

Project Economics

Project value is derived from multiple sources of revenue and savings, including biochar, CORCs, wood vinegar, syngas and carbon offsets. Minus the operational costs, such as feedstock, power, maintenance and water.

Projects typically have a payback under 4 years, depending on local variabilities, delivering exceptional IRRs. RBE and Optimal can assist with a high-level assessment, followed by a more detailed engineering study to enable the project to proceed.

Support

$ECHO_2$ is manufactured and serviced in Australia, with local support services established in each region.

Operation, maintenance training, and documentation included. Remote SCADA monitoring and troubleshooting support included.

DATA SHEET

The $ECHO_2$ system from RBE converts low-value biomass residues to clean syngas for the generation of renewable energy and biochar. $ECHO_2$ is the first biochar technology to be registered outside Europe by puro.earth™ for international carbon removal certificates.

Typical Performance [1]

Feedstock [kg/hr, wet basis]	700 - 1,000
Feedstock energy content [kW]	2,950 – 4,250
Biochar [kg/hr, dry basis]	230 - 340
Syngas [kW] (GJ)	600 (10.7 GJ) – 800 (15.3 GJ)
Power Input [kW]	22
Water In/Wood Vinegar Out [l/hr]	220/200

Dimensions and Technical Connections

Dimensions ea. $ECHO_2$ module (mm)	11,900 (L) x 3,050 (W) x 3,700 (H)
Foundation load (t)	< 10
Voltage / Frequency	400 VAC / 50 Hz
Communication	2 Mbit/s internet connection

Typical Syngas Composition

H_2 (%)	8
CO (%)	23
CO_2 (%)	18
CH_4 (%)	13
O_2 (%)	2
N_2 (%)	36
Oils/Tars (ppm)	<100
Temp (°C)	<30
Calorific Value (MJ/m^3)	8

$ECHO_2$ Module Core Elements

- Feedstock Delivery System from Customer Storage
- $ECHO_2$ Reactor
- Syngas Cooler, Wood Vinegar Condenser
- Syngas Delivery to Customer Energy Demand
- Biochar Delivery System to Customer Storage
- Continuous, fully automated turnkey
- Carbon Removal Certification

Ideal applications: continuous/semi-continuous energy demand >20,000 GJ/annum

Feedstock

Low value clean organics such as straw, wood and nut residues
Particle size: Mixed sizes best, 90% between 2 & 20mm
Moisture:
- Maximum moisture content: 20%.
- Pre-drying is required if >20%.

Ash Content:
- Maximum ash content: 8%.
- Blended fuel may be required if >8%.

Typical Biochar Composition

Carbon (%)	>80
Moisture Content % wb	45
pH	9
Typical Molar H:Corg	<0.5 (molar)
Quenching Method	Water or PA to 60% H_2O

Bio-Oil [2]

Typical GJ/dt feedstock	Nil

Typical Pyroligneous Acid (PA) Composition

Organic Acids (~Acetic Acid) %	3
Phenolic Compounds %	2 to 8% (dependent on Feedstock)
pH	3

Fulfilled Emission Limit Values

Total dust (PM10)	< 20 µg/m^3
Carbon monoxide	< 30 ppm
Noise	< 75 dB(A) at 10 m

Note 1: Feedstock 15% H_20 and 18 GJ/dt.
Ambient air temperature: 15 °C. Humidity: 80%.

Note 2: Micro amounts of bio-oil may be skimmed from external settling of PA @ grams per hour and recycled into biomass feed.

Contact us for your renewable energy solutions.

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