MAXIMIZING BIOCHAR VALUE THROUGH WASTE HEAT RECOVERY

Natalie Van Dyke

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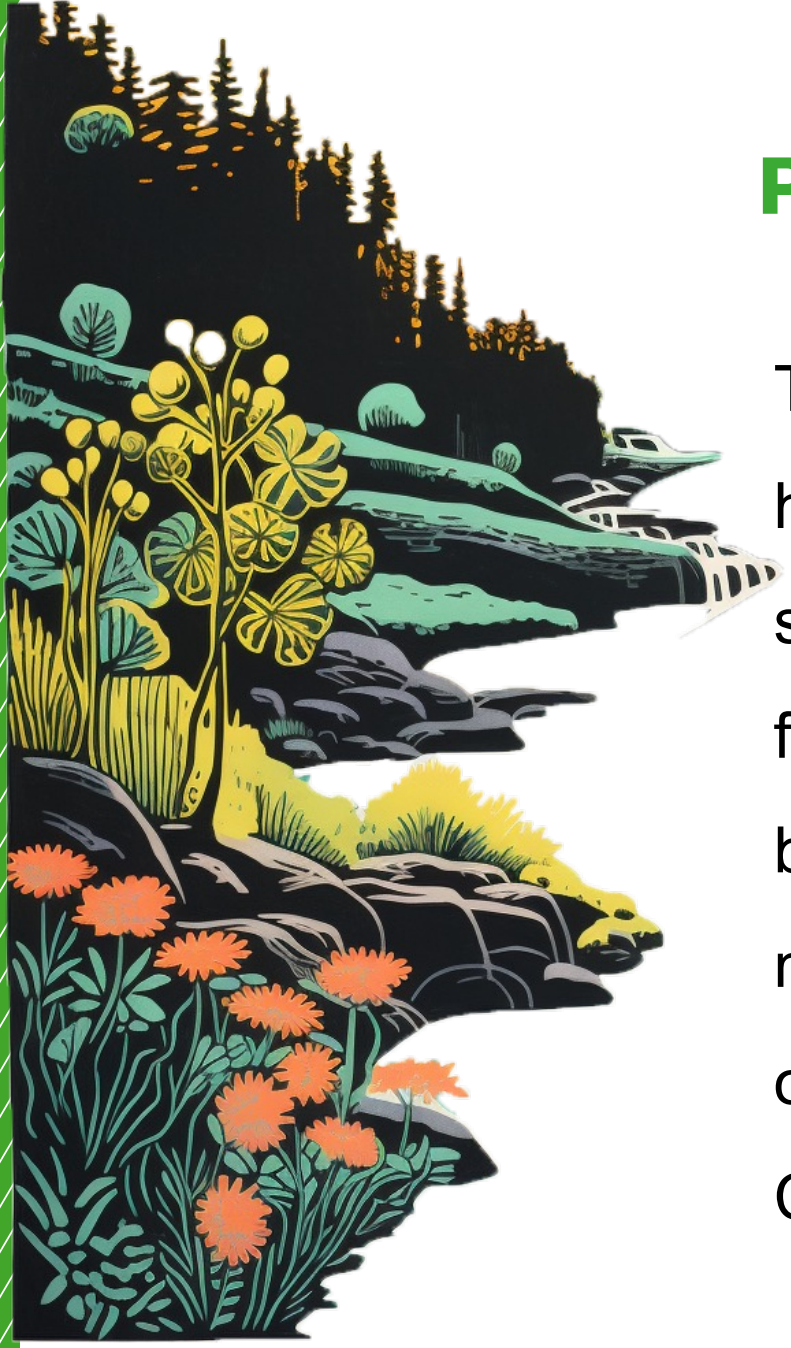
ElectraTherm, Inc.



PREMISE:

The addition of high tech waste heat utilization within pyrolysis system design is beneficial to future proofing the value of biochar operations seeking to maximize both longterm benefits of Carbon Credits, and shortterm CapEx advantages.

DRIVE THE VALUE OF BIOCHAR --

BIOCHAR Pyrolysis production takes place at temperatures typically reaching between 300° to 700° Celsius.

This represents a significant opportunity to extend Biochar profitability through the addition of WASTE HEAT RECOVERY POWER GENERATION to Pyrolysis operation system designs.

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MAXIMIZING THE VALUE OF BIOCHAR --

PRESENTATION GOALS:

- **Briefly Introduce ElectraTherm**
- **Explain the Organic Rankine Cycle (ORC)**
- **Examine profitability of Waste Heat Recovery as a system design addition.**
- **Illustrate how ORC Power Generation can co-exist with and often enhance existing Biochar production system processes.**

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ELECTRATHERM

ElectraTherm
BY BITZER GROUP

Global Leader in Low Temperature Organic Rankine Cycle (ORC) Waste Heat Recovery

Supported By BITZER – Leader in Compression (Refrigeration)

200 ORC units / 100+ installations worldwide

in 14 countries

2,500,000 operating hours

ELECTRATHERM

ElectraTherm
BY BITZER GROUP

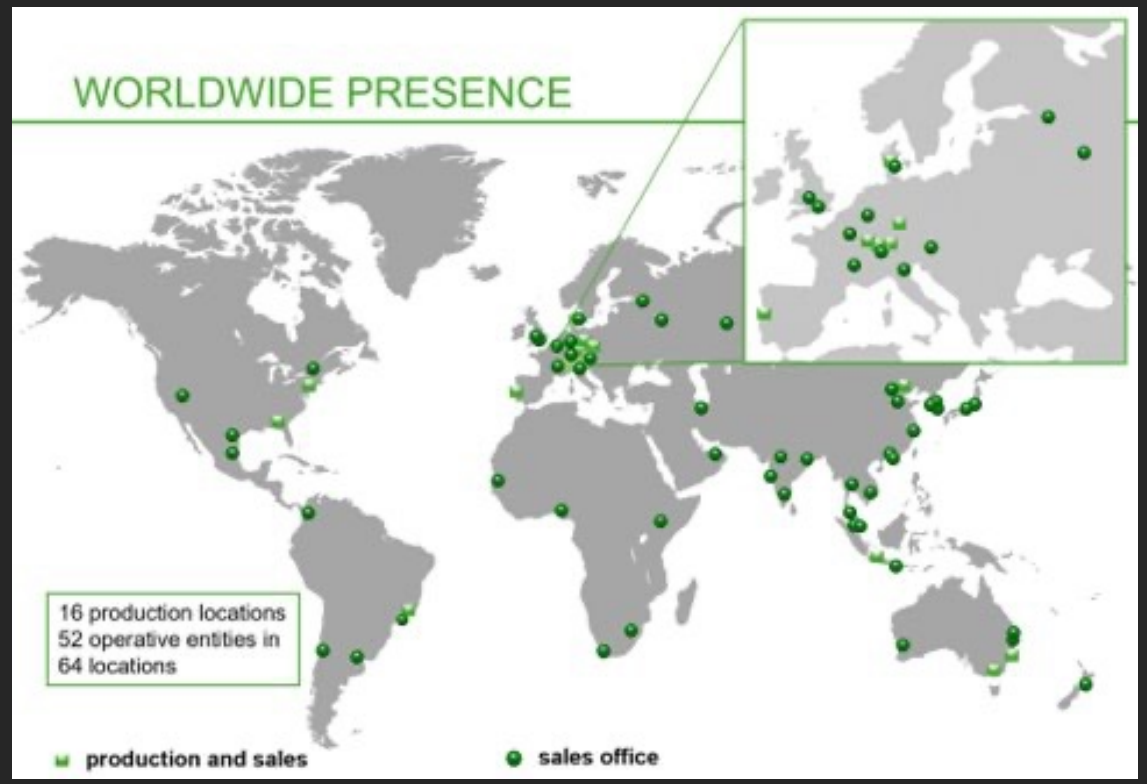
SUPPORTED BY BITZER

Global Leader in Compression…. Refrigeration

Heart of the ORC: Screw Expander

20 – 30,0000 per Year Compressors & Expanders (Stuttgart, Germany)

Global Support in 60+ Countries



ORGANIC RANKINE CYCLE-

ElectraTherm
BY BITZER GROUP

HOT WATER CIRCUIT

ELECTRICITY OUT

COOLING WATER CIRCUIT

ELECTRATHERM ORC TECHNOLOGY

- Heat Boils Refrigerant
- Under pressure, the vapor is fed to a twin-screw expander, spinning an electric generator which then produces power.
- Vapor then re-cooled in condenser (cold side)
- Refrigerant pumped to higher pressure and cycle repeats

PRODUCT LINE

POWER+ GENERATORS

PM75

// Up to 75 kWe

6500B / 6500B+

// Up to 150 kWe

* 300 kW Unit in 2024

ACTIVE COOLER

AC-800 (Up to 800 kWth)

// Up to 75 kWe*

* Plus Cooling Benefit

* Target Direct Replacement of Electric Coolers.

DIVERSE & FLEXIBLE – HEAT AGNOSTIC

ElectraTherm
BY BITZER GROUP

Water in Temperatures: 150-300°F are ideal. **Higher Temps are easily converted.

- Pyrolysis Equipment
- Compression Heat Recovery
- Engine Waste Heat Recovery
- Flare Reduction / Elimination
- Industrial Process
- Geothermal/ Coproduced Fluid
- Biomass / Biogas
- Combined Heat and Power (CHP)



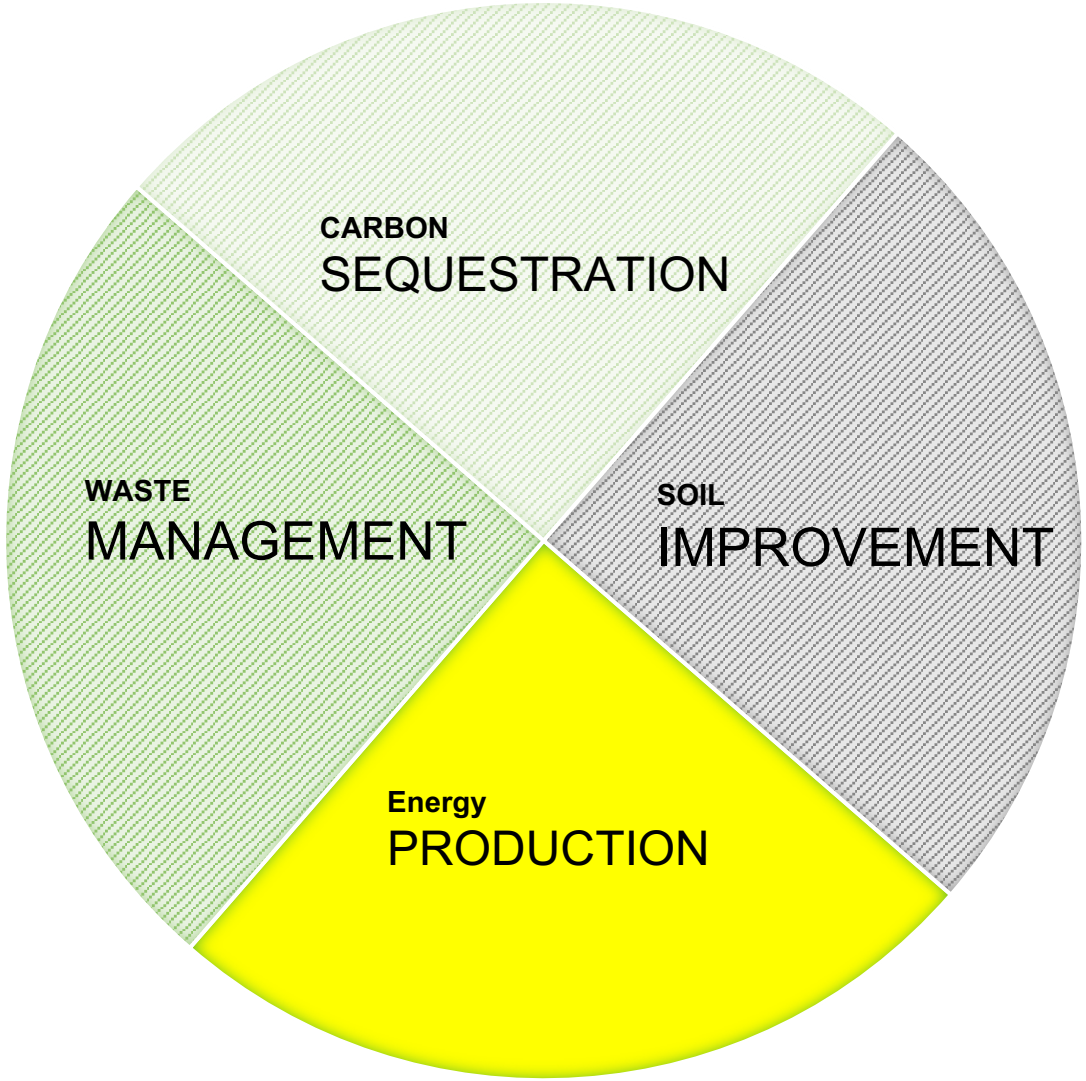








Biochar Is a Vehicle of Multiple Economic Value Streams



BIOCHAR PRODUCTION
offers opportunities to monetize….

The CARBON ECONOMY

The CIRCULAR ECONOMY

The RENEWABLE ENERGY ECONOMY

.

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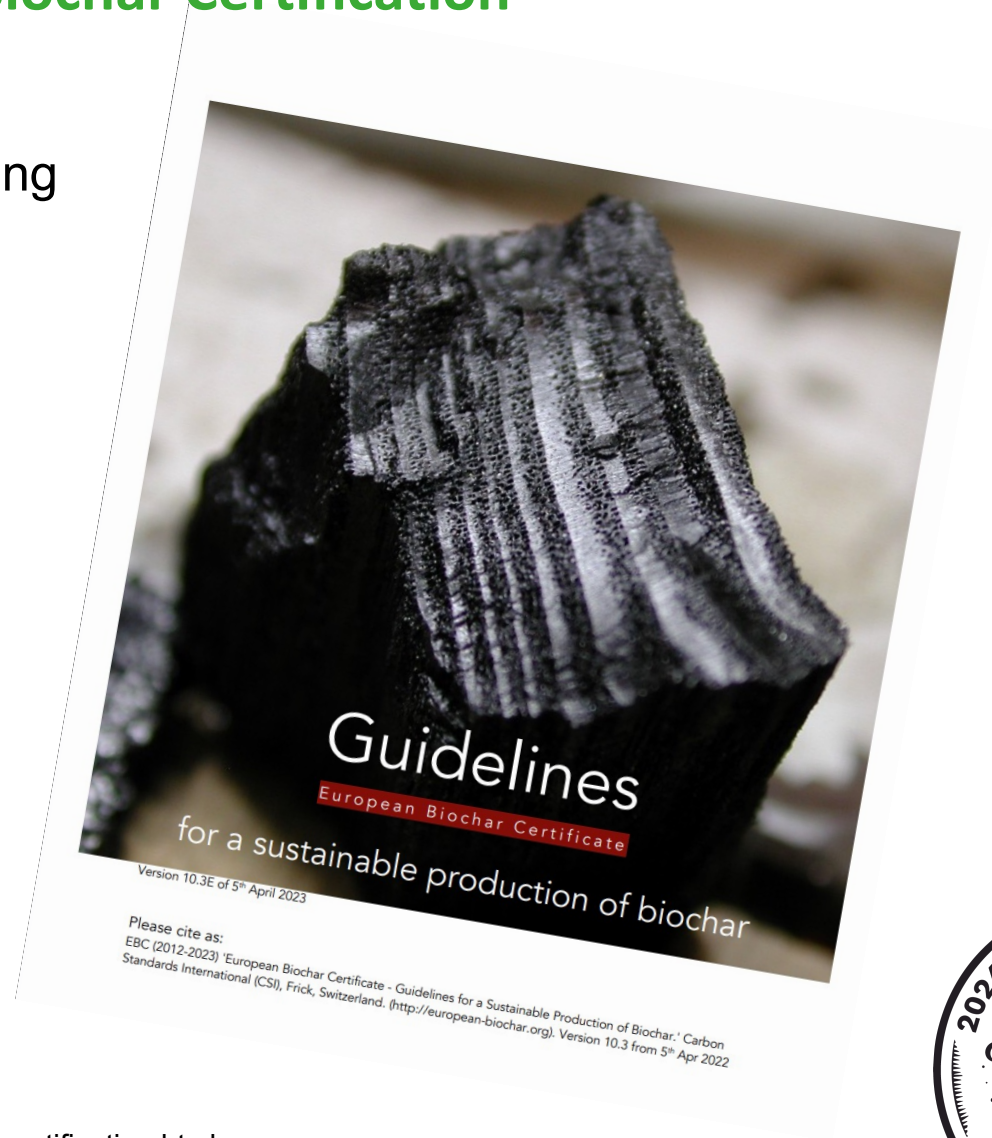
Future Proofing Pyrolysis Operations for Biochar Certification

When a key profitability goal hinges on creating "High Quality" or "High Technology" Biochar….

Don't neglect Waste Heat Energy Production in your design.



Sources:
https://www.european-biochar.org/media/doc/2/version_en_10_3.pdf

https://www.carbon-standards.com/en/standards-and-services/service-496~audit-and-certification.html

Established in 2012, the EBC is currently on version 10.3 of the Guidelines.

There have been two revisions within just the past 12 months.

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Future Proofing Pyrolysis Operations for Biochar Certification

EBC foundation | certificate

8. Pyrolysis

8.1 Biomass pyrolysis must be operated in an energy efficient manner.

Except for the preheating of the pyrolysis reactor, the use of fossil fuels for heating the pyrolysis reactor is prohibited. The use of waste heat from other industrial processes, such as bio-digesters or cement production or the use of solar thermal energy is permitted. If the pyrolysis reactor is electrically heated, the use of renewable energy sources or the use of surplus electricity is recommended.

"…Must be operated in an energy efficient manner…….

The use of renewable energy sources or surplus electricity is recommended."

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Future Proofing Pyrolysis Operations for Biochar Certification

EBC foundation | certificate

"…Excess Heat must be used to at least 70%…for generating electricity or for similar sustainable purposes."

8.4 Biochar production must be energy and carbon efficient

Approximately 35 to 60 % of the energy contained in the biomass feedstock is eventually contained in the pyrolysis gas, which is usually burned in the pyrolysis unit. Part of the energy released during the combustion of these gases is often used to heat the biomass for pyrolysis. Excess heat must be used to at least 70%, e.g., for drying biomass, for district heating, for generating electricity or for similar sustainable purposes. For a transitional period of maximum 3 years after installation of the pyrolysis plant, an exemption for missing waste heat recovery can be applied for. In the meantime, a solution for efficient waste heat recovery must be developed.

Alternatively, the pyrolysis oil and/or gas can also be captured and used for energy storage, e.g., to deliver peak loads in district heating in winter by burning pyrolysis-oil that was collected during summer. The material use of the bio-oil and/or the upgrading of the pyrolysis gas into basic chemicals such as methanol are also conceivable options to reach eventually a carbon efficiency of at least 70%.

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Future Proofing Pyrolysis Operations for Biochar Certification

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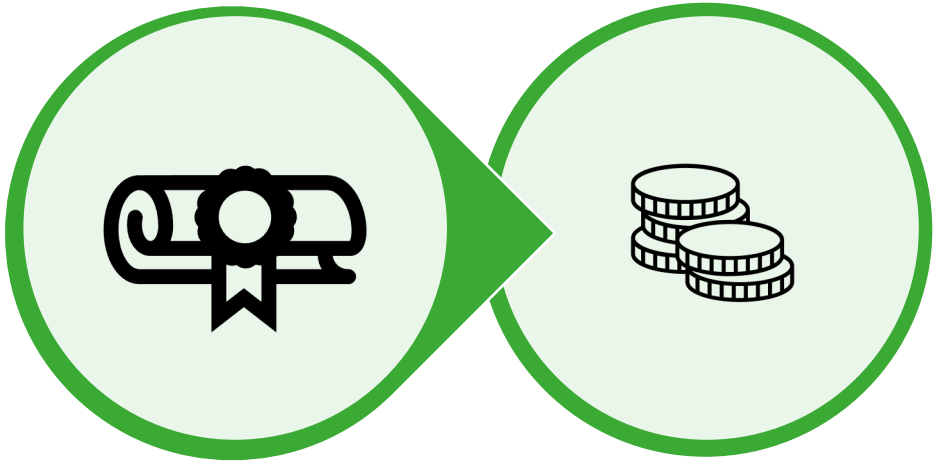
Driving Value of Biochar through Waste Heat Recovery

Biochar and Certified Carbon Credits with Higher Energy Efficiencies are likely to be in higher demand by consumers, and command a greater price on Carbon Markets.

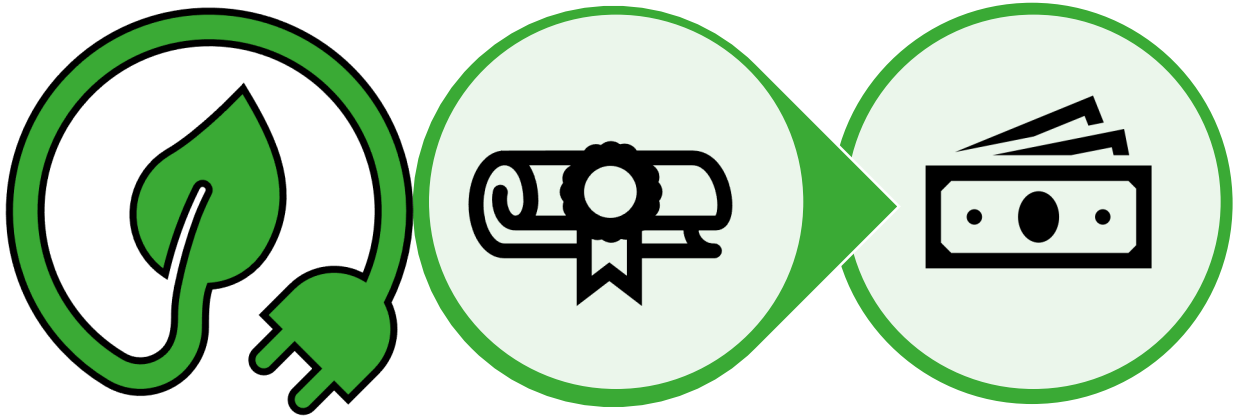


Google Sustainability

Microsoft

Meta

Chevron



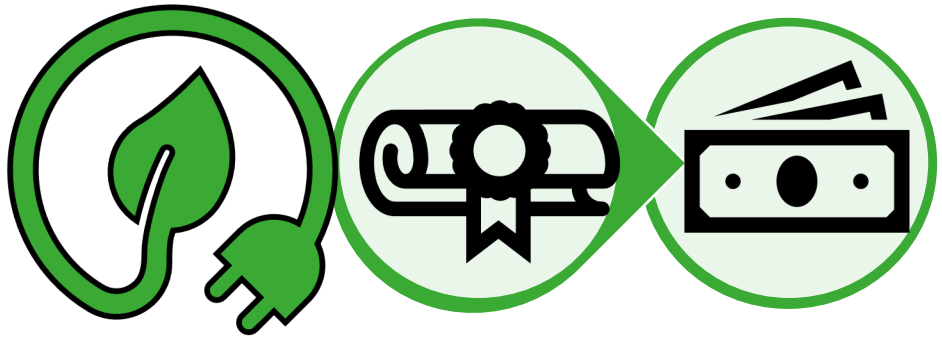
WASTE HEAT BOTTOM LINE

A WEBINAR SERIES

PRESENTED BY: ElectraTherm

BY BITZER GROUP

Driving Value of Biochar through Waste Heat Recovery



Reducing Carbon Intensity aka "CI Score" has been predictive of commodity value increase in Renewable Natural Gas (RNG) markets.

Resources: https://ww2.arb.ca.gov/resources/documents/lcfs-pathway-certified-carbon-intensities
https://ww2.arb.ca.gov/resources/documents/lcfs-life-cycle-analysis-models-and-documentation

Driving Value of Biochar through Waste Heat Recovery

Consider Opportunity Cost!

Tax Credit Financial Advantages for R & D Test Project (Section 48E)

Waste Heat projects currently eligible for funding/cost offsets through the **Inflation Reduction Act** in the USA in the form of an Income Tax Credit (ITC) or Production Tax Credit (PTC). Credit ranges from 30-50% of project cost based on eligibility factors.

Includes Direct Pay and Transferability.

RESOURCE: https://bipartisanpolicy.org/blog/inflation-reduction-act-summary-energy-climate-provisions/

DEPLOYMENT – ORC IS EASY

POWER+ GENERATORS BENEFITS --

Small Footprint facilitates installation with extremely minimal plant/facility impact.

Immediate Availability of *Carbon Neutral, Zero Emissions* Energy production for onsite use, or deployment back to the grid.

As near to “plug and play” energy solution as is available today.

Actual internal componentry is less than you would anticipate.

Modular & Re-Deployable.

Often Remote fleet control available, and no onsite operator is necessary!

DEPLOYMENT – ELECTRATHERM IS EASY

POWER+ GENERATORS BENEFITS --

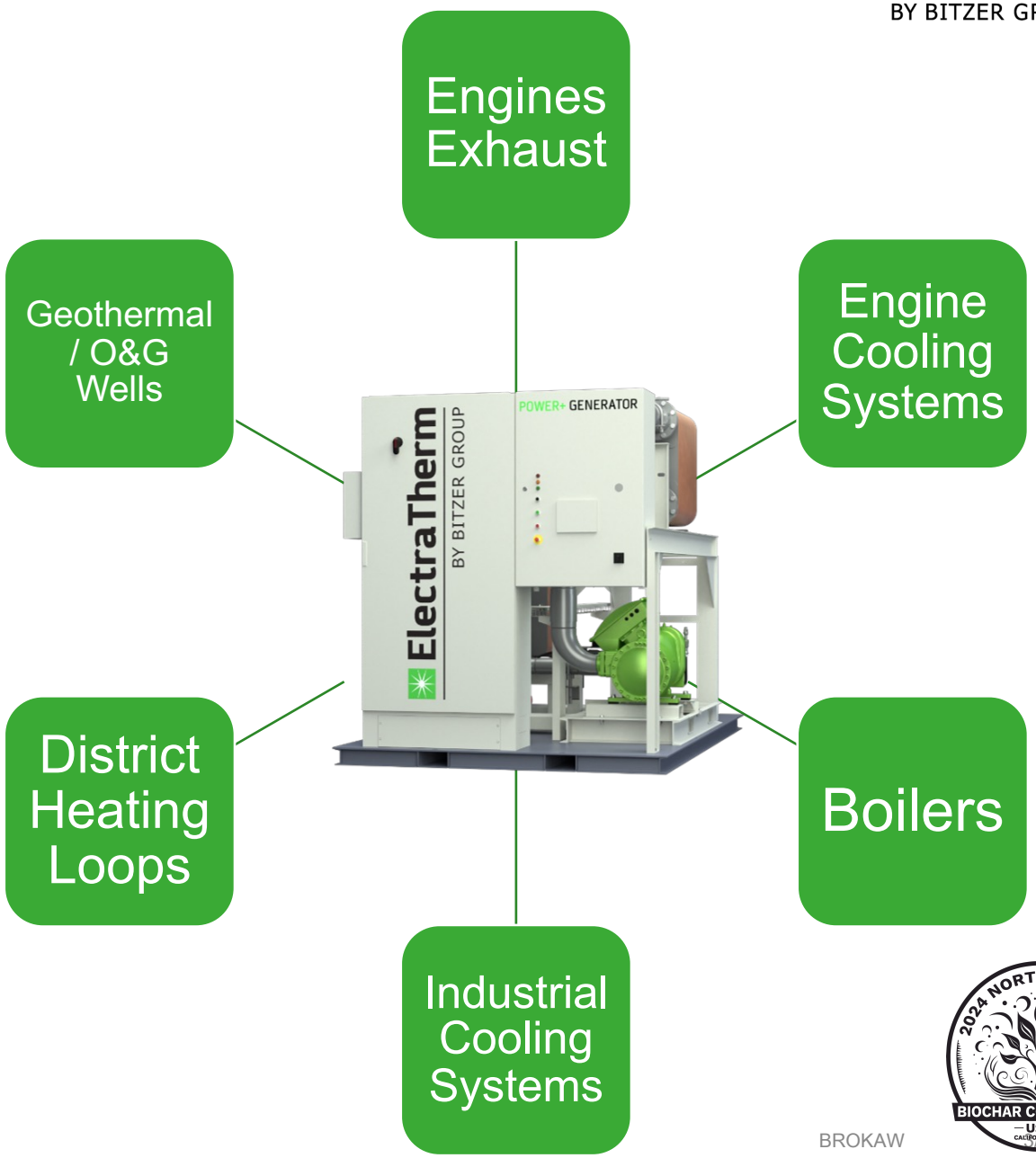
ORC integration for Pyrolysis is comparatively easy!

WE'VE DONE IT MANY TIMES FOR MUCH TOUGHER APPLICATIONS.

Your Pyrolysis unit likely has need of a cooling function of same nature anyway….why not pull out that heat and create energy rather than expend it?

DEPLOYMENT – ELECTRATHERM IS EASY

ORC Implementation in your design will not interfere with your primary business mission….
which is handling feed stock, creating biochar, and generating Carbon Credits.



ENHANCE EXISTING BIOCHAR SYSTEM PROCESSES

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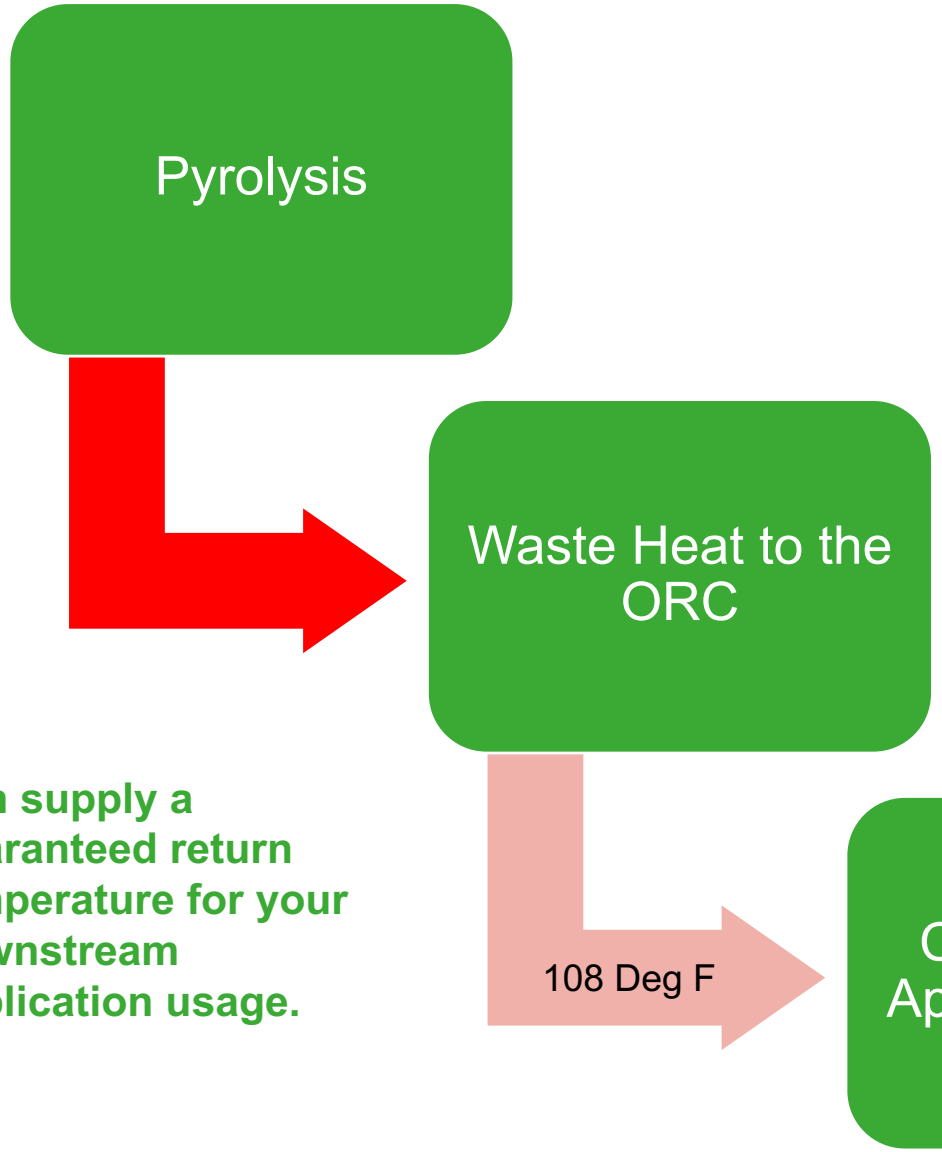

Can supply a guaranteed return temperature for your downstream application usage.

ORC Implementation can often be integrated with existing system design heat usages.

- Feedstock Drying
- Building Heat
- Agricultural Heating / Drying Applications
- Anaerobic Digestor Heating*

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MAXIMIZING BIOCHAR VALUE THROUGH WASTE HEAT RECOVERY – Conclusions

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1. Certification requirements for biochar credits is a moving target…Future proofing is Key. Don't forget Waste Heat utilization.

2. The heat utilization you are pursuing today to meet 70% usage thresholds may not be sufficient for credit certification in the future, or meet the expectations of key consumers focused on aggressive green initiatives.

3. Carbon intensity (CI Score) will likely be a key market driver! Plan now to meet this challenge, because your competition certainly will.

4. Funding available under the Inflation Reduction Act can greatly assist with CapEx of a full project, so contact your Tax Pros.

5. Deployment of Organic Rankine Cycle technology for these strategic financial benefits will not interfere with your primary mission of creating High Quality Biochar.

THANK YOU FOR PARTICIPATING

SPEAKER:

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We look forward to talking with you soon.