Forest Energy

Biochar Carbon Removal (BCR)

Using Local Biomass for Power Generation

FOREST ENERGY, INC
Founder and CEO, Shingo Numa

January 2024

Before we begin

A) If you would like a copy of Forest Energy's presentation, or

B) If you have any questions to the speakers of webinar

Please fill in the feedback after the webinar, via below site.
Don't forget to write your email address, so that we can get back to you.

Feedback

About Forest Energy

A) Developer and operator of wood biomass power plant in Japan

B) For power generation, we use both boiler turbine (BTG) and gasification (CHP)

C) We have sold more that 50 units of CHPs in Japan

D) We are developing biomass energy business in ASEAN countries





First carbon-negative power plant in the APAC region

Full article

https://bit.ly/3Shv1kh

Diesel & Gas Turbine WORLDWIDE

LATEST NEWS ▾ SPECIAL FEATURES SERIES SPECS-AT-A-GLANCE E-NEWSLET

Jenbacher engines at the heart of Japanese-led wood power plants

A wood power plant in Shingu City serves as the first carbon-negative power plant in the APAC region, operating with SynCraft's reverse power plant technology. The combination of Syncraft's climate-positive system and INNIO's innovative Jenbacher engine technology is expected to continuously feed Japan's grid with renewable power for approximately the next 20 years. (Image: Shingu Forest Energy LLC)

A wood power plant in Shingu City serves as the first carbon-negative power plant in the APAC region, operating with SynCraft's reverse power plant technology. The combination of Syncraft's climate-positive system and INNIO's innovative Jenbacher engine technology is expected to continuously feed Japan's grid with renewable power for approximately the next 20 years.

Tapping into Tariff Power

Japan committed to achieve carbon neutrality by 2050, reduce greenhouse gas emissions (GHG) by 46% in 2030 from its 2013 levels, and decrease dependency on nuclear power. As part of these efforts both to decarbonize and reduce the country's reliance on nuclear energy, the government of Japan established Feed-In Tariffs (FIT) to provide renewable energy projects in order to accelerate the adoption of renewable energy. Under the FIT initiative, Japanese utilities can buy electricity from renewable sources, such as, biomass, at pre-set premiums. Japan's FIT policy has stimulated the growth of two energy segments: Wood gas and biogas.

To empower the governmental plans, Shingu Forest Energy LLC -- an entity of Forest Energy Corporation -- moved forward with plans to construct the first biomass power generation project to operate in Shingu City, Wakayama Prefecture, Japan. The Japanese-led team turned to INNIO's Jenbacher J412 engines.

The use of biomass for decentralized power and heat generation is an increasingly important aspect of the energy transition and associated decarbonization. In contrast to wind and sun, regrowing raw materials such as wood are constantly available and can be used in the form of wood gas to generate power and heat in SynCraft's reverse power plant using Jenbacher engines. Wood gas has a hydrogen content (energy based) of over 40%. These plants achieve a fuel utilization rate of up to 92%, as well as offer another valuable advantage: in contrast to conventional plants, this new and innovative system produces biochar, rather than ash.

CERTIFIED BIOCHAR
EBC
EUROPEAN BIOCHAR CERTIFICATE (EBC)

Forest Energy

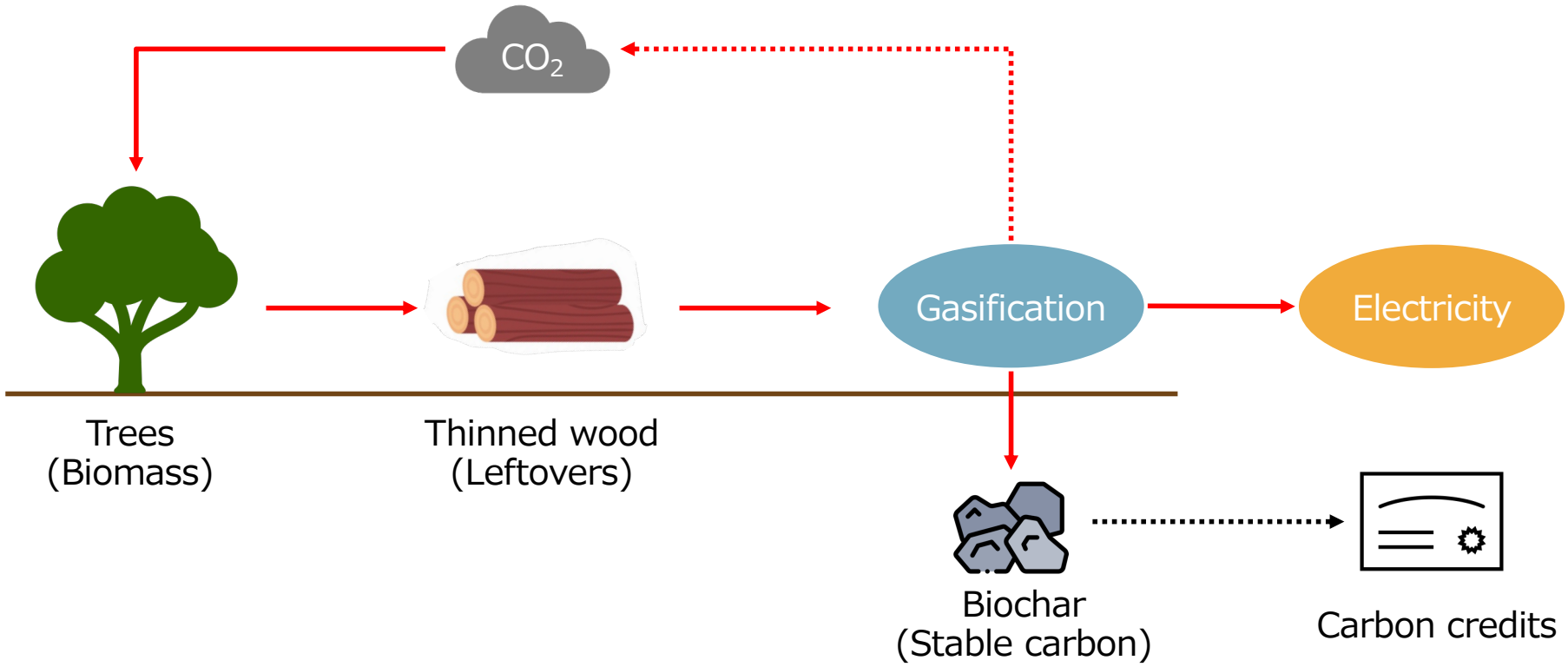
Carbon negative power generation: the mechanism

- Trees captures CO2 from the atmosphere (photosynthesis)
- Energy produced from use of biomass is regarded carbon neutral
- BIOCHAR is carbon resulting from gasification / pyrolysis of trees
- Thus, through use of biochar to store carbon, gasification biomass power plant can become “carbon negative”

CO_2 neutral energy

+

Negative emission

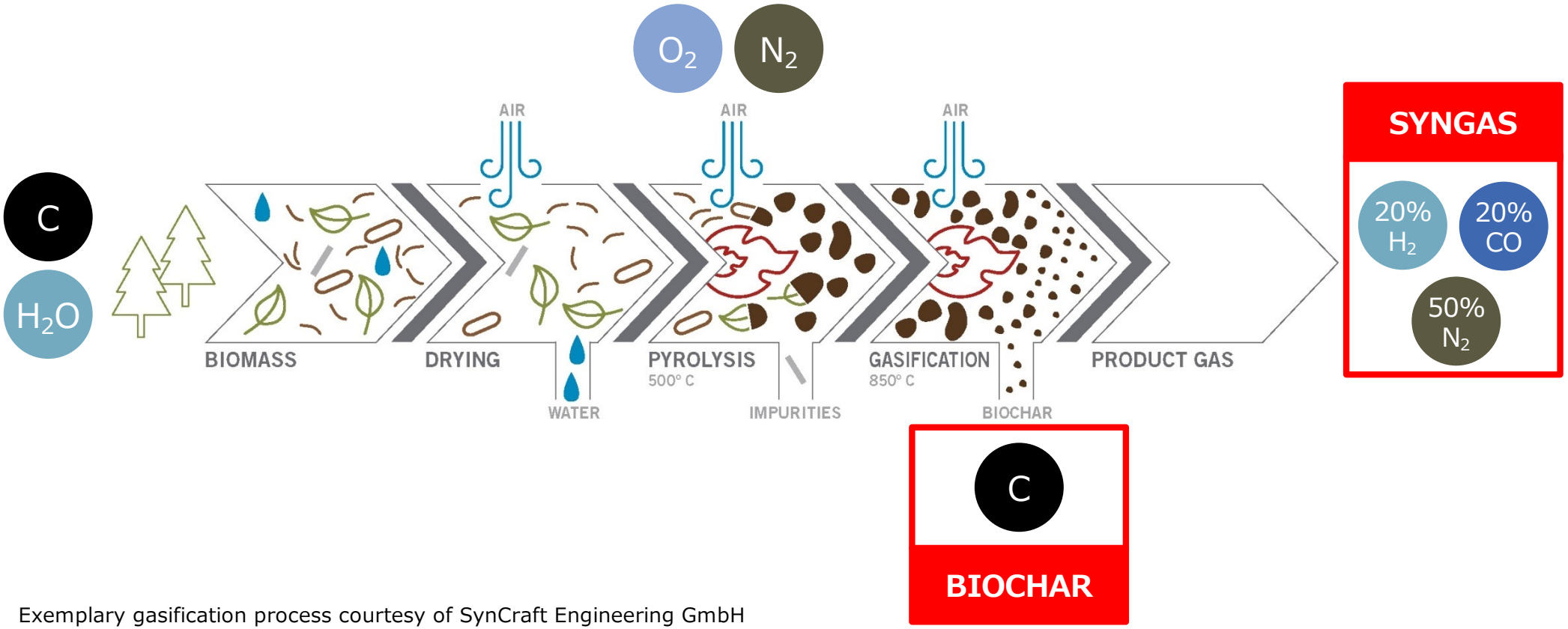


Biochar image: Flaticon.com

Biomass gasification: the process

- By heating biomass at high temperature without oxygen, biomass is converted into SYNGAS (energy gas, product gas)
- Byproduct of energy is BIOCHAR (carbon)
- Process need to modified depending on type of biomass

PROCESS FLOW OF GASIFICATION



Exemplary gasification process courtesy of SynCraft Engineering GmbH

What is BIOCHAR ?

Definition

(Definition by U.S. DEPARTMENT OF AGRICULTURE)

A) BIOCHAR is black carbon produced from biomass sources for the purpose of transforming the biomass carbon into a more stable form

- Biomass sources: wood chips, plant residues, manure or other agricultural wastes
- Stable form: carbon sequestration = process of storing carbon dioxide (CO_2)

B) “Terra Preta” (dark earth)

- Biochar is speculated to have been used as a soil supplement thousands of years ago in the Amazon basin, where regions of fertile soil called "Terra Preta” were created to improve soil fertility and crop yields (Mann, 2005)

What is BIOCHAR ?

Biochar, a material with exceptional properties
(Exempt from EBI: European Biochar Industry Consortium)

A) Biochar has a high carbon content of up to 90 % and binds carbon material reliably, long-term and without negative side effects

B) It is characterized by highly interesting physical and chemical properties and has a positive effect on biochemical processes

Biochar from wood, 850ºC
Shingu Forest Energy, Japan

<90% Carbon

Porous

Alkaline

Why are we interested in BIOCHAR ?

Carbon Sequestration
Carbon Dioxide Removal (CDR)

×

Product using carbon

A) The international scientific community identified biochar as a promising net negative emissions technology (NET) for the first time in the 2018 IPCC report.

B) Biochar Carbon Removal (BCR) is one of high-durability CDR technology

- DACS: direct air capture and storage
- BECCS: bioenergy with carbon capture and storage
- BCR: biochar carbon removal
- ERW: enhanced rock weathering

C) BCR is ready for use. No new technology development required

D) In many applications, biochar replaces scarce resources while improving the quality of the end-products

Creating business using BIOCHAR

<Key items for business development>

1. Type of biomass, availability and cost
2. Production methodology
3. MRV (Measurement, Reporting, and Verification) for CDR
4. Is BIOCHAR main product, or by-product of energy

WORLD ECONOMIC FORUM

<5 Key Recommendation for confident carbon removal investment>

1. Invest in high-durability technologies
2. Insist on comprehensive transparency
3. Prioritize verified and certified carbon removal credits
4. Engage in transparent marketplaces
5. Consider multi-year offtake agreements

Full article

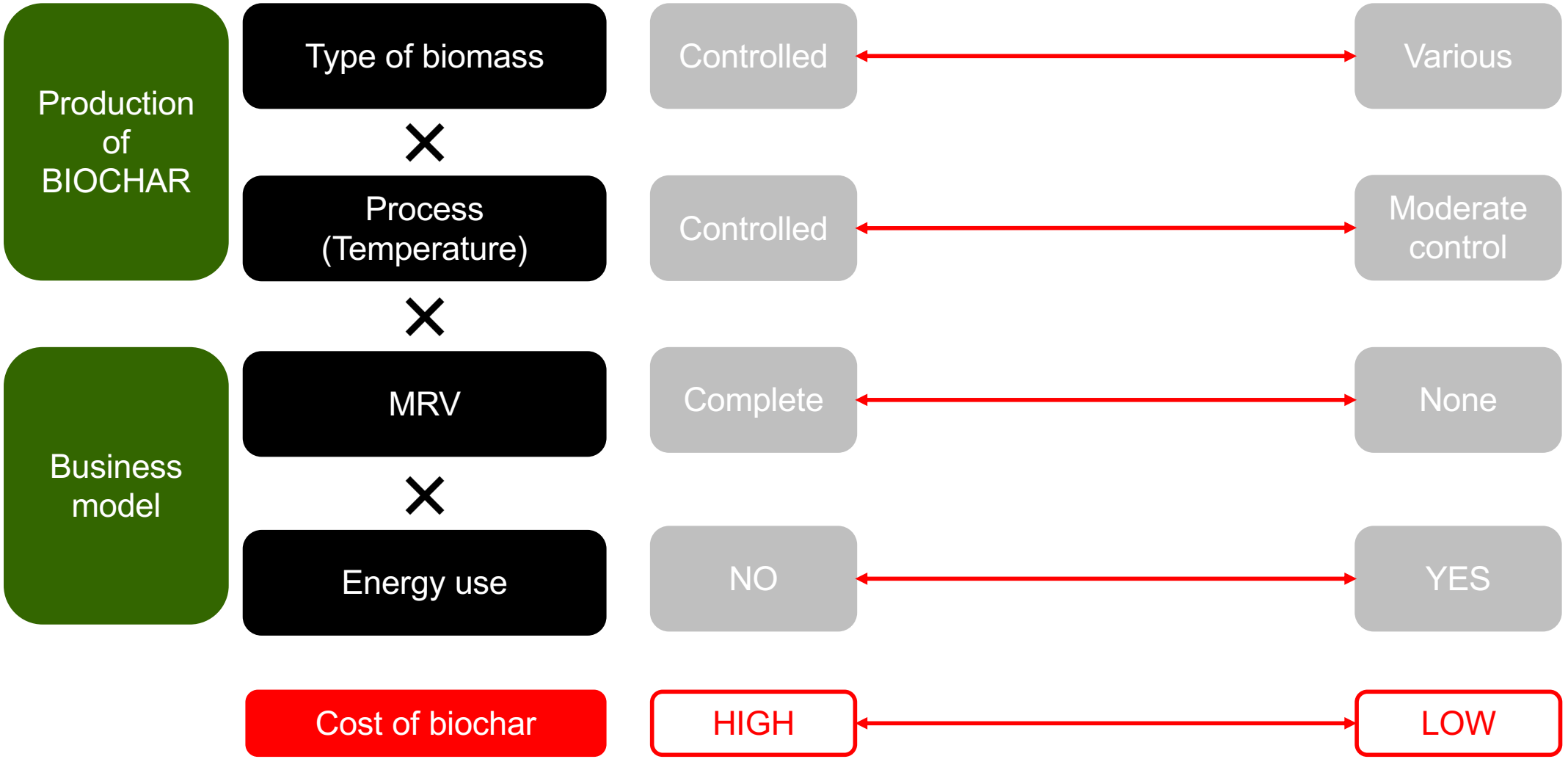
World Economic Forum, 9 Oct 2023

Creating business using BIOCHAR

BIOCHAR comes in various characteristics …

Various combination of different type of biomass and production temperature

What is the best and realistic combination for your biochar business ?



Production of BIOCHAR

Pyrolysis / gasification of biomass is a thermochemical process in which solid biomass is treated with a limited amount of oxygen to convert it into valuable gases and a solid residue named biochar.

Process (Temperature)

Pyrolysis

Gasification

Route	Temperature (K)	Pressure (Mpa)	Main Products
Torrefaction	503–573	0.1	Solid fuels
Liquefaction	523–603	5–20	Bio-oils, Gases
Pyrolysis	573–873	0.1–0.5	Bio-oils, Transport Fuels
Gasification	773–1573	≥0.1	Syngas, Heat, Electricity
Combustion	973–1673	≥0.1	Heat, Electricity

Diagram based on Elsevier, Chichester (2010) and Basu P. (2013)

Production of BIOCHAR

A) The temperature reached during pyrolysis makes a big difference in the nature of the biochar produced.

B) Optimal biochar properties seem to result from pyrolysis temperatures between 500 and 600 °C.

Process (Temperature)

Pyrolysis

Gasification

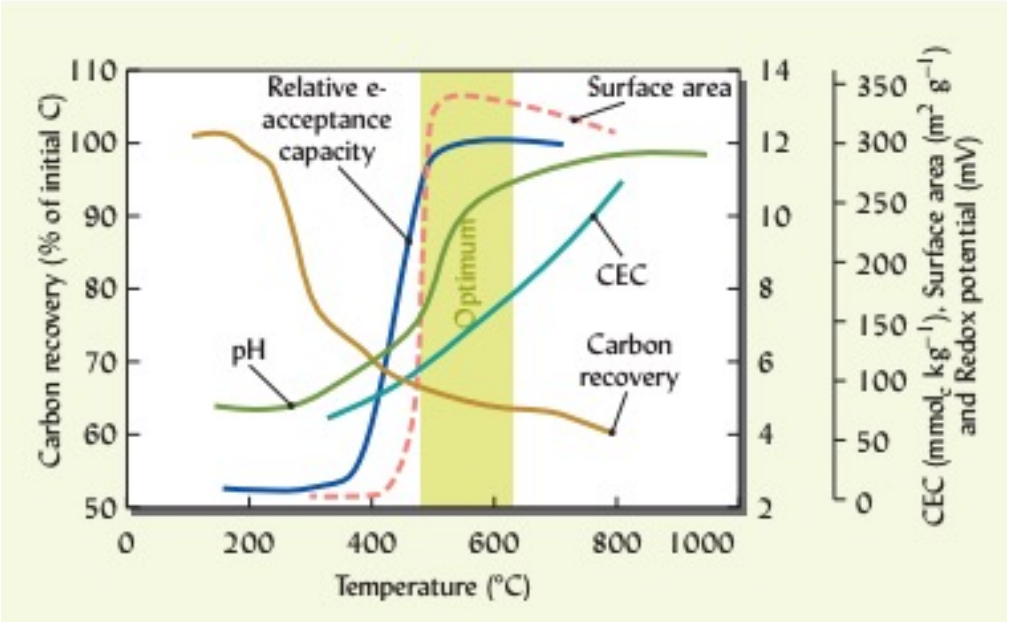


Diagram based on data in Klüpfel et al. (2014) and Lehmann (2007)

Forest Energy's business in Japan

A) BIOCHAR is by-product of power generation

B) Process / temperature is not optimized for quality of biochar, but for power generation

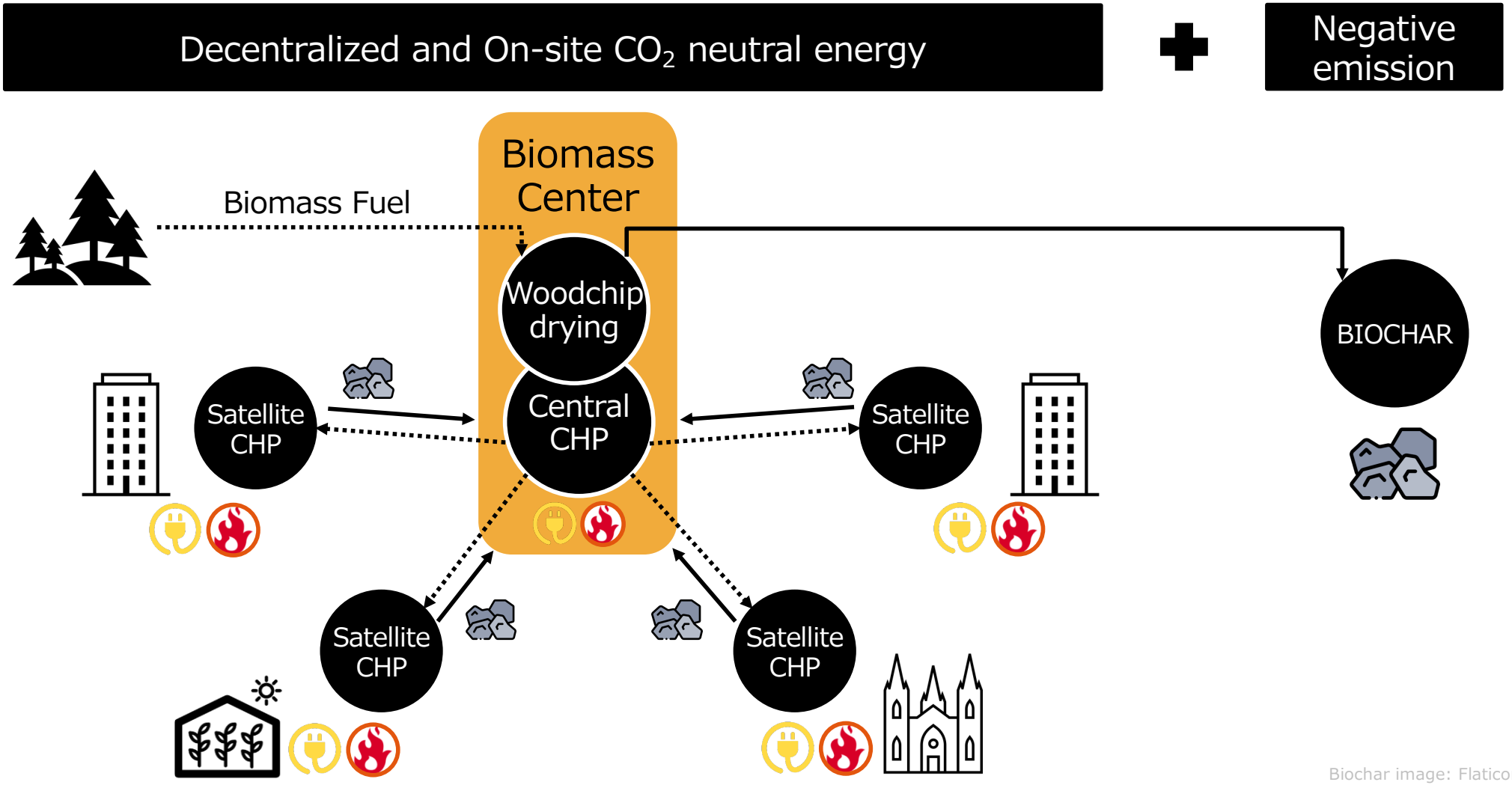
C) Revenue from business: Electricity, sale of biochar and carbon credit

Type of biomass	Controlled	Forest residue, defined under Feed-in Tariff (FIT) system
×		
Process (Temperature)	Controlled	Gasification designed for power generation
×		
MRV	Complete	Compliance with J-Credit and European Biochar Certificate
×		
Energy use	YES	All CHP (power generation)

Forest Energy: Power generation x BIOCHAR

Decentralized / On-site energy

- Decentralized / On-site “carbon negative” power generation
- Network of small CHPs, suited for less populated area, close to biomass



Biochar image: Flaticon.com

Forest Energy: Power generation x BIOCHAR

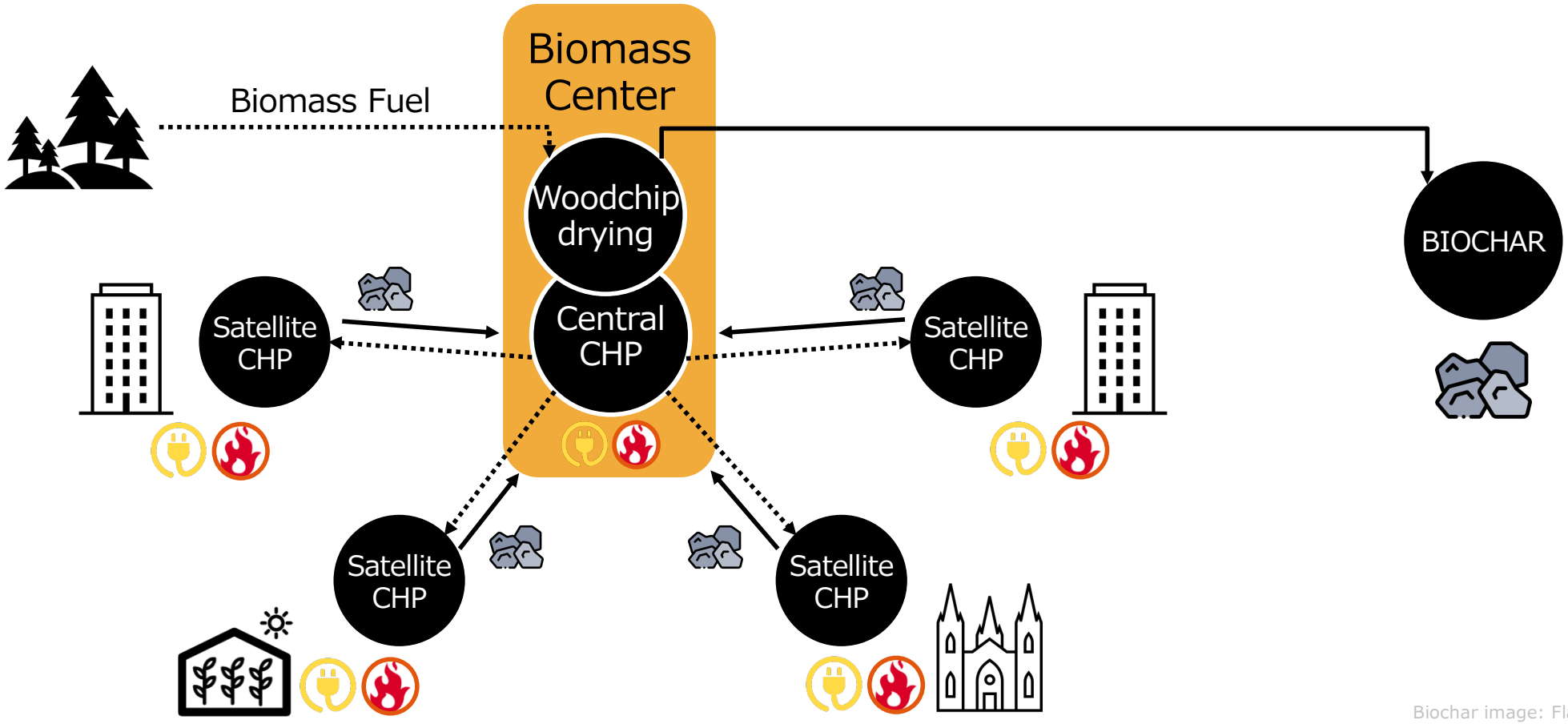
Why this model

A) Energy resilience. Demand for decentralized energy source, suited for CHP

B) No district heating. Demand for heat is on-site

C) Demand for BIOCHAR is still small, but interest is high

D) Gasification technology is designed for wood, not for agriculture residue



Biochar image: Flaticon.com

Forest Energy: BIOCHAR

- Product development in progress
- Carbon farming: Biochar can increase soil fertility, water holding capacity and crop productivity, Thus, it can be used to reduce usage of fertilizer and improve crop yields
- Green construction material: Biochar can be mixed in asphalt and concrete. Carbon credit can be issued in certain voluntary market

CARBON FARMING

SOIL IMPROVEMENT

CONSTRUCTION MATERIAL

ASPHALT

CONCRETE

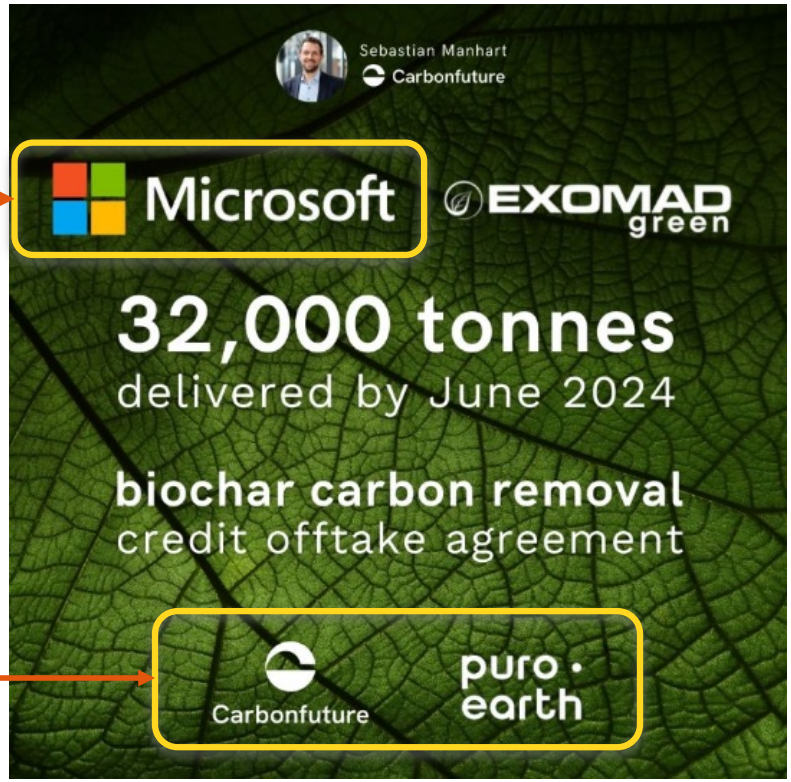
Picture courtesy of Forest Energy's partners

Case study: EXOMAD green, Bolivia

A) Project by EXOMAD. Concepción, Bolivia
- The biomass used reduces the risks of forest fires and improves air quality
- The biochar is redistributed directly to farmers who can improve soil fertility and yields

B) All 32,000 tons of biochar carbon removal (BCR) will be delivered in the next 6 months.

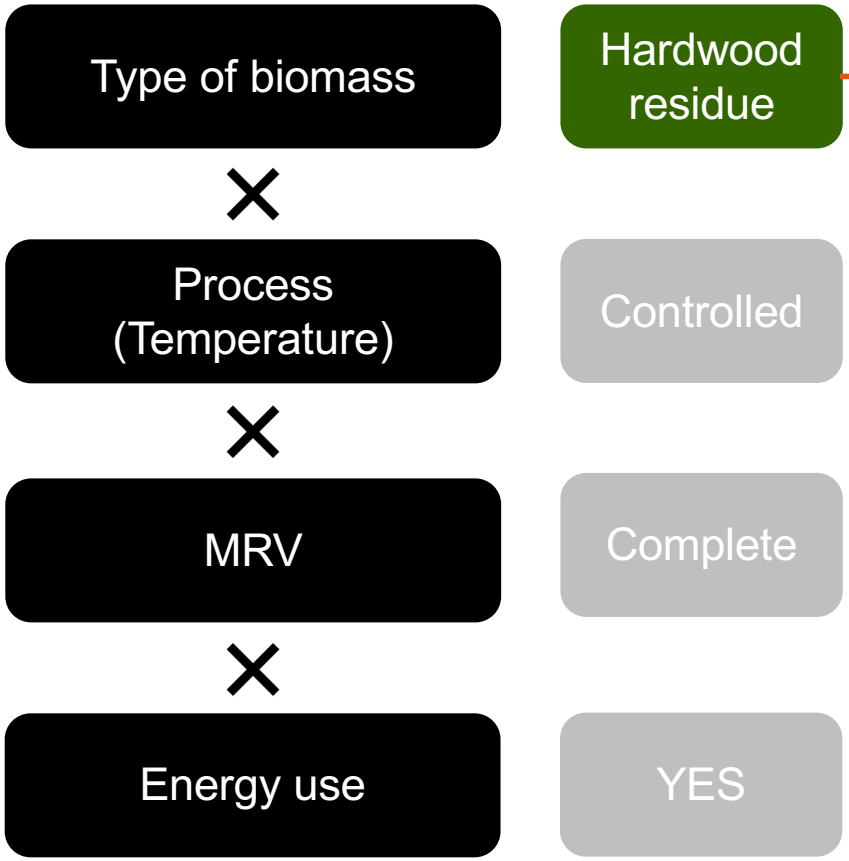
Type of biomass	Hardwood residue
Process (Temperature)	Controlled
MRV	Complete
Energy use	YES



Case study: EXOMAD green, Bolivia

A) Project by EXOMAD. Concepción, Bolivia
- The biomass used reduces the risks of forest fires and improves air quality
- The biochar is redistributed directly to farmers who can improve soil fertility and yields

B) All 32,000 tons of biochar carbon removal (BCR) will be delivered in the next 6 months.



"The procurement of these residues strictly adheres to all local and international laws, and we only partner with suppliers who share our commitment to sustainability and legal compliance.

Through this approach, we ensure that our operations do not contribute to deforestation or illegal logging practices, but rather add value to existing forestry activities by repurposing waste materials into valuable Biochar."

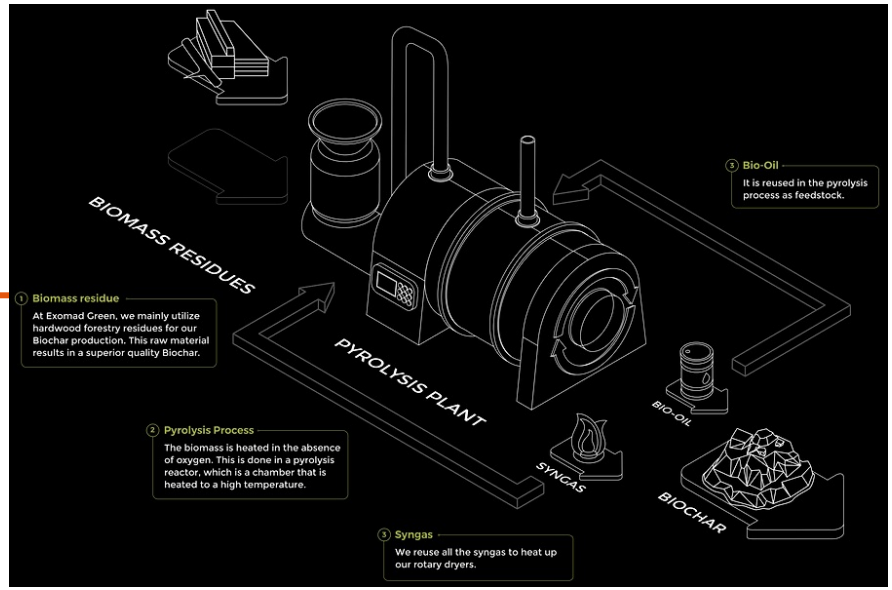
(EXOMAD green)

Case study: EXOMAD green, Bolivia

A) Project by EXOMAD. Concepción, Bolivia
- The biomass used reduces the risks of forest fires and improves air quality
- The biochar is redistributed directly to farmers who can improve soil fertility and yields

B) All 32,000 tons of biochar carbon removal (BCR) will be delivered in the next 6 months.

Type of biomass	Hardwood residue
Process (Temperature)	Controlled
MRV	Complete
Energy use	YES



(EXOMAD green)

Which energy use is suited for your country?

Variety of energy output

- By gasifying biomass, there are multiple options for energy output
- Particularly useful in the energy transition period, as output energy can be changed using same gasifier, minimizing transition cost