Forest Energy

CO_2 Neutral Energy + Biochar Carbon Removal using Local Biomass

FOREST ENERGY, INC
Founder and CEO, Shingo Numa

About Forest Energy

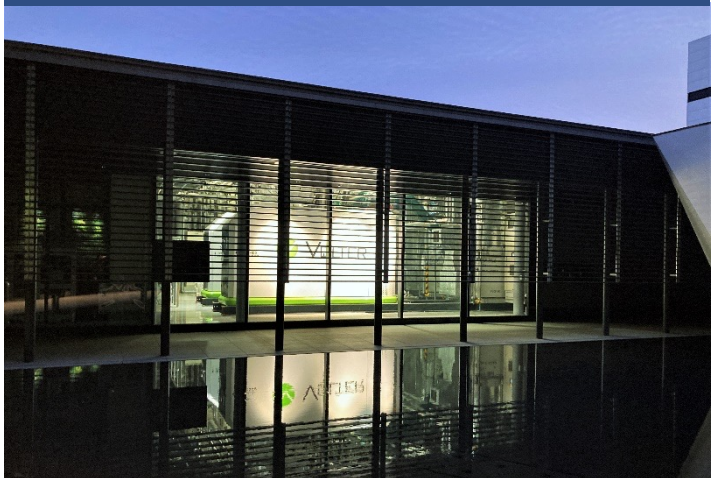
Forest Energy build-own-operate (BOO) wood biomass power plant in Japan.
We utilize both boiler (BTG) and gasification (CHP) technology.

United Renewable Energy
BTG 20.5MW

Shingu Forest Energy
CHP 1.8MW

Enshu Forest Energy
BTG 7.1MW、建設中

Net Zero Energy Building using CHP



12 units of small CHP

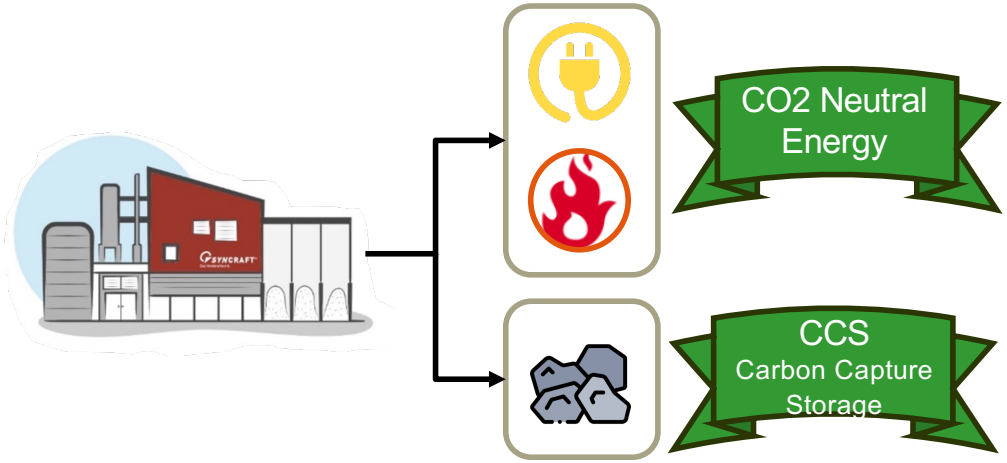
Tsuwano Forest Energy, CHP 0.5MW

Forest Energy's Local Biomass Energy Model

1. Decentralized: We operate small CHPs (40–2,000kWel) using local biomass
2. Carbon Negative: CO_2 Neutral Power & Heat (CHP)
   +
   CCS using BIOCHAR

LOCAL BIOMASS

DECENTRALIZED ENERGY + BIOCHAR



Use of thinned wood

- Promote proper forest maintenance
- Increase employment in forestry

Short distance transportation

- Low emission
- Increase local employment

Gasification CHP plant

- Compact, distributed energy supply
- High energy efficiency

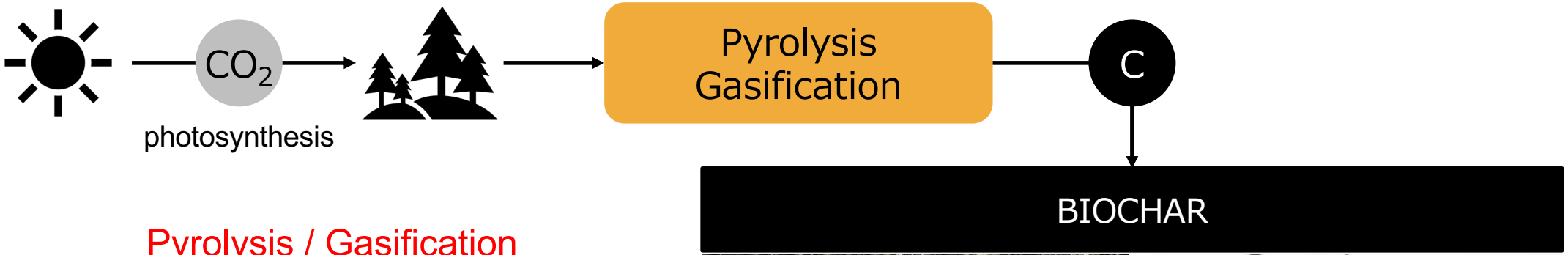
Net Climate Positive Process

- Baseload renewable electricity
- Carbon sequestration using BIOCHAR

Biochar image: Flaticon.com

What is Biochar?

1. Biomass accumulates carbon (C) through photosynthesis
2. Through pyrolysis / gasification, biomass is transformed into BIOCHAR =charcoal from organic matter, rich in carbon
3. Biochar Carbon Removal = burying BIOCHAR in soil / material to sequester carbon. It is a science-backed approach to carbon dioxide removal (CDR), recognized in IPCC



Pyrolysis / Gasification

Thermal chemical process, heating biomass in inert (oxygen free) atmosphere.

- Pyrolysis: 400℃ - 800℃
- Gasification: 750℃ - 1100℃

NOT combustion, where biomass is burned, releasing CO2.

What is Biochar Carbon Removal (BCR)?

1. BCR is a readily available. It does not require new technology development. It requires us to changes how we produce forests / crops / materials
2. As of 2022, BCR accounted for 87% of total CDR deliveries (52kt delivered) at a substantially lower cost than all other durable CDR approaches. On average, $179/t CO2 for BCR compared to an average price of $388/t across all CDR approaches

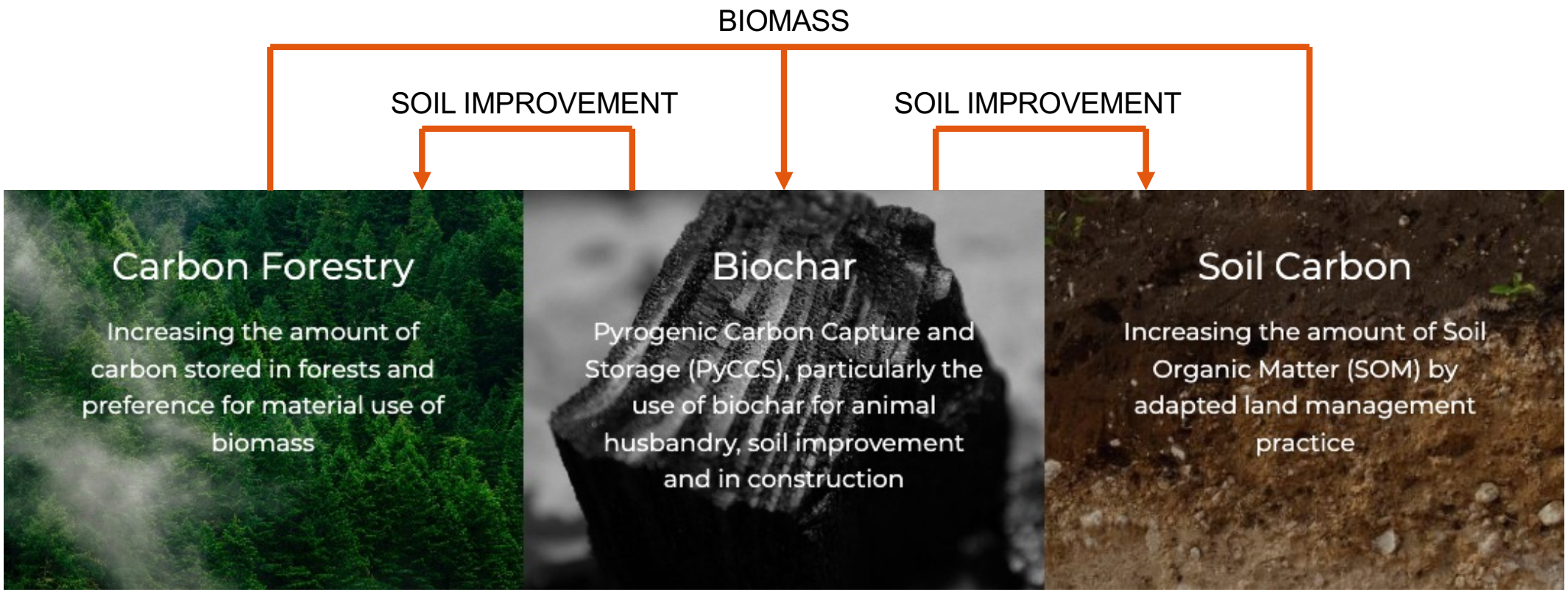


Image: European Biochar Industry Consortium (EBI)

Our Activity in Developing BIOCHAR Applications

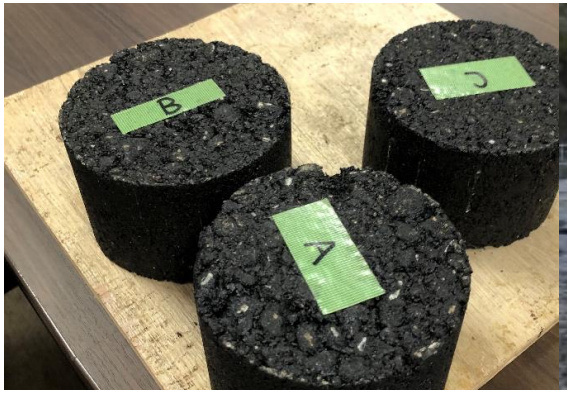
- Carbon farming: Biochar can increase soil fertility, water holding capacity and crop productivity, Thus, it can be used to reduce usage of fertilizer and improve crop yields
- Green construction material: Biochar can be mixed in asphalt / concrete/ cement. Carbon credit can be issued in certain voluntary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

Carbon Farming

2024/2025

Evaluation of biochar & compost pellet production factory (Japan)

Construction Material



2024/2025

Production of demonstration product.
Biochar concrete retaining wall / panel

Picture courtesy of Forest Energy's partners

Effective CO_2 Fixation by BIOCHAR per KG

Following '2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories'

Effective CO_2 fixation by BIOCHAR = **2.29 kg-CO_2/kg**

= CO_2 fixation by BIOCHAR − CO_2 emission while collecting raw materials and producing the biochar

Carbon content※1×Carbon residual after 100 years※2
×CO_2 molecular weight/carbon atomic weight
= 0.776×0.89×44/12= 2.532 kg-CO_2/kg

CO_2 emission while collecting raw materials※3
+CO_2 emission while producing the biochar※3
= 0.057 kg-CO_2/kg+0.176 kg-CO_2/kg
= 0.233 kg-CO_2/kg

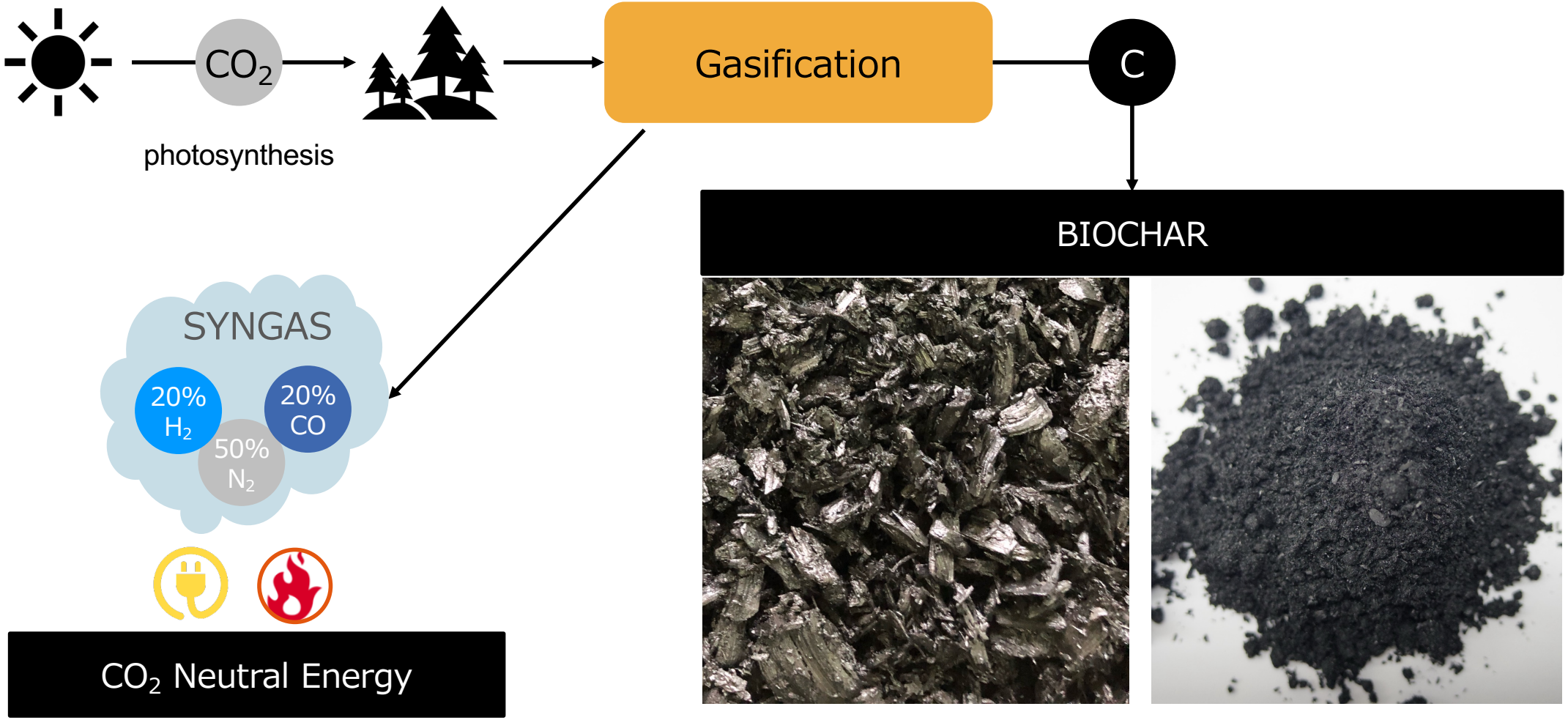
※1 : based on test results of the biochar
※2 : value when storing the biochar to soils

※3 : Calculated from fossil fuels and electricity used in the production of biochar

Calculation presented in Biochar Webinar 2024 by Mr. Shinya Yamamoto, Shimizu Corporation. 15 Jan 2024

Biochar and Energy

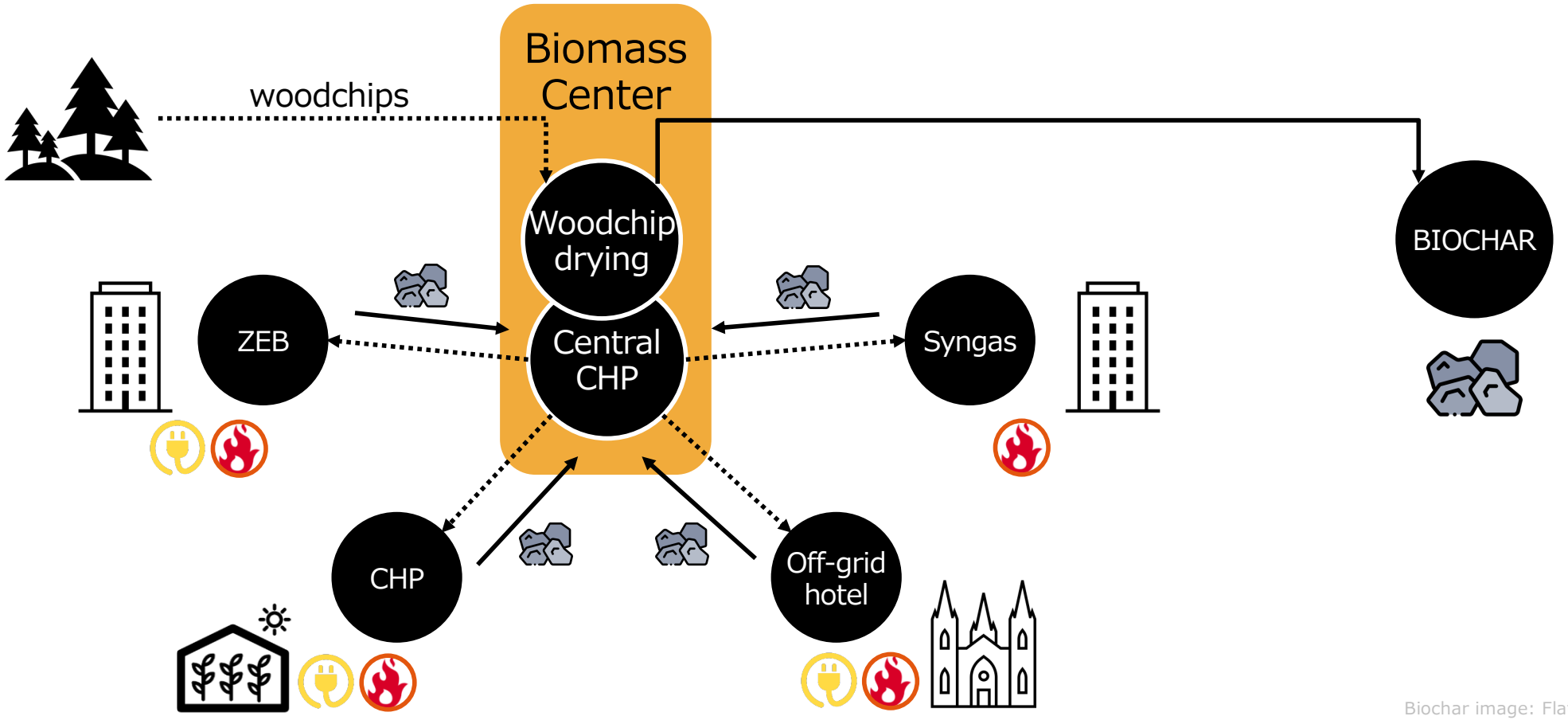
1. Through gasification, SYNGAS is produced. Applicable biomass is wood
2. SYNGAS can produce power and heat (CHP), using gas engine
3. In this case, BIOCHAR can be produced as by product of energy



Decentralized “Carbon Negative” Energy Production

1. Network of Decentralized / On-site energy production
2. Centralize fuel preparation, logistics, maintenance, and biochar processing to reduce investment and operation cost
3. Produce BIOCHAR as byproduct of energy, to reduce cost of carbon removal

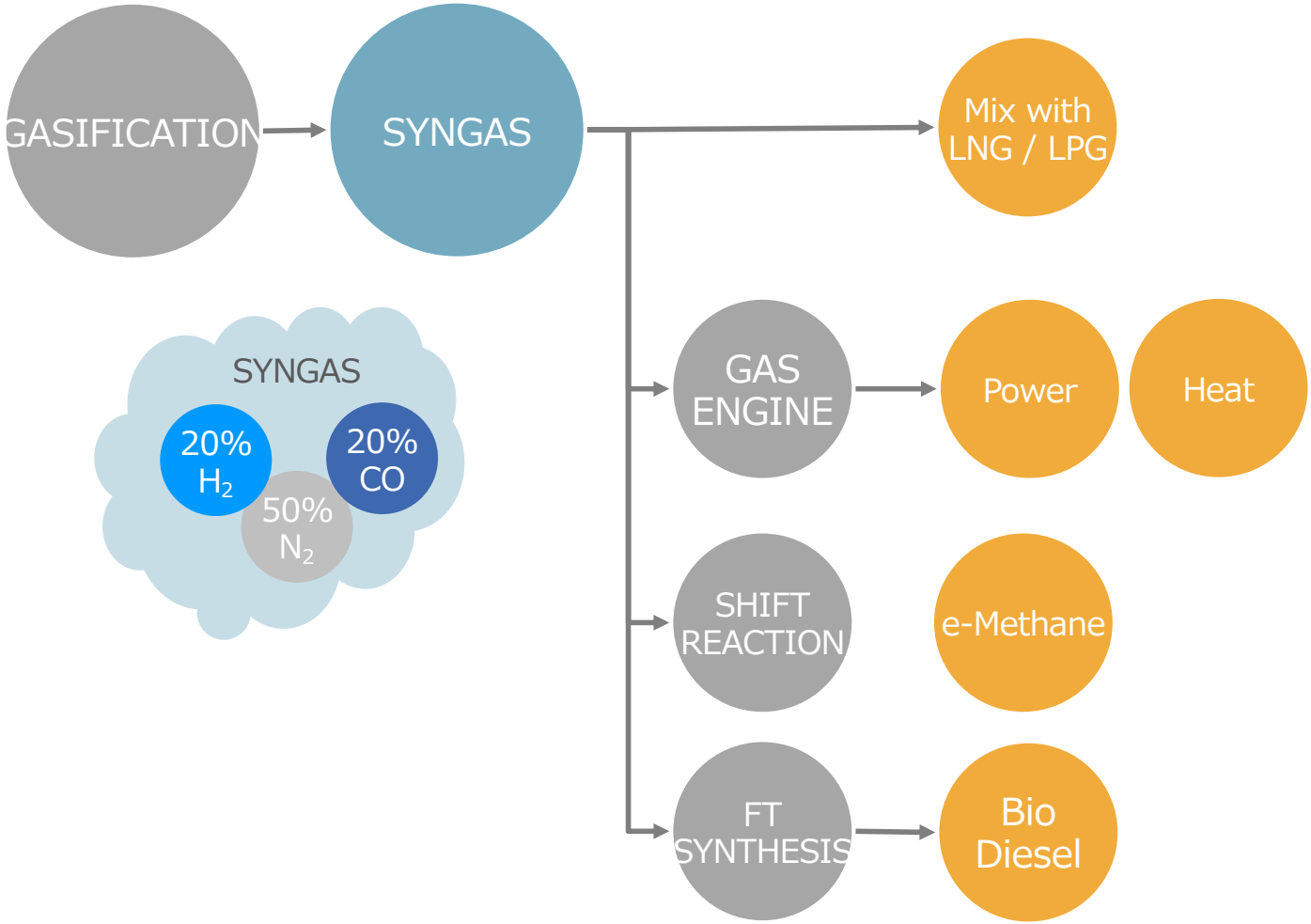
Decentralized and On-site CO_2 Neutral Energy ✚ **Negative emission**



Biochar image: Flaticon.com

New topics – Testing Use of SYNGAS to reduce LPG / Diesel

1. We are now preparing SYNGAS plant to partially replace LNG / LPG / Diesel
2. We will mix 5-20% of SYNGAS with LNG / LPG used for high temperature heat process in factory
3. NO additional process needed



In preparation

- Gas to Gas
- Reduce LNG / LPG / Diesel

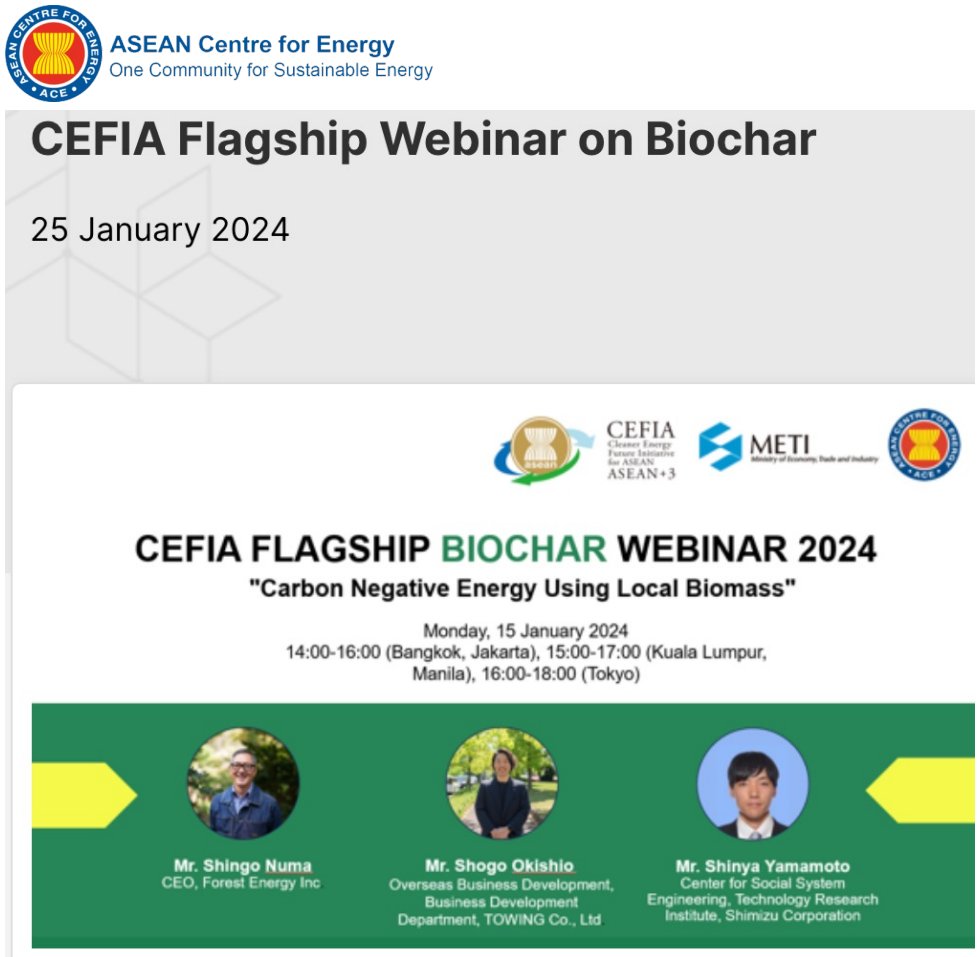
Commercialized

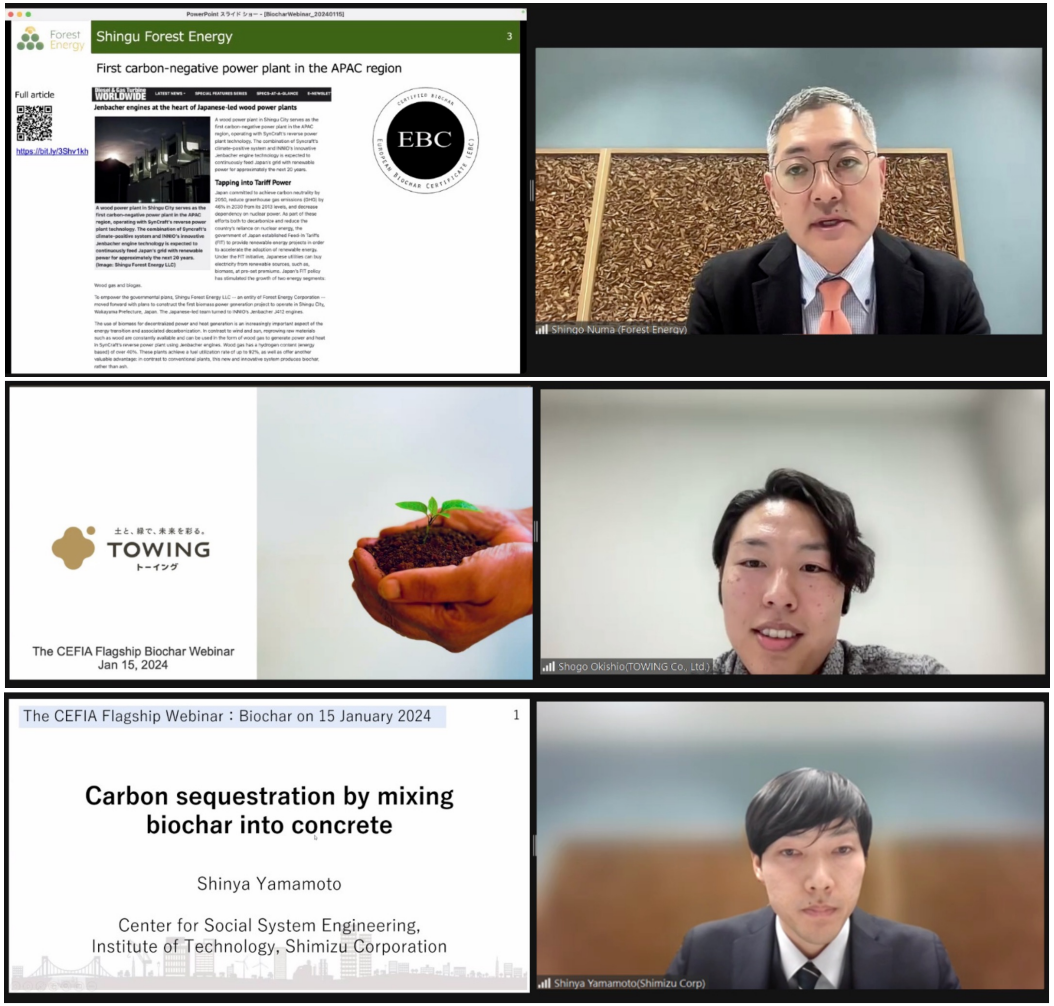
- CHP, Combined Heat & Power
- Power generation efficiency 20-30%
  Total energy efficiency 80-90%

Laboratory test

1st Webinar on BIOCHAR / 15 January 2024

1. Forest Energy, together with Towing and Shimizu Corporation, held webinar to introduce production and application of BIOCHAR
2. 131 people attended the webinar : Indonesia 39, Thailand 18, rest of Asia 25
   - Public company 70, Government 28, University 19, etc.





Next activity

2024/2025 | Seminar

- Organize 2nd seminar
- On-site & Online
- This time, we would like to do the seminar in one of CEFIA member country
- Candidate : Thailand
- LOOKING FOR: University / Research Institute / Company interested in co-hosting this seminar

2025/2026 | Feasibility Study

- We would like to conduct feasibility study in one of CEFIA member country
- Theme : Build “Biochar x Energy” model using local biomass
- LOOKING FOR: University / Research Institute interested in co-working with Forest Energy to do the feasibility study