CEFIA Biomass Flagship Project

TSUKAMOTO Osamu
President
Japan Carbon Frontier Organization

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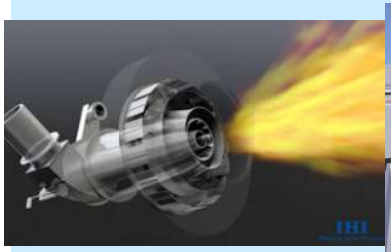
JCOAL: A Long-standing Partner of the resources sector, the power sector and the industrial sector

- Established in 1990, with its origin back to 1948
- Deals with technologies and measures for carbon neutrality with a broad scope of work involving various energy technologies such as biomass, ammonia and hydrogen utilization in addition to all coal related issues from upstream to downstream of the coal value chain.
- The unique team with engineers and analysts covering a broad range of areas enables well fabricated advisory and consultancy work that is deep-rooted in engineers' spirit.
- Chairperson: Ex-President of J-POWER
- President: Ex-Director-General for Technology Policy Coordination, METI
- Members: 152 incl. both domestic and international organizations and companies; such as mining companies, utilities, Plant manufacturers, engineering companies, trading houses, etc.

Technologies for energy transition and the future carbon neutrality

Coal ash utilization

Biomass co-firing



Ammonia co-firing

Facilitation of CCT and clean utilisation practices

Coal Center

Power plant

Cement plant

Iron works

Chemical plant

Environmentally compliant coal resources development and post-project land utilization

Coal utilisation technology development

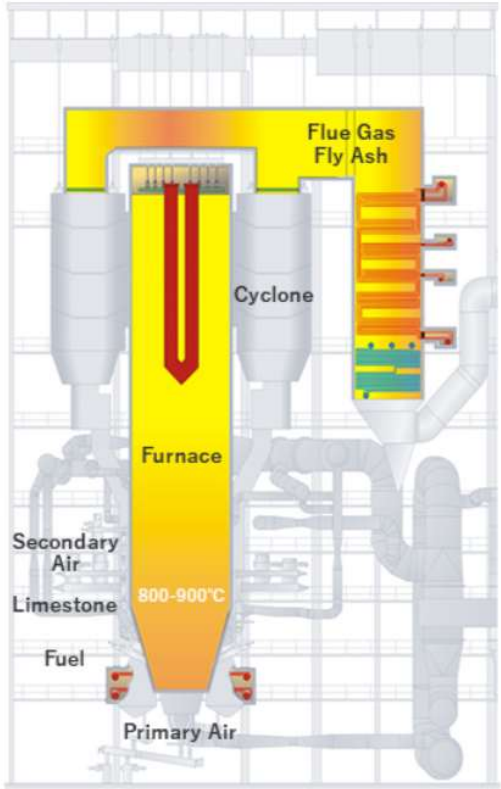
0. Why biomass?

Biomass is renewable and inherently carbon-neutral, derived from biological resources such as plants, animals, and other living organisms and municipal wastes. Biomass has come to be re-emerging while countries are trying hard to go their respective transition pathways, for the features such as renewable nature, geographical diversity and availability.

- Biomass, indigenous as it is, can be central to local community development.
- Biomass can be value-added export-quality product, if it is processed with appropriate technology to be pellets that can provide the same or similar level of efficiency with conventional fuels.
- Biomass is clean and non-VRE, so it is expected to contribute to grid stability management in energy transition.

1. CFB Boiler: SHI's SUMITOMO SHI/FW CFB

Countries in Asia have been trying to utilize biomass, inherently carbon-neutral, in power generation for the sake of cleaner and sustainable electricity supply, reduced wastes, and local development, which ultimately will bring them to a circular economy in the future.
For dedicated biomass power generation from agricultural biomass to municipal wastes, CFB (circulating fluidized bed) boiler has become a potential option.



A CFB (circulating fluidized bed) boiler, as well known, is suitable to both dedicated biomass power generation with quite a wide range of biomasses and wastes and co-firing of coal with biomass. CFB can be flexible about the choice of biomasses-such as wood chips/pellets, palm kernel shells (PKS), etc., leading to their widespread adoption by Japanese industries.
Sumitomo Heavy Industry(SHI)'s SUMITOMO SHI/FW stands out from the crowd in providing solutions for optimal biomass utilization with CFB and related equipment.

<Key technical features>
High fuel flexibility: allowing for the use of wood, PKS, other wastes and even biomass with high-moisture.
Helpful to lower emissions: SOx emissions are reduced inside the furnace by introducing limestone. NOx emissions are avoided by low furnace temperatures and staged combustion.

2. Co-firing of biomass at existing coal fired power plant: Efforts by AMS

In Asia, where many countries have embarked on their respective energy transition journeys while coal as a reliable generation source remaining in their energy mix, co-firing of biomass at existing coal fired power plants is emerging initiated by governments.

Tenaga Nasional Berhad (TNB) conducted a study to pioneer small-scale co-firing project at its two thermal power plants in close collaboration with its subsidiaries, TNB Power Generation Sdn Bhd (TNB Genco) and TNB Fuel Services Sdn Bhd (TNBF). After the success of 1% co-firing, they are now heading to 2%. This development aligns seamlessly with TNB's ambitious 2050 net-zero goals.

Indonesia has identified 47 power plants for co-firing of coal and biomass. In 2025 the above is to reach 52 with over 100 units in all Indonesia, utilizing woody and agricultural biomass.
In addition to the extensive biomass co-firing activities, the government and PT PLN (Persero), the national utility have been trying to explore possibilities for waste-to-energy power generation.

3.1 Biomass pellets and briquettes: Grind Mill providing unique form options by Tromso

While being environmentally-friendly and carbon-neutral by nature, biomass just as it is, is not really suitable for use as fuel due to its characteristics such as low bulk density, etc. Accordingly, densification by pelletizing or briquetting is common before utilization of biomass as fuel. Since the properties of biomass pellets or briquettes affect handling convenience, many types of technologies have been developed in pursuit of efficiency and better economy, and many of them are commercially established.

Grind Mill is designed to convert biomass—primarily rice husks—into solid fuels.
This technology has been widely adopted by users seeking fuel flexibility and hands-on solutions to decarbonization.

<Key technical features>

Solid fuel conversion: Transforms rice husks and other biomass into solid fuels with stable, uniform particle size, optimized for coal co-firing requirements.

Fuel flexibility: High adaptability to diverse feedstocks, including rice husks and wood residues, even those with high hardness or irregular shapes.

Enabling higher co-firing ratio: Possible to reduce dependence on fossil coal while maintaining stable boiler operations.

3.2 Biomass pellets and briquettes: Idemitsu Green Energy Pellet™ by Idemitsu Kosan

Black pellets are decarbonized fuels with a quality similar to coal produced by heating biomass at a certain time at 200-320 degrees Celsius.
Compared to conventional white pellets without such carbonization process, it has a higher calorific value, water resistance and better grindability in fine mills, and can be used in almost the same way as coal by utilizing existing coal infrastructure.

In Gia Lai Province, Vietnam, Idemitsu Kosan has constructed a plant for production of Idemitsu Green Energy Pellet™, a biomass black pellet, after the success of years of their research activities.

In the demonstration stage, it was confirmed that the existing facility can be used for co-firing without modification if the co-firing ratio is low, and it is expected that dedicated combustion can be carried out with minor modifications

The black pellet plant with production capacity of 120,000 ton per year is owned and operated by Idemitsu Green Energy Vietnam.

4. BECCS (bioenergy with carbon dioxide capture and storage) by Toshiba and a team of Japanese companies

Biomass as carbon-neutral fuel can even be carbon-negative if combined with carbon capture and storage (CCS), which is called BECCS in abbreviation.

-After 10 ton/day pilot plant, Toshiba Energy Systems & Solutions Corporation (Toshiba ESS) has installed and begun operation of the world's first large scale BECCS demonstration facility at 50 MW palm kernel shells (PKS)-based Mikawa Power Plant in Omuta City, Fukuoka Prefecture operated by Sigma Power Ariake.

-The current capture capacity is more than 500 ton/day, equivalent to 50% of daily emissions. The on-going demonstration is implemented under "Sustainable CCS Project" toward 2030 by Ministry of the Environment, Government of Japan (MOEJ).

-16 Japanese companies are participating in the project.

5.1 Biochar: Two unique production systems by Tromso

Screw-based continuous carbonization process

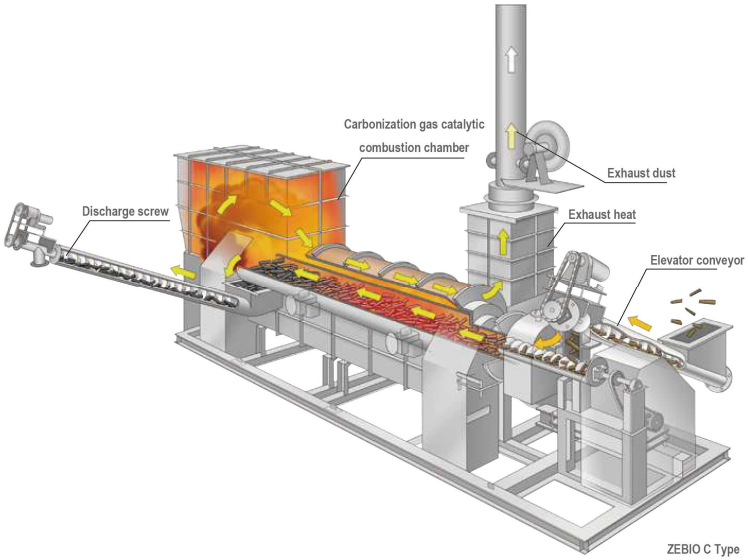
-Suitable for small-size biomass materials
-Compatible with a wide range of raw materials
-Operational flexibility by custom engineering
-Energy efficiency: Minimal electricity consumption with self-combustion carbonization method
-Quality control: The continuous-type system allows precise adjustment of carbonization conditions to produce biochar with tailored physical and chemical characteristics

Batch-type carbonization process

-No electricity required; can be for off-grid use
-It does not require raw material size uniformity, allowing for the carbonization of larger feedstocks such as bark and coconut shells.
-Feedstocks with high moisture content can be processed directly without prior drying
-Versatility of feedstocks: Capable of processing a wide variety of biomass, from fine rice husks to large coconut shells

Tromso philosophy: “Transforming biomass into resources for the future.”

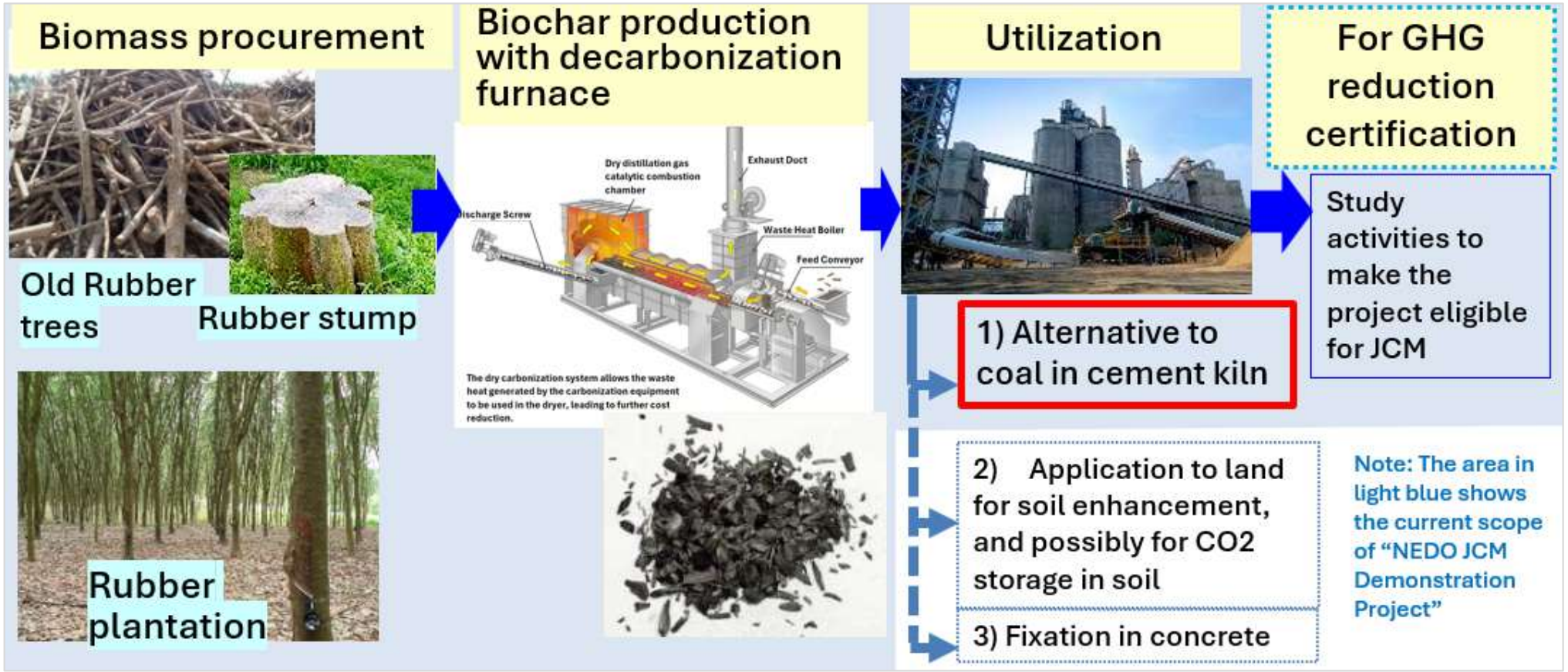
5.2 Biochar: ZEBIO-C carbonization machine by ZE Energy



-Designed for energy efficiency throughout the life cycle; such as that the machine recovers gases generated in the carbonization process for reutilization as a heat source.
-Combination with optional equipment enables to build a generation system with biomass energy as alternative to fossil fuels
-Suitable for high-moisture material such as processing of paper sludge and other sludges, in addition to standard agricultural biomasses

5.3 Biochar: NEDO Biochar Demonstration Project

- JCOAL team, in close collaboration with a Thai cement company and supported by relevant institutions of both Japan and Thailand, has been engaging in a biochar project that is in the FEED stage in JFY 2025 (August 2025-July 2026).
- It is common in Japan and many other countries that cement kilns use industrial waste as fuel. Normally, coal is used in the cement kiln that operates at quite high temperature compared to calciner, which is the case with the Project.
- As such, biochar will alter coal so that steady reduction of CO_2 emissions is expected.



We look forward to continuously working with you

Japan Carbon Frontier Organization (JCOAL)
Website: https://www.jcoal.or.jp/eng/
Email:
fyamada@jcoal.or.jp
ozawa@jcoal.or.jp
oshima@jcoal.or.jp