Overview of Biogas Experimental Plant

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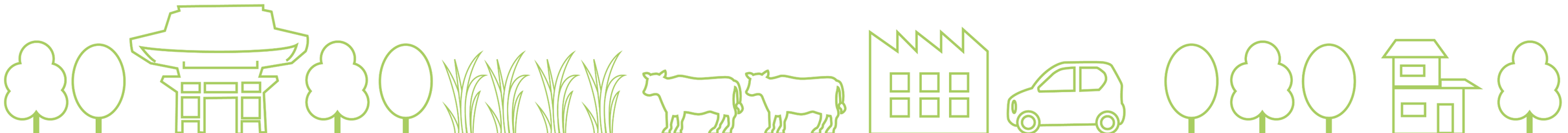
1 Overview of the Biogas Project

2 Background

3 Properties of the Biogas Experimental Plant



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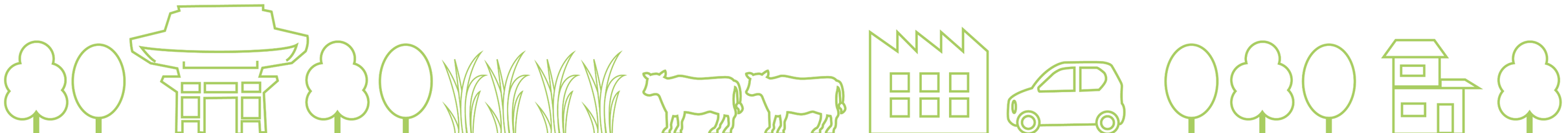
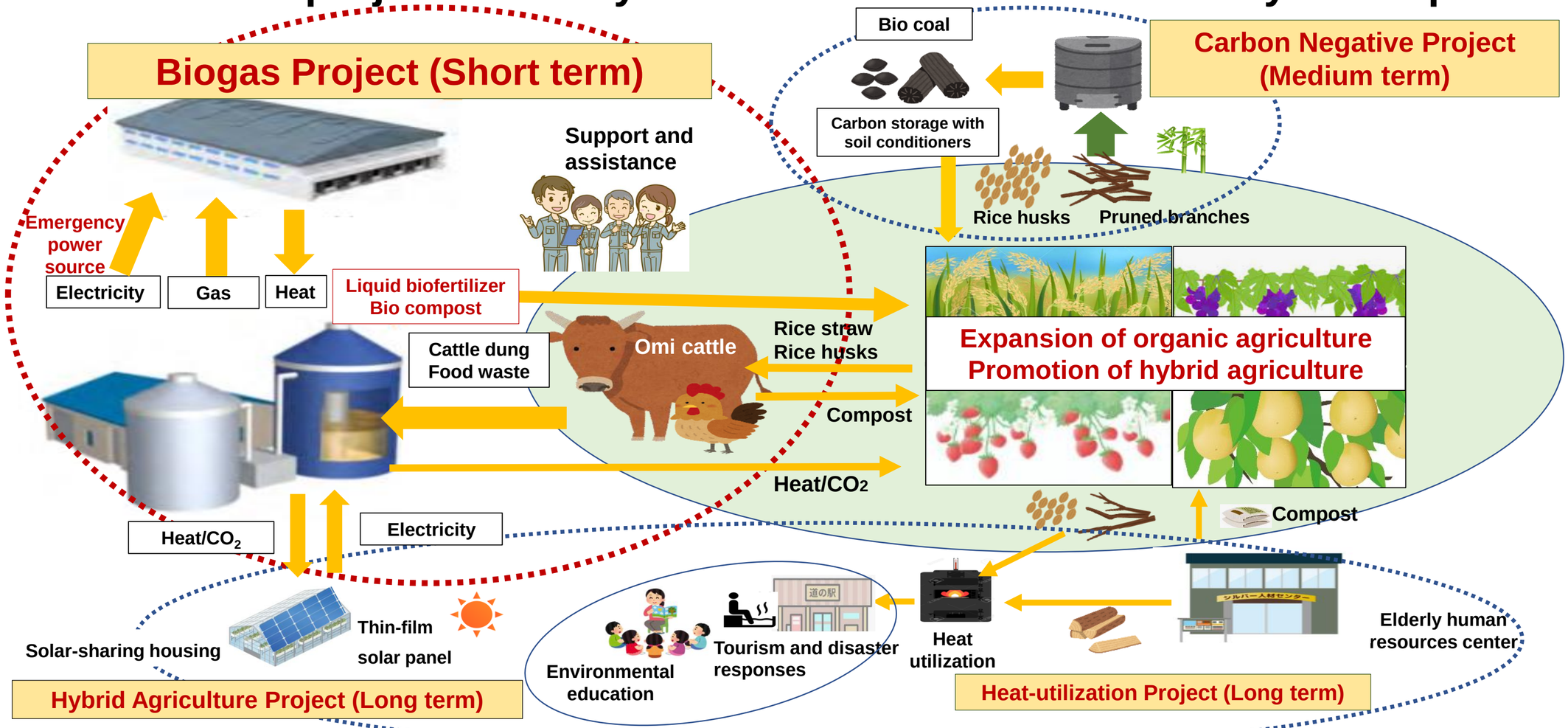
3 **Properties of the Biogas Experimental Plant**



1 Overview of the Biogas Project

The backbone project of the Ryuo Town Biomass Industrial City Concept

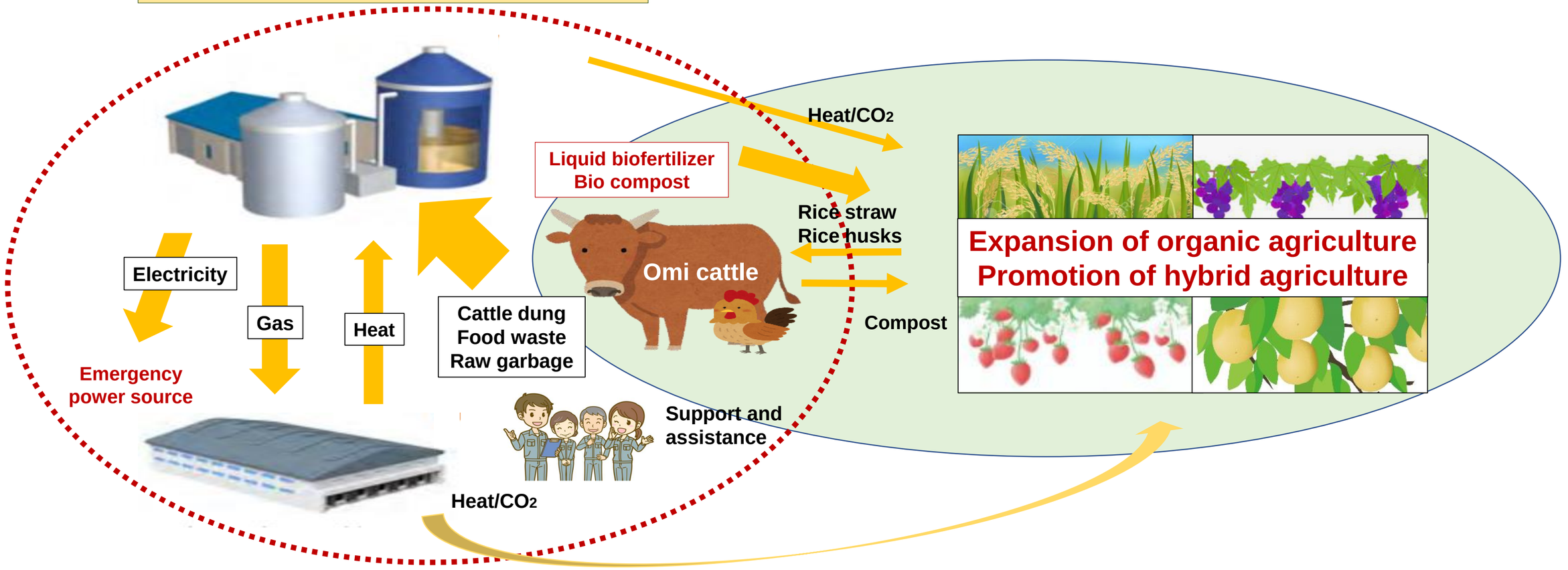


- Aiming to achieve intra-regional resources circulation, local energy production and consumption, and enhanced brand power of environment-friendly products made in Ryuo Town (agricultural, livestock, and industrial products)

1 Overview of the Biogas Project

Being promoted as the short-term project of the Biomass Industrial City Concept led by Ryuo Town

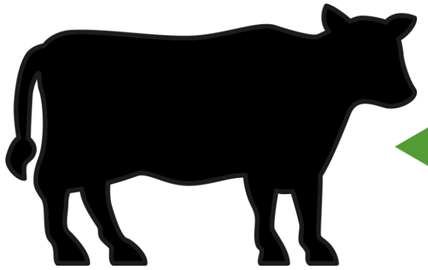
Biogas Project (Short term)



- Aiming to achieve intra-regional resources circulation, local energy production and consumption, and enhanced brand power of environment-friendly products made in Ryuo Town (agricultural, livestock, and industrial products)

1 Overview of the Biogas Project

Livestock farmer



Rice straw supply of cattle feed.

Feed

Crop farmer

Local government
+ Crop farmers, livestock farmers and manufacturers are working together
Establishment of Sustainable Circulation

DAIHATSU

Cattle dung

Fermentation using cattle dung and refining biogas

Manufacturer

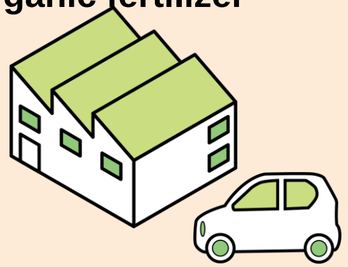
Biogas plant

Liquid fertilizer /Compost

Production of compost and liquid fertilizer from fermentation residues, Utilization as organic fertilizer

Biogas

Co-firing in a melting furnaces as carbon-neutral fuel



Automobile factory

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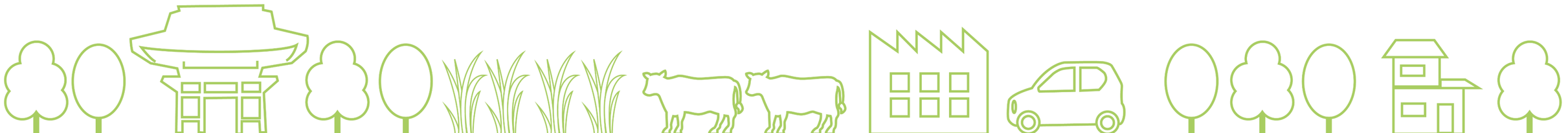


2 Background

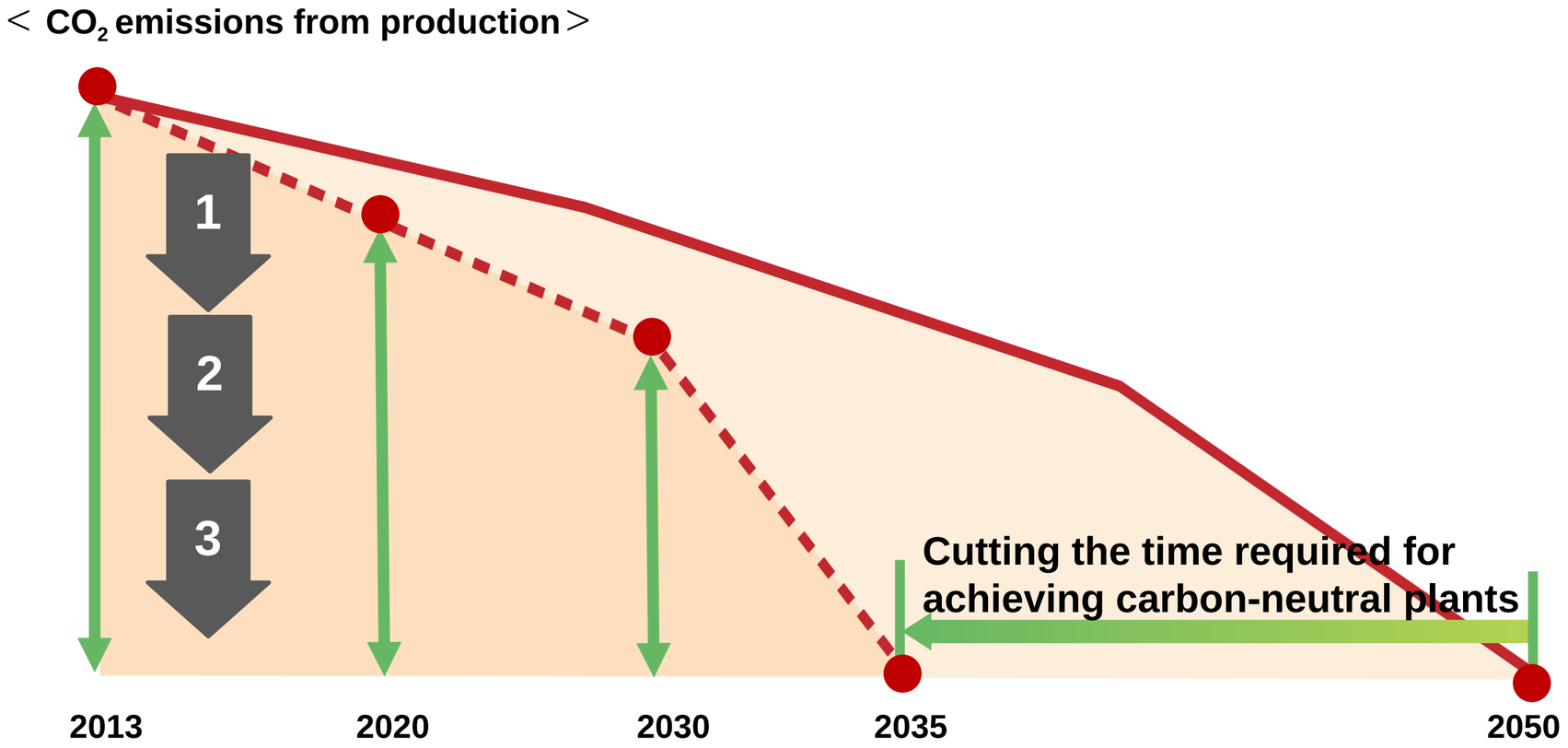
Aiming for the attainment of a carbon-neutral society, we promote:

- Reduction in CO_2 emitted from plants as an automobile manufacturer
- Diverse environmental initiatives in collaboration with communities

1 Extensive energy savings by pursuing SSC

2 Development and incorporation of innovative technologies

3 Utilization of renewable energy



2 Background

Development and use of new renewable energy

- **Manufacturing of key automobile parts by aluminum casting**
  - **Gas combustion is more efficient (emits less CO_2) as the heat source for aluminum melting than electricity**

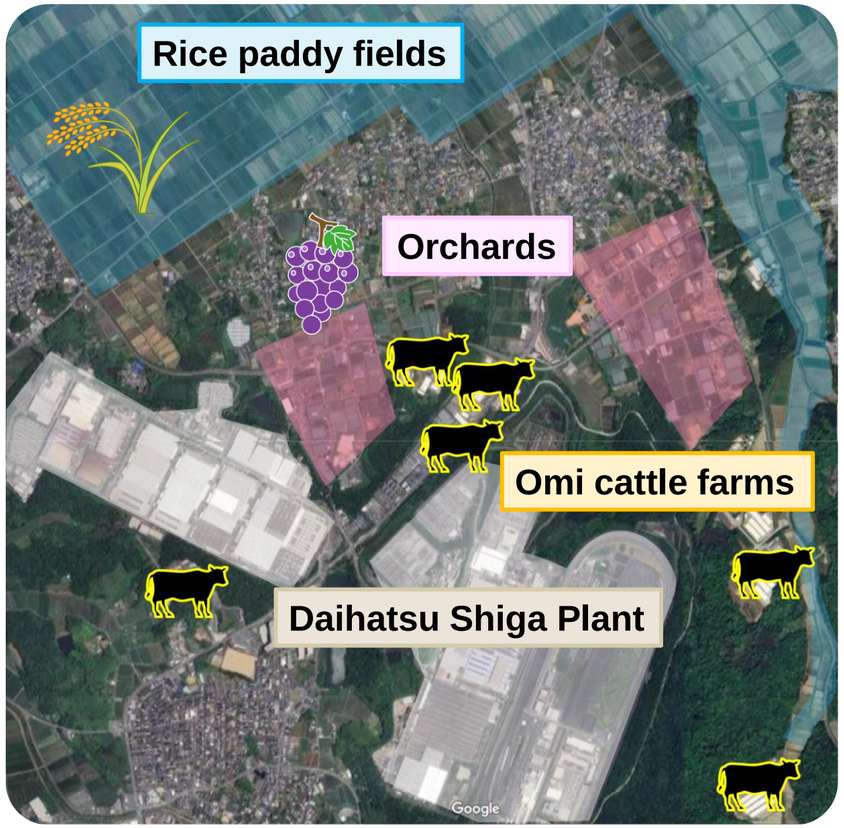
Wishing to use environmentally-friendly carbon-neutral fuel gas

2 Background

Self-production of carbon-neutral fuel by utilizing biomass resources available at the surrounding area of the plant

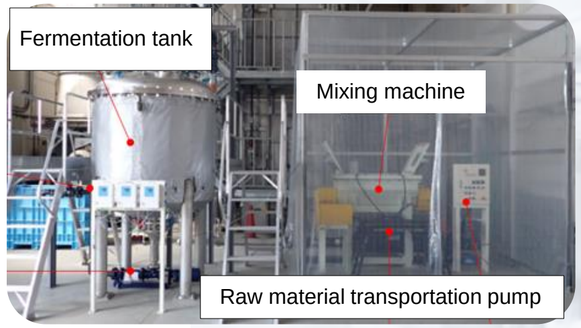
- Many Omi cattle farms, rice paddies, and orchards exist around the Shiga (Ryuo) Plant
- Started developing technologies to ferment Omi cattle dung and generate biogas with them

→ Adopted as a NEDO project in 2021 and the three-year experiment has been progressing



Fermentation test
(Syringe)

Fermentation test
(Beaker)



Fermentation test
(Fermentation tank of unit consumption of 2t)

Technology development by scaling up from basic tests

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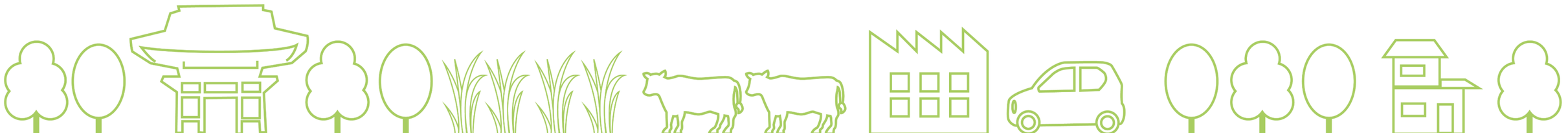
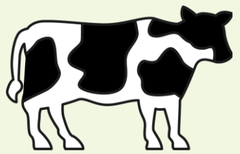


3 Properties of the Biogas Experimental Plant

Differences from the conventional wet methane fermentation plants

Properties of dairy cattle dung



Rich moisture content and low contamination of the bedding material (Sawdust functioning as the cattle bed)

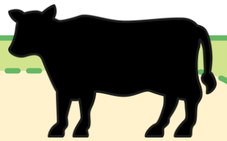
Wet fermentation

Fermentation of liquid dung in large fermentation tanks

Wet fermentation plant (Urimaku Biogas Plant)

Source: Ministry of Agriculture, Forestry and Fisheries (In Japanese)

Properties of Omi cattle dung



Use of sawdust as the bedding material to improve quality of beef

Solid with low moisture content and contaminated by the bedding material

Omi cattle dung is not suitable for conventional wet fermentation.

Development of a unique methane fermentation technology for Omi cattle dung

3 Properties of the Biogas Experimental Plant

Daihatsu's unique dry methane fermentation technology

- Developed methanogenic bacteria and a fermentation process to enable cattle dung with low moisture content to ferment
- The volume of digestive liquid discharged is significantly low compared to that with wet methane fermentation

Small plant with a batch-type fermentation process

- Employed the batch-type process with super-small fermentation tanks for individual fermentation to limit the plant size
- Possible to monitor and manage each tank individually as per their fermentation progress

Utilization of knowledge and technologies accumulated through automobile manufacturing

- Achieved process automation by utilizing vehicle production robots and knowhow
- Developed a biogas-fueled generator by utilizing automobile engine

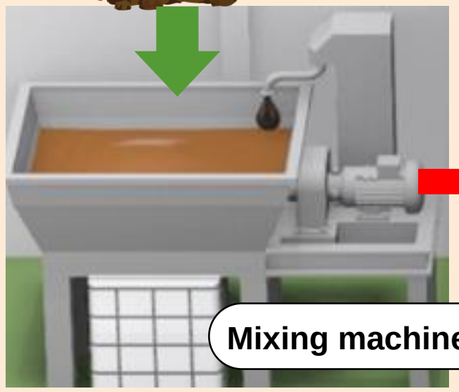
➡ Facilitate self-production of renewable energy by internalizing technologies

3 Properties of the Biogas Experimental Plant

Operational flow in the plant

(1) Cattle dung collection and fermentation preparation

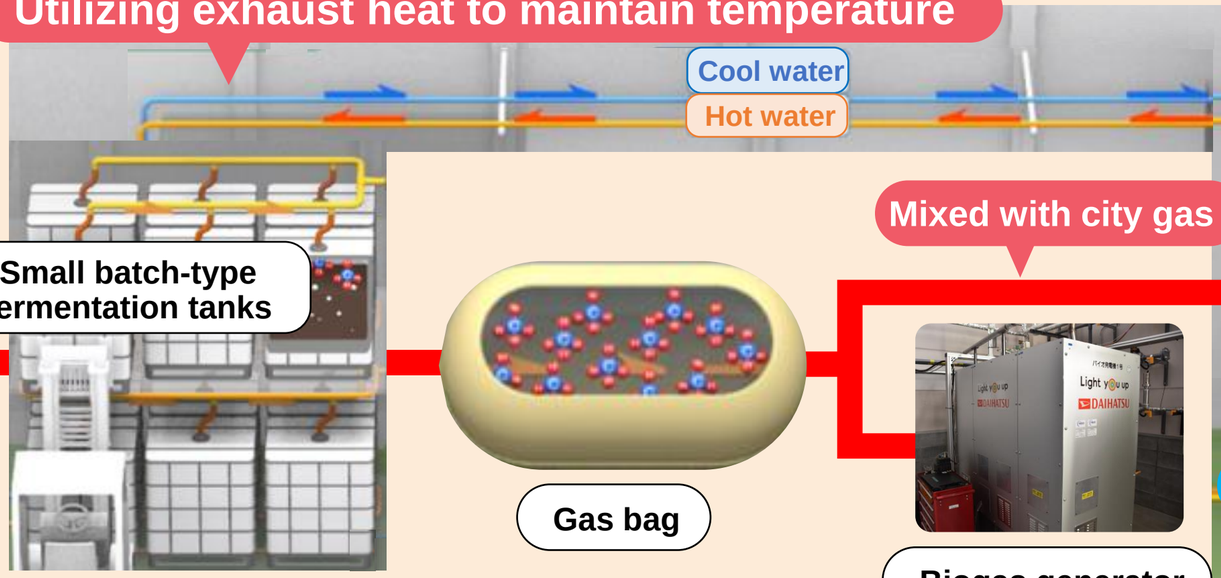
Collecting cattle dung



Mixing machine

(2) Cattle dung fermentation and biogas utilization

Utilizing exhaust heat to maintain temperature



Heat exchanger

Small batch-type fermentation tanks

Gas bag

Mixed with city gas

Biogas generator

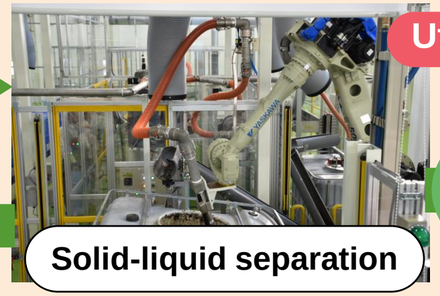
Future

Combustion in aluminum melting furnaces

Digestive liquid

Fermentation residue

(3) Utilization of fermentation residues



Utilizing robot

Solid-liquid separation

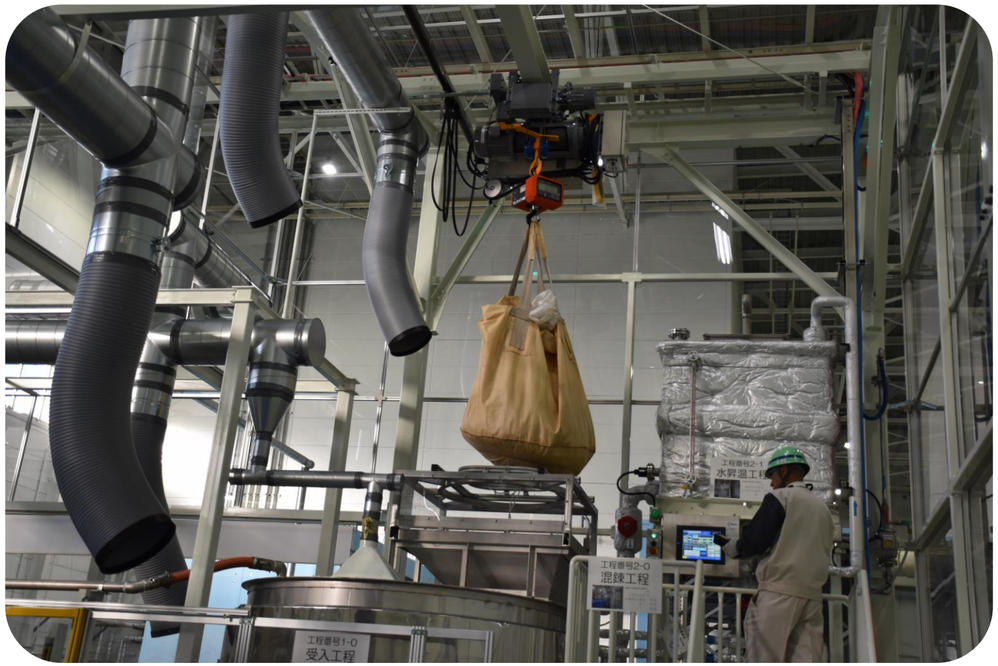
Liquid fertilizer/ Compost

3 Properties of the Biogas Experimental Plant

(1) Cattle dung collection and fermentation preparation

- Collect approximately two tons of cattle dung per day from farms
- Mix cattle dung, liquid containing methanogenic bacteria (digestive liquid), and water in the Plant

Collecting cattle dung at farms

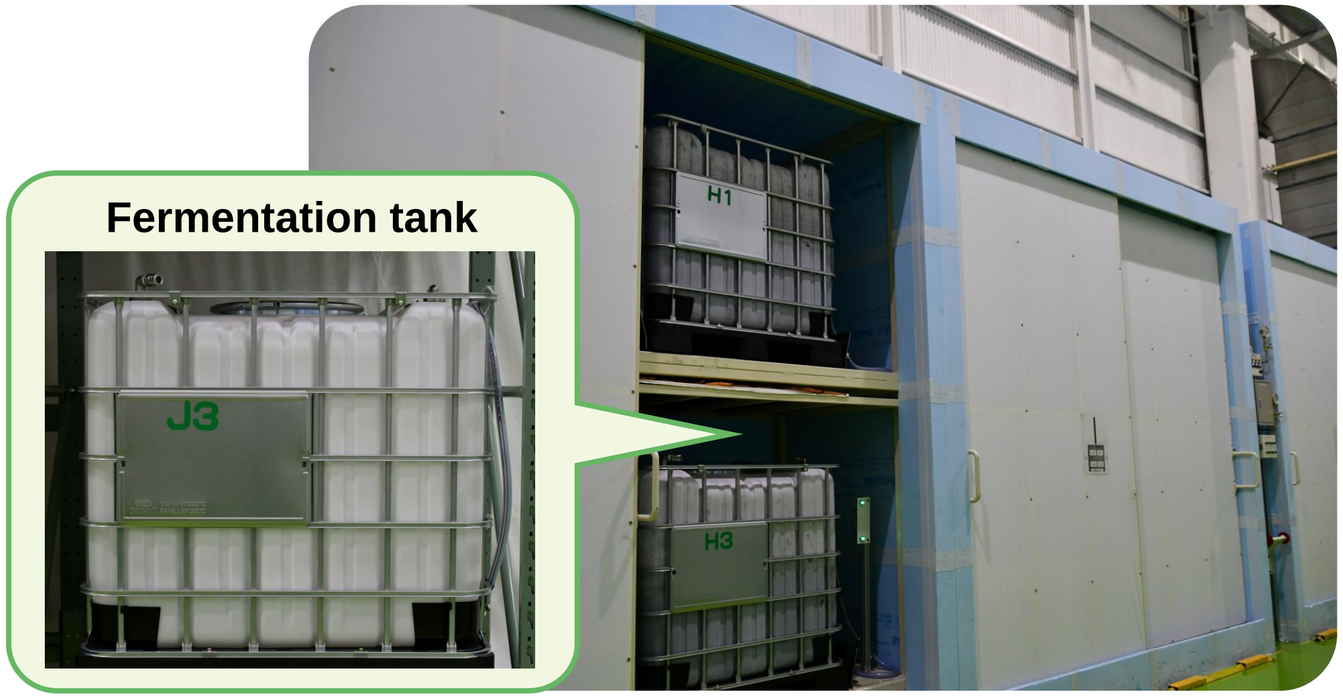


Feeding cattle dung into the mixing machine

3 Properties of the Biogas Experimental Plant

(2) Cattle dung fermentation and biogas utilization

- The temperature of the inside of the fermentation tank is always kept at 37 degrees Celsius utilizing exhaust heat from the aluminum melting furnace; fermentation takes two weeks in the tank
- Generated biogas is stored temporarily in a gas bag to level the concentration



Shelf containing fermentation tanks

Gas bag to store biogas

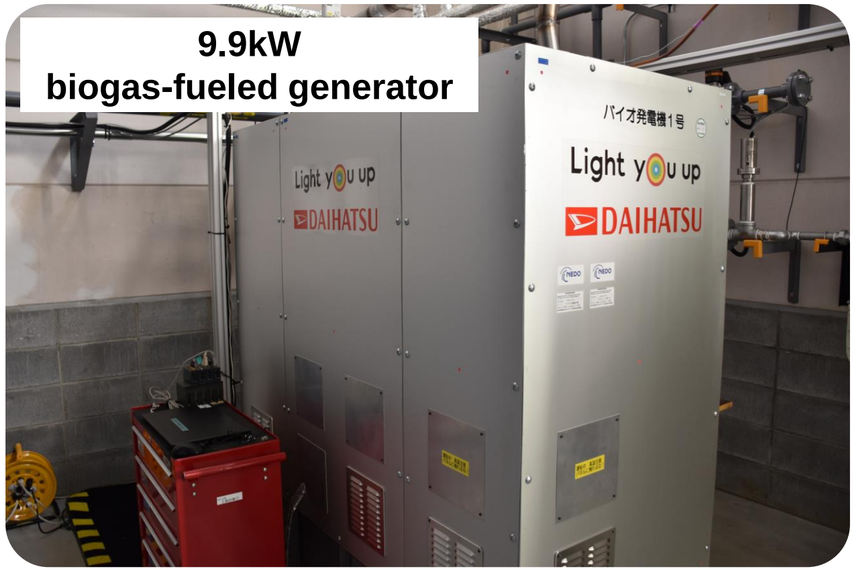
3 Properties of the Biogas Experimental Plant

(2) Cattle dung fermentation and biogas utilization

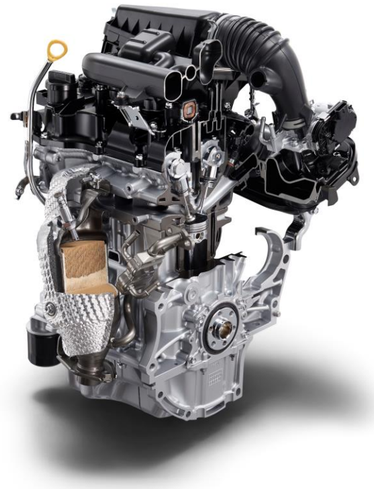
- Planning to deliver biogas to aluminum melting furnaces in foundries for using it as a carbon-neutral fuel (partial replacement with city gas)
- Being used as fuel for the automobile engine-powered generator at present (during the experiment)

→ Also planning to use it as a resilient power source in emergencies in the future

Aluminum melting furnace



Generator that can stably generate power by automatically responding to fluctuations in the gas concentration



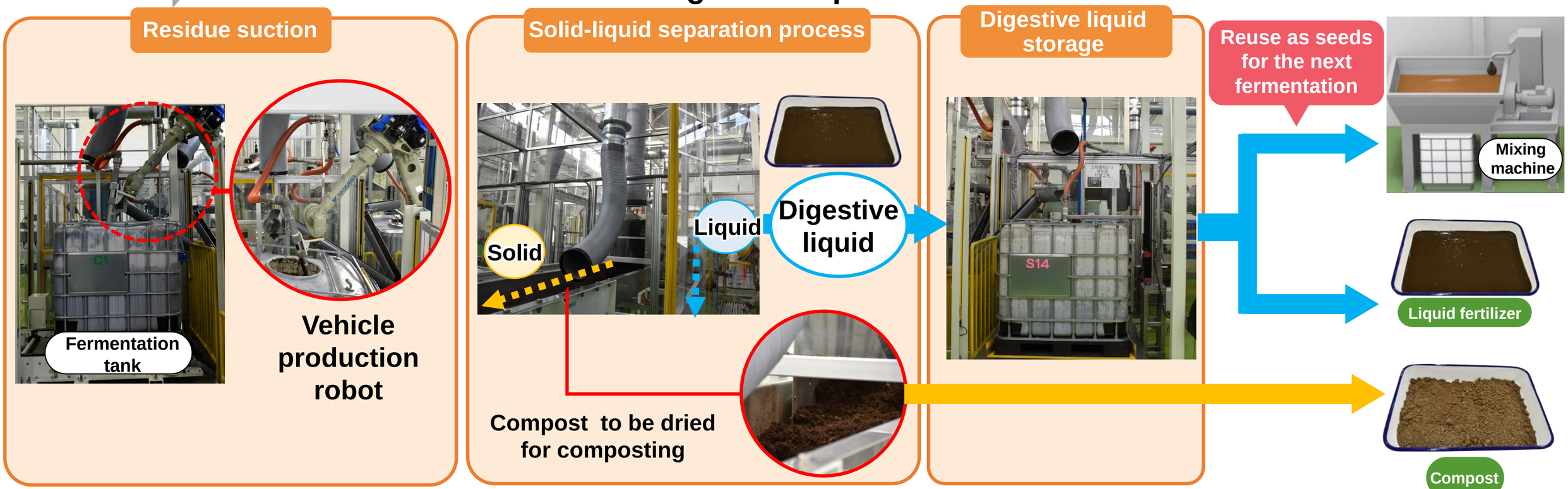
Utilization of a small-sized engine being manufactured in the Shiga Plant

3 Properties of the Biogas Experimental Plant

(3) Utilization of fermentation residues

- Automatic residue suction from the fermentation tank by equipment equipped with a vehicle production robot
- Separation of compost and liquid (digestive liquid) fertilizers through the solid-liquid separation process

➡ Reuse a certain volume of the digestive liquid in the next fermentation



This outcome has been obtained through a project subsidized by the New Energy and Industrial Technology Development Organization (NEDO)

3 Properties of the Biogas Experimental Plant

(3) Utilization of fermentation residues

- **Compost and liquid fertilizers are consumed as organic fertilizers at farms in Ryuo Town to measure crop growth, etc.**

Annual flow of activities in 2024 (Liquid fertilizer experiment with rice and wheat)

Rice experiment

Apr. | May | Jun. | Jul. | Aug. | Sep.

Spreading the liquid fertilizer at the time of sowing to facilitate initial growth

rvesting after fully observing effects

Wheat experiment

Oct. | **Nov.** | Dec.-Mar.

Spreading the liquid fertilizer at the time of sowing

Young seedlings growing steadily

* Compost experiment started in Dec. 2023

Aiming to brand environment-friendly agricultural products in future.

Rice

Experiment started in Dec. 2023

Cabbage

Experiment started in Aug. 2023

Wheat

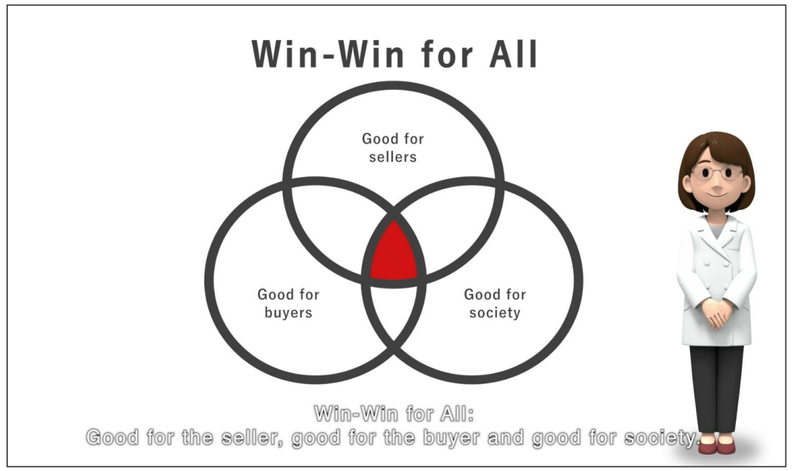
Experiment started in Oct. 2024

3 Properties of the Biogas Experimental Plant

Communication regarding the Project

- **Exhibition at the COP28 UN Climate Change Conference in Dubai in Nov. 2023**

  Globally communicated the “Win-Win for All” concept, the Project’s principle



Booth exhibition in the Japan Pavillion

Presentation at a seminar hosted by the Japan Automobile Manufacturers Association