

大阪発スゴ技CN

カーボンニュートラル

Innovative Carbon-Neutral Technologies from Osaka

Osaka Prefectural Government

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Innovative Carbon-Neutral Technologies from Osaka
Renewable Energy

Approximately 66% of Japan is covered by forests.
Will local forests be used for power plants?



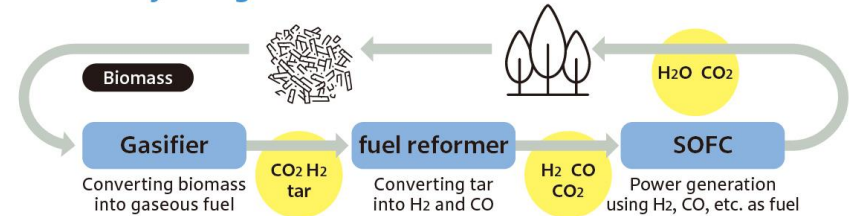
Local production and consumption of energy through the use of unused biomass

Energy generation from unused biomass resources

Japan has forest resources that cover nearly 66% of the land area. Developing and popularizing facilities aimed at generating and utilizing renewable energy locally will lead to a sustainable society and revitalization of local communities.

Overview of SOFC biomass power generation technology

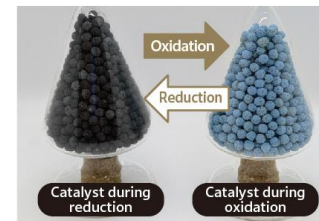
Realizing sustainable energy sharing by generating electricity using local forest resources



Development of a catalyst that can be easily regenerated by heating

The need for tar reforming catalysts

A catalyst regeneration mechanism (reforming function) is incorporated into the equipment



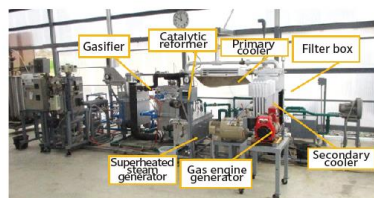
Tar generated during the pyrolysis gasification process has been a factor in increasing the burden of equipment maintenance and reducing power generation efficiency.

This technology has developed a catalyst regeneration mechanism, which significantly reduces the frequency of catalyst replacement.

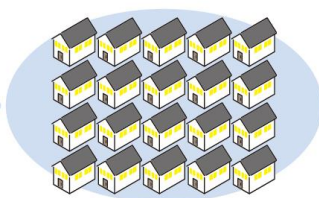
Our unique catalyst technology significantly reduces tar emissions.

Here's the Innovative Technology !

This power generation system can be introduced in small and medium-sized forestry and manufacturing industries.



Power generation
capacity of **100kW or less**



Approximately
20 households

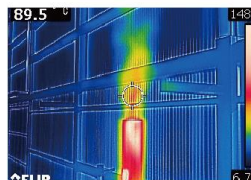
Can provide the electricity needed for
approximately 20 average households

- Power generation possible using both gas engines and SOFCs
- Tar removal confirmed in demonstration experiments
- Reformed tar itself can be used as fuel, improving power generation efficiency

Tar combustion



Reformed gas combustion



A transparent flame of tar-reformed H₂ captured with an IR camera

How might the spread of

this innovative technology transform future society !?



Turning waste from forestry pruning
and lumbering processes into biomass
fuel



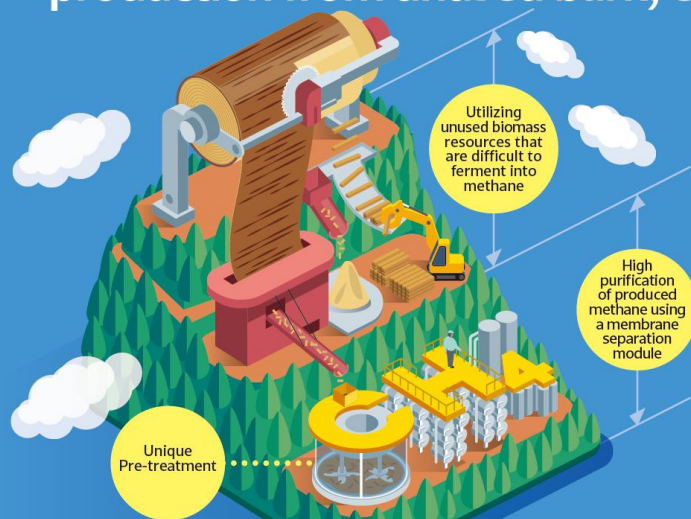
Energy use in local community
facilities and disaster prevention
facilities

Creating a sustainable community through forest
resources and “local production for local consumption”
energy infrastructure

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Innovative Carbon-Neutral Technologies from Osaka
Renewable Energy

Highly efficient methane production from unused bark, etc.



Unique pretreatment technology and CO₂ separation membranes enable highly efficient biomethane production

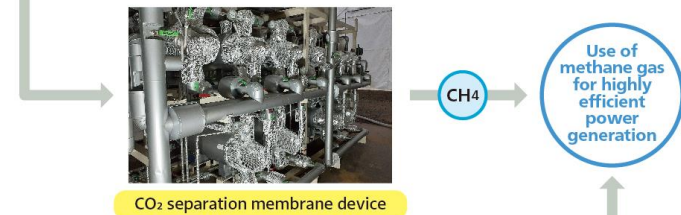
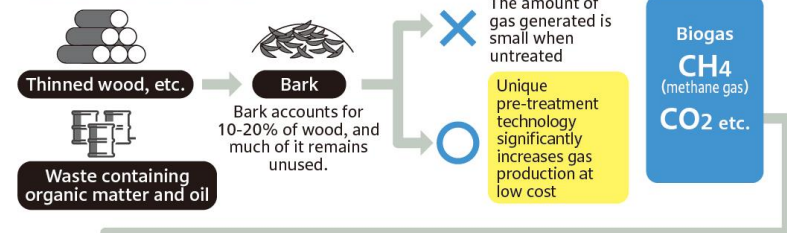
Next-generation biogas power generation using highly efficient methane fermentation system and membrane separation

This system was developed with the aim of increasing methane production from unused biomass resources and improving power generation efficiency. The demonstration plant incorporates world-class technologies that are highly versatile as decarbonization solutions, such as methanation technology using advanced catalyst technologies and membrane technology that efficiently separates generated CO₂.

How biomethane production technology works

Pre-treatment promotes biogas generation, and CO₂ separation membrane separates and captures CO₂, producing high-quality methane.

Unused biomass resources

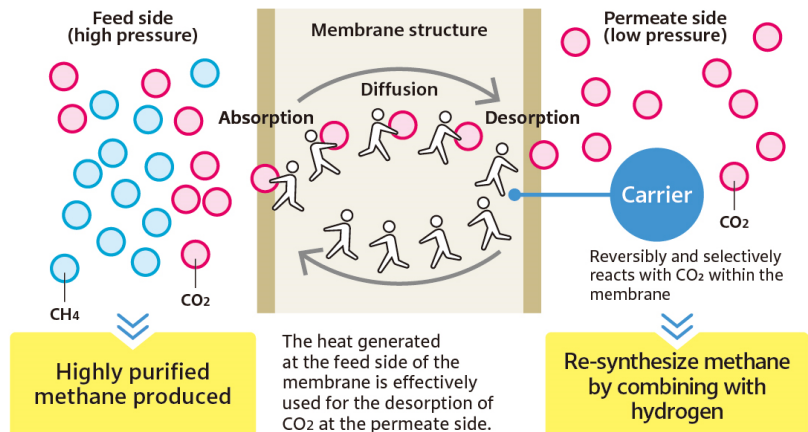


Spiral element incorporating CO₂ separation membran



Here's the Innovative Technology !

Schematic of facilitated transport membrane using selective reversible reaction between CO₂ and carrier



Incorporating a unique CO₂ separation membrane and methanation catalyst

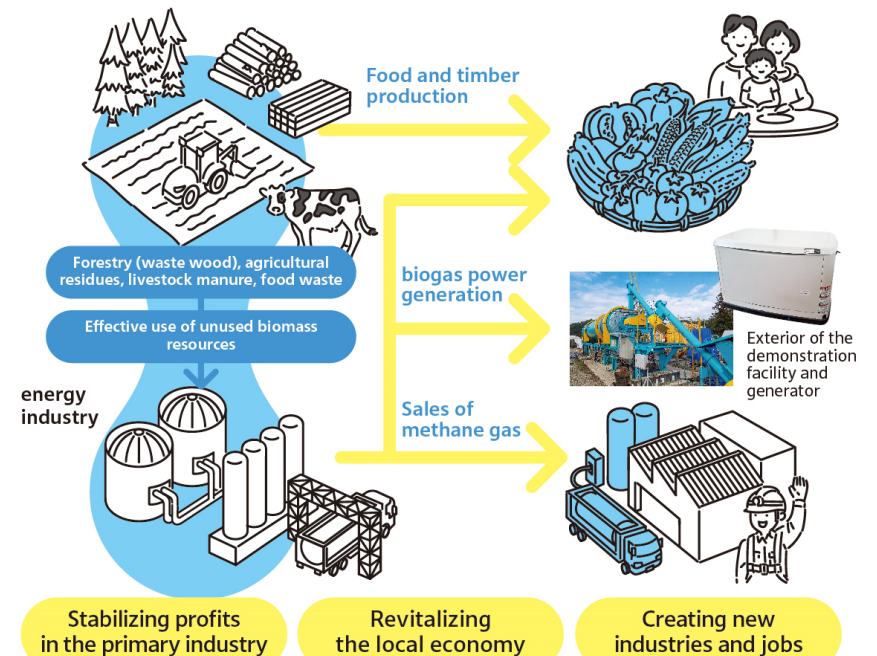
- 1 CO₂ separation membranes are world-class in both separation capacity and speed
- 2 Developed Ni-based catalyst with Ru-equivalent performance for steam reforming catalysts in fuel cells
- 3 Achieves high performance and low-temperature activation of methanation catalyst

No energy loss, enabling more efficient methane production

How might the spread of

this innovative technology transform future society !?

Primary industry



Integrating agriculture, forestry and fisheries with energy production businesses to develop the region through sustainable industrial growth

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CO₂ Capture

Promotion of CCUS (Carbon dioxide Capture, Utilization, and Storage) through manufacturing



With the technology to capture and enclose CO₂ in metals, flexible manufacturing has become possible.

Promoting CCUS through manufacturing

Metacol is a new material that can capture greenhouse gas CO₂ and use it as a manufacturing material. Utilizing recycled resources and trapping the generated CO₂ in everyday products contributes to carbon neutrality and the circular economy.



Humanity's deep relationship with CO₂

CO₂ is a familiar substance to us, which makes "decarbonization" difficult.



Both people and society emit CO₂ in exchange for using energy.

Solve problems through new ideas

What if the CO₂ emitted from our daily lives could be transformed into various "things"?

Here's the Innovative Technology !

Capturing CO₂ from daily life and economic activities — that is Metacol, a new material that enables circular manufacturing.



(Products made using Metacol)



metacol™ golf gift



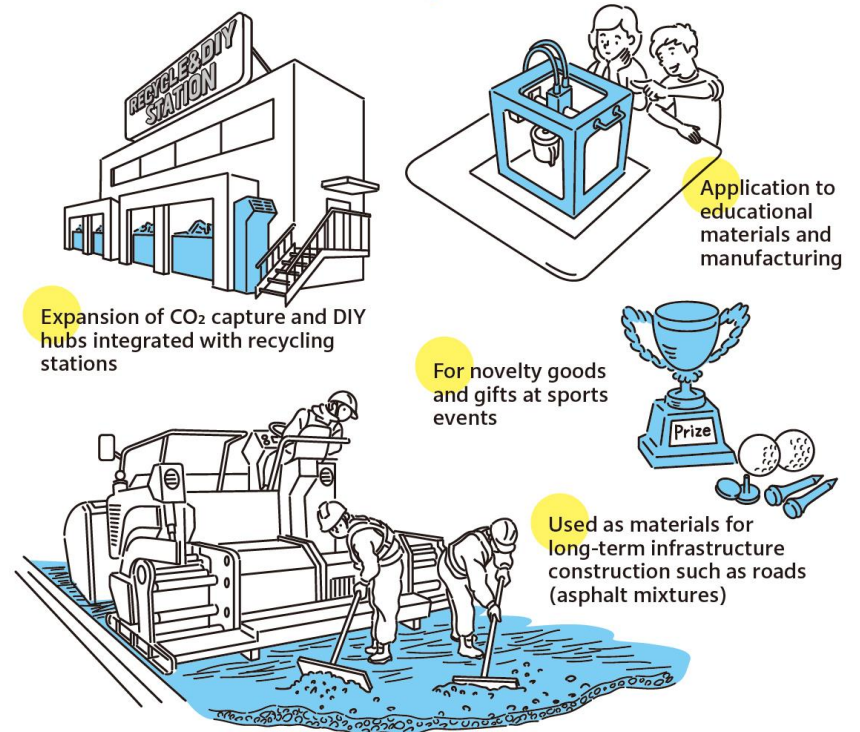
metacol™
“Yasashisa” craypas



metacol™ eco notebook

How might the spread of

this innovative technology transform future society !?



CO₂ capture and fixation with carbonate metals contribute to a circular economy and a decarbonized society.

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Energy Management & Energy Saving

GX (Green Transformation) in maritime mobility



Promote the greening of ships through renewable energy × fuel cells × energy management

Green transformation of maritime transport

Similar to the electrification of automobiles, research and development of renewable energy utilization technologies and the dissemination of energy management systems for ships and other maritime mobility are important initiatives in achieving carbon neutrality.

Transition of ship energy and power sources

Since ancient times, humanity has repeatedly undertaken challenging voyages (transportation) using “ships.” Throughout this history of movement, diverse forms of energy and power sources have been developed.

Ancient	Medieval	Modern	Present
Main energy and power sources	Human power/Wind	Steam engine, Coal	Engine, Fossil fuels
Environmental burden	Small		Large Need for decarbonization

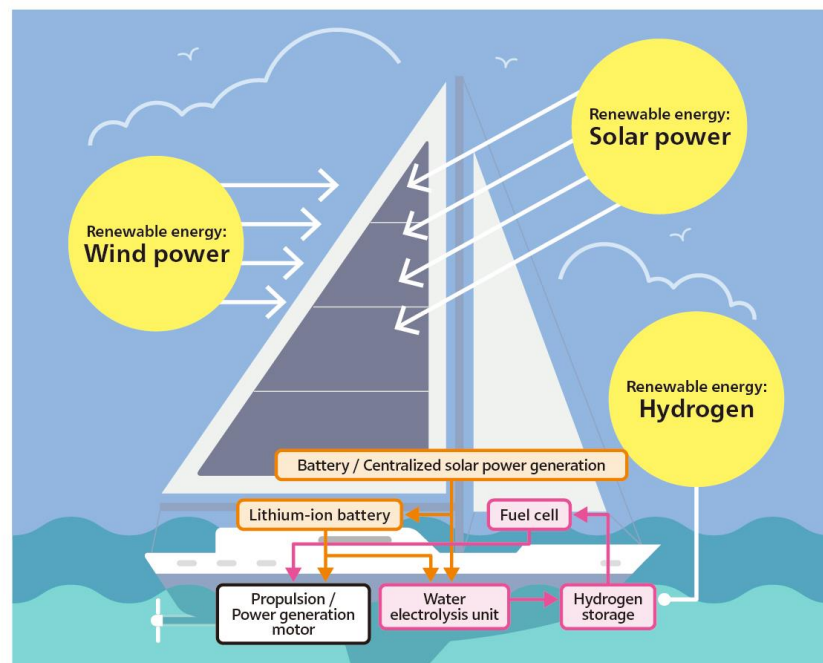
Decarbonization is needed not only for cars.

As the world aims for carbon neutrality, new industries combining shipping and maritime transport with new energy production, as well as environmentally friendly transport services, may be rapidly created.

Here's the Innovative Technology !

The latest yacht generates its own energy!!

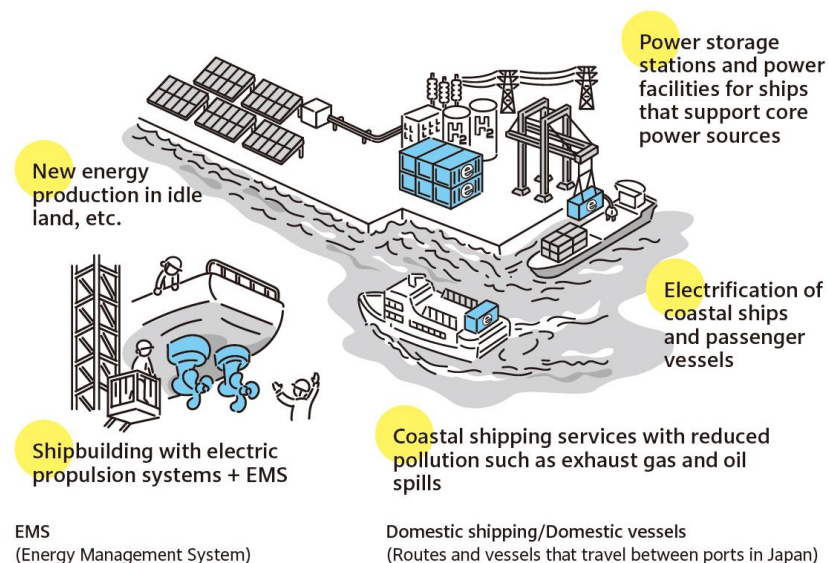
The electric yacht, developed and demonstrated with support from Osaka Prefecture, is equipped with advanced energy systems as well as technologies cultivated through the "history of ships."



How might the spread of

this innovative technology transform future society !?

As GX (Green Transformation) in maritime mobility advances, not only will it reduce environmental impact, but it may also create new industries combining shipbuilding and maritime transport with new energy production, as well as eco-friendly transport services.



*For social implementation and commercialization of the technology, legal and safety issues must be addressed.

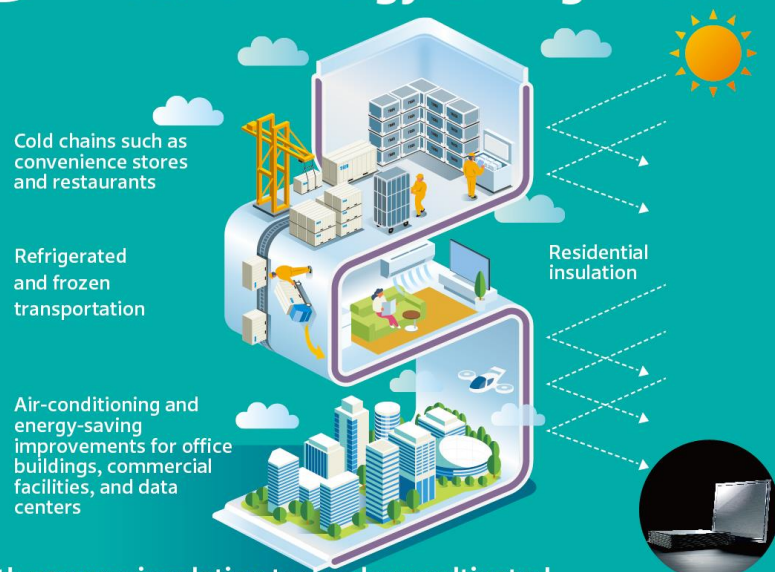
New coastal industries will be born that combine new energy production with energy utilization at shipyards and port facilities.

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Innovative Carbon-Neutral Technologies from Osaka

Energy Management & Energy Saving

Expanding with “Vacuum Insulation Panel Technology” Future “Energy-Saving” Fields



With vacuum insulation technology cultivated through thermos bottle development, we are revolutionizing energy saving across diverse industries and applications

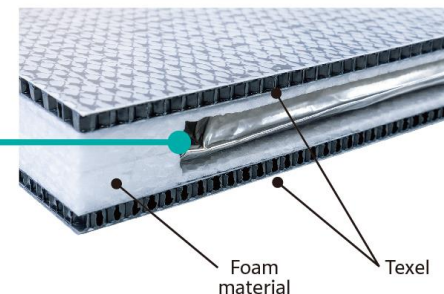
Vacuum insulation panels expand the energy-saving field of the future
This vacuum insulation panel is a technology that further evolved the heat preservation and cooling technology developed over 100 years. With stainless steel as the base material, this product excels in thermal insulation, durability, and non-combustibility, contributing to a carbon-neutral lifestyle and services.

Structure of Vacuum Insulation Panels

Vacuum insulation panels, derived from thermos bottle heat-retention and cooling technology, bring “energy saving” to a new dimension.



TIVIP (Vacuum Insulated Panel)
TIVIP: TIGER Vacuum Insulated Panel



(Applications and Deployment Examples)



Vacuum Insulated
Reefer Container



Vacuum Insulated Sleeve
Box “Protect BOX Thermal”



Vacuum Insulated
Roll Box

Here's the Innovative Technology !



High thermal insulation

Contributes to CO₂ emissions reduction



Long service life

Reduces life-cycle costs



Non-flammability

High safety

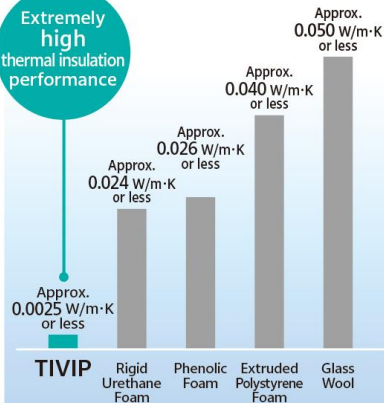


Thin

Remarkably thin despite high insulation performance

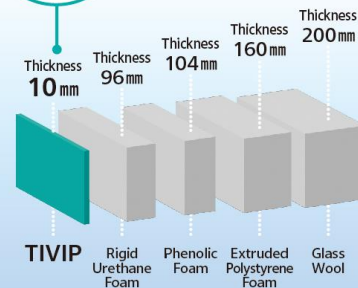
(Comparison of thermal insulation performance)

Extremely high thermal insulation performance



(Thickness comparison for the same performance)

Astonishingly thin!



TIVIP | TIVIP (TIGER Vacuum Insulated Panel - Stainless Steel Vacuum Insulation Panel)

How might the spread of

this innovative technology transform future society !?

Space development and thermal/cooling services using vacuum insulation will enrich everyone's lives

Logistics field

Building materials field

Medical field

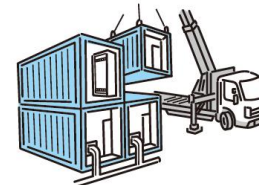
Industrial field

Environmental & energy field

For example...

What happens when vacuum insulation panels combine with "containers" or "mobility"?

Data center module with improved air-conditioning efficiency



More comfortable disaster relief facilities and pharmaceutical transportation

Delivery of fresh and frozen foods in areas with unstable power supply



New services utilizing "vacuum insulation technology" will emerge in all areas where energy efficiency and temperature management are required

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Energy Management & Energy Saving

With AI that predicts the future and the air,
Energy saving becomes even more powerful



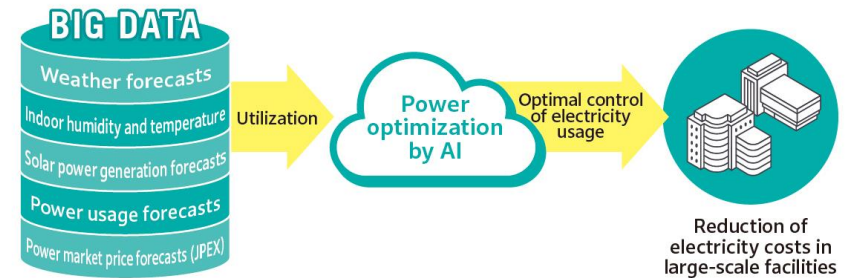
EMS (Energy Management System)
that collaborates with
power market data,
weather information,
and air conditioning
through AI

Air conditioning automatic control system utilizing AI
and renewable energy

Energy management in large facilities is an important theme in achieving energy
conservation and carbon neutrality, and there is a demand for energy management using AI
and regional energy sharing.

Mechanism of AI-equipped EMS

AI centrally manages facility power energy based
on big data



(Applications and Examples)

Large-scale facilities where many people gather and are used for various purposes,
achieving integrated energy-saving and energy management linked with air conditioning
and renewable energy equipment.



Hospitals and schools



Public facilities and
sports facilities



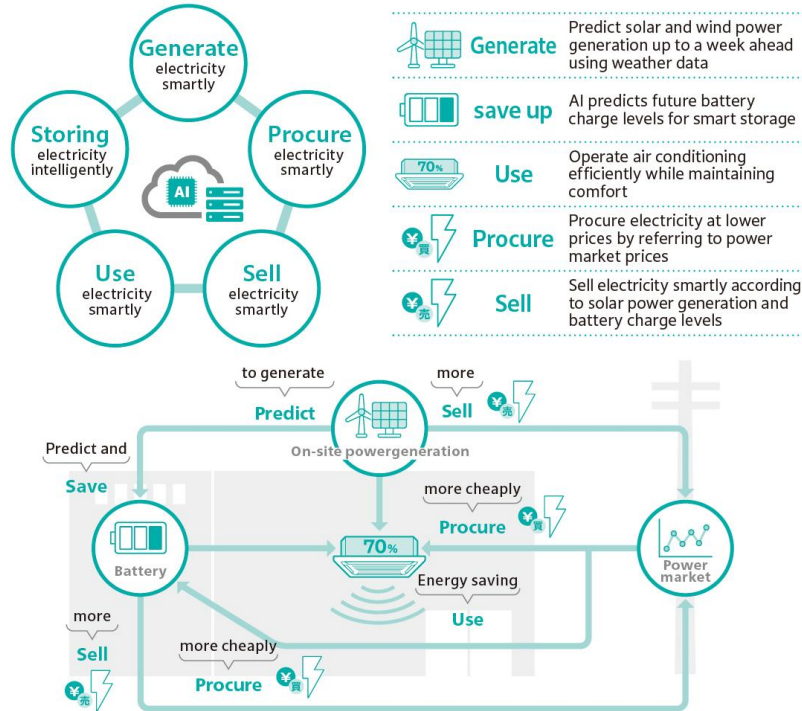
Amusement and
commercial facilities



Factories and
warehouses

Here's the Innovative Technology !

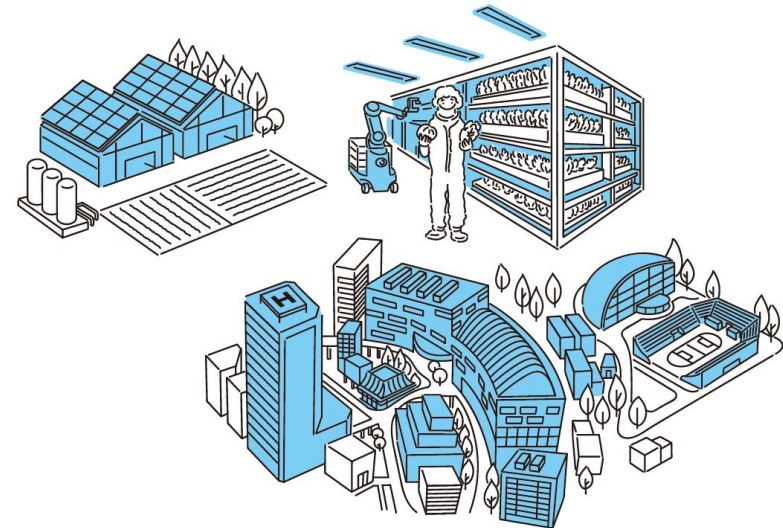
Integrated management of five types of information in the cloud. AI analyzes the most efficient power procurement for smart power consumption.



How might the spread of

this innovative technology transform future society !?

Plant factories and agricultural greenhouses that provide a comfortable environment for crops 24/7/365 by generating, buying, and selling electricity.



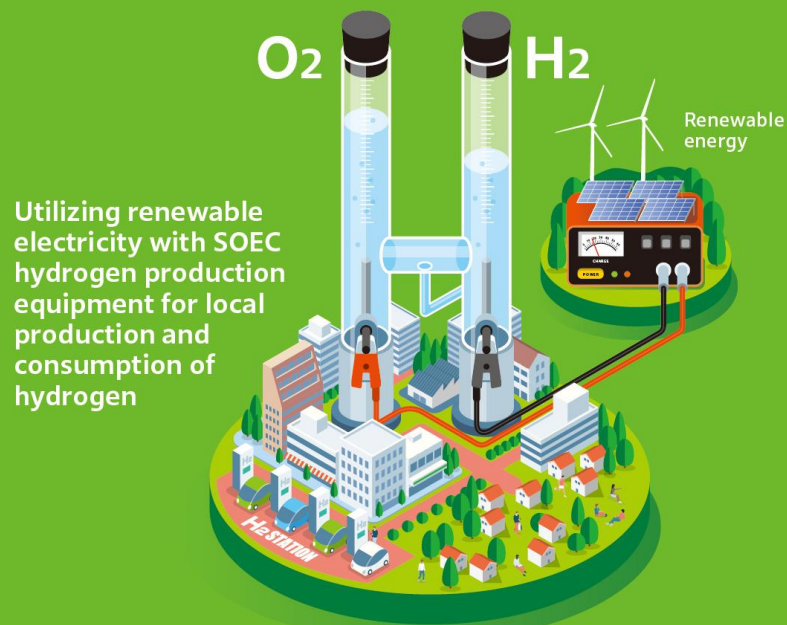
Spread of systems (CEMS) that enable electricity sharing and energy management across entire communities.

CEMS (Community Energy Management System)
A system for managing energy across entire communities.

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Hydrogen

Eco-friendly energy infrastructure



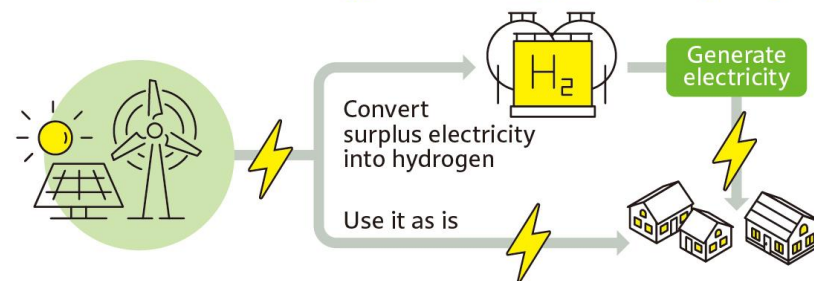
Utilizing renewable electricity with SOEC hydrogen production equipment for local production and consumption of hydrogen

Development and demonstration of SOEC (Solid Oxide Electrolysis Cell) hydrogen production equipment

Hydrogen production using renewable energy is expected to be a decarbonized energy source, but its widespread use currently requires large-scale infrastructure investment. The technology introduced here is a proposal for realizing a hydrogen society and providing access to renewable energy to many people without requiring large capital investment.

What's good if everyone can produce hydrogen?

What if renewable energy could freely produce hydrogen?

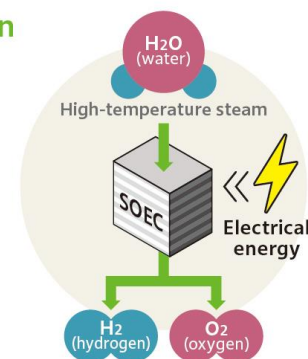


Surplus renewable electricity can be converted into hydrogen, stored, and used anytime, freely.

How does SOEC produce hydrogen with water and electricity?

SOEC (Solid Oxide Electrolysis Cell) is one of the technologies that generates hydrogen by electrolysis of water.

The principle is the same as the water electrolysis experiment conducted in school science classes. By using renewable electricity, CO₂-free "green hydrogen" can be obtained, making it a promising energy technology.



Here's the Innovative Technology !

Hydrogen can be produced at about **80 yen**
per 1 Nm³ (normal cubic meter).

Based on electricity costs (e.g., national average unit price of low-voltage power = 28.39 yen/kWh), estimated by the Green Innovation Research Institute, the technology developer.



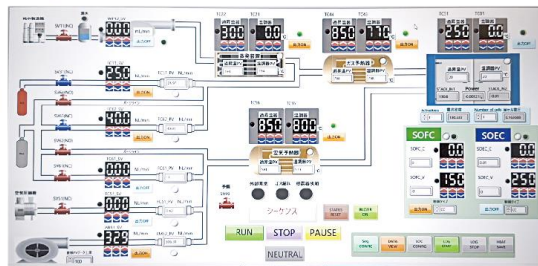
Item	Specifications	
	SOEC	SOFC
1 Operating (Stack) Temperature	700°C	
2 Current*	60.5A	30A
3 Operating Stack Voltage *	152.9V	100V
4 Operating Stack Power*	9250W	3000W
5 Steam Flow Rate (Pure Water)	83.6L/min(N)	
6 Water Flow Rate		35L/min(N)
7 Air Flow Rate	329L/min(N)	329L/min(N)
8 Hydrogen Production Unit	3.08kWh/Nm ³	
9 Dimensions	(D)870*(W)1850*(H)2000 (excluding protrusions)	

*When operating in SOEC mode, electricity is input; in SOFC mode, electricity is output.

Hydrogen production system



Internal structure



Control system screen

How might the spread of this innovative technology transform future society !?

With SOEC hydrogen production technology,
we will realize eco-friendly and disaster-resilient urban
development.

Disaster-preparedness
warehouses and
community centers that
can also generate
electricity



Applications such as hydrogen
stations and mobility hubs that
supply energy to mobility



Hydrogen stations

Bases for refueling "hydrogen" used as
fuel by fuel cell vehicles (FCVs).

Mobility hubs

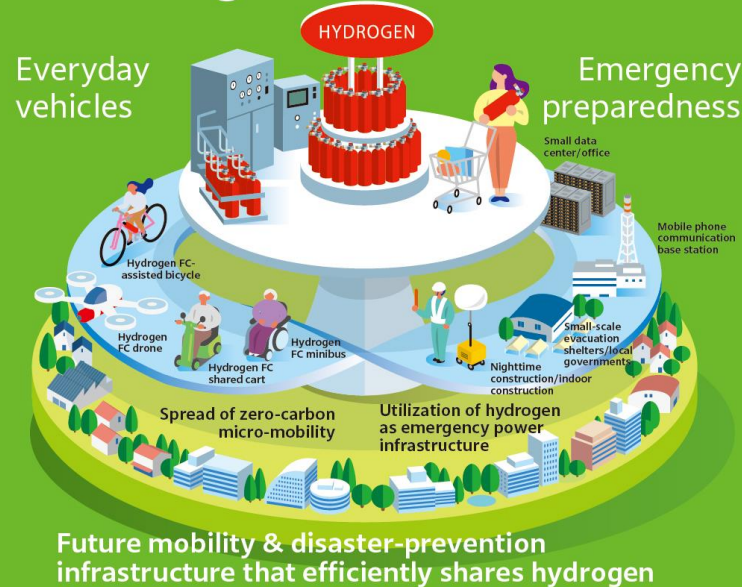
Hubs where multiple means of transportation gather.
New transportation services and urban development
functions are being considered.

*For social implementation and commercialization of the technology, legal and safety issues must be addressed.

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Innovative Carbon-Neutral Technologies from Osaka
Hydrogen

Hydrogen safely and easily, both in daily life and in emergencies



Development and demonstration of a multi-type hydrogen filling system and hydrogen-based micromobility
This is an introduction to the supply system essential for hydrogen utilization and the spread of micromobility. If hydrogen can be safely and easily provided for daily mobility and disaster prevention infrastructure, the future society will become cleaner and more comfortable.

What kind of society is a hydrogen society?

What's amazing about hydrogen?

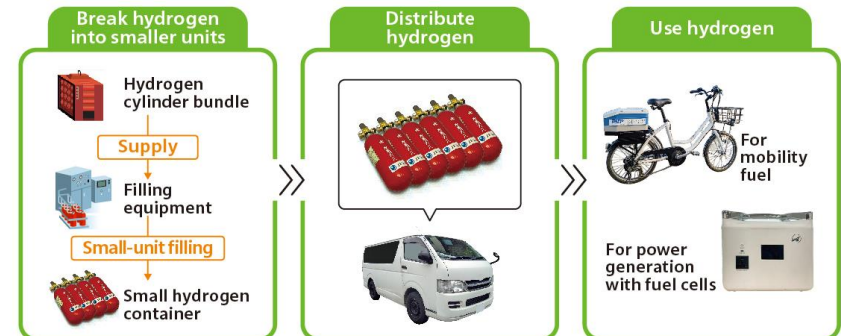


- 1 Does not emit CO₂ even when burned.
- 2 Can be produced from water and electricity.
- 3 Can store energy for long periods and be used in fuel cells.
- 4 Can produce methane from hydrogen and use it in city gas, etc.

What are the current challenges?

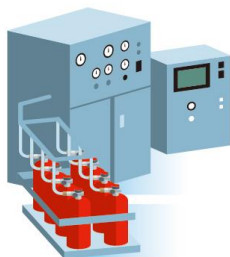
Insufficient development of supply infrastructure

What's needed are mechanisms and technologies to fill the "gaps"



Here's the Innovative Technology !

Addressing the challenge of hydrogen delivery: filling and efficient supply



Multi-unit simultaneous filling system
Significantly shortens the gas filling time
for small hydrogen cylinders (bottles)

Fill 10 units
simultaneously
in 70 minutes

One
container
can charge
160 mobile
phones (15W)

If a portable hydrogen fuel cell is
available at an evacuation shelter,
it can charge 160 mobile phones
for one hour each.



Supporting the spread of everyday mobility using
“hydrogen fuel cells”

How might the spread of

this innovative technology transform future society !?

Refuel hydrogen at drive-throughs or roadside stations and enjoy
comfortable outdoor leisure at campsites



On the way back from shopping,
purchase an energy bottle for an
electric bicycle from a vending machine



*For social implementation and commercialization of the technology, legal and safety issues must be addressed.

Starting from “Osaka,” it would be wonderful to see new
services utilizing the advantages of hydrogen expand
further!

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Innovative Carbon-Neutral Technologies from Osaka
Recycling

Are scallops twice as valuable in one shell (cycle)?



“Waste” generated from primary industries such as scallop aquaculture



“Waste scallop shells” generated from aquaculture scallops are reborn as eco-materials



Using advanced processing technology, reborn as eco-materials and reused as product raw materials and construction materials

Development and commercialization of eco-friendly materials using waste materials

We are introducing product development that utilizes carbon fixation in waste scallop shells. By mixing waste scallop shells with recycled plastics and concrete, it is possible to reduce CO₂ emissions throughout the product life cycle and develop products that contribute to carbon neutrality.

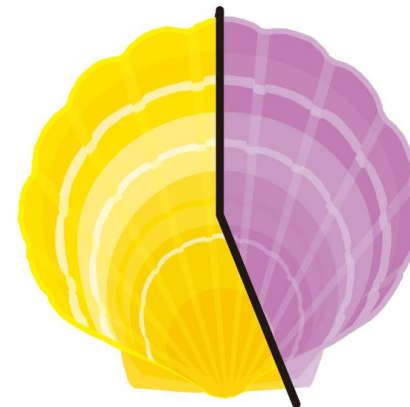


Relationship between shell growth and “CO₂”

Did you know that scallops absorb “CO₂” as they grow in the sea?

In general, scallops grow from juvenile shells, and about half of their weight becomes a shell skeleton of calcium carbonate fixed with CO₂ absorbed from the ocean, taking 2 to 4 years before shipment.

Absorb dissolved CO₂ in seawater and grow



More than 90% of scallop shells consist of calcium carbonate, of which

about **44%** is CO₂.

100 tons of discarded scallop shells have the ability to fix about 44 tons of CO₂!?

Here's the Innovative Technology !

Manufacturing with lower GHG emissions (CO₂) is now possible



Combined with plastic and developed into “eco-products”



Mixing into concrete also helps reduce CO₂ emissions in the construction industry

How might the spread of

this innovative technology transform future society !?

The keywords for future manufacturing and city development are “carbon fixation” and “circularity”



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Recycling

Microwave technology for recycling plastic — saving time and energy

The Key Powered by Microwave Heating



Contributing to improved efficiency, quality, and CO₂ reduction in “plastic resource recycling”

Compact and distributed chemical-recycling system using microwave heating

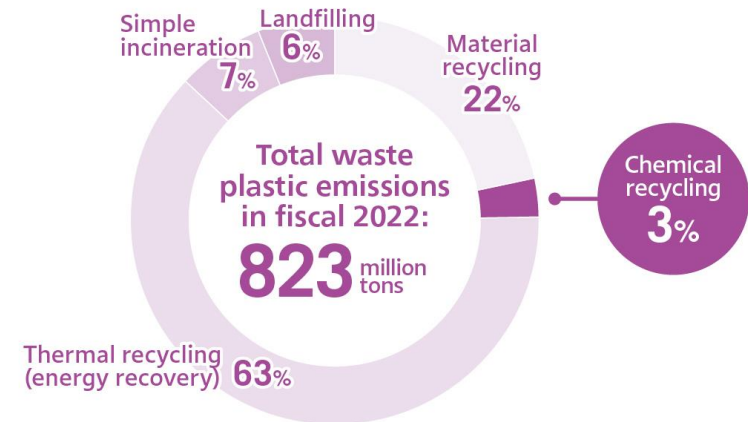
This is an introduction to technology to promote chemical recycling of recycled plastics. By utilizing microwave heat treatment technology and popularizing decentralized recycling, economical plastic recycling with less environmental impact can be realized.

What is required for spreading the Plastic Recycling System

What challenges do we face in further promoting plastic resource recycling?

Current issues

- Currently, the recycling rate for plastics other than those for energy recovery is around 20%.
- Chemical recycling, which breaks down used plastics and returns them to their raw materials, needs to become more widespread.



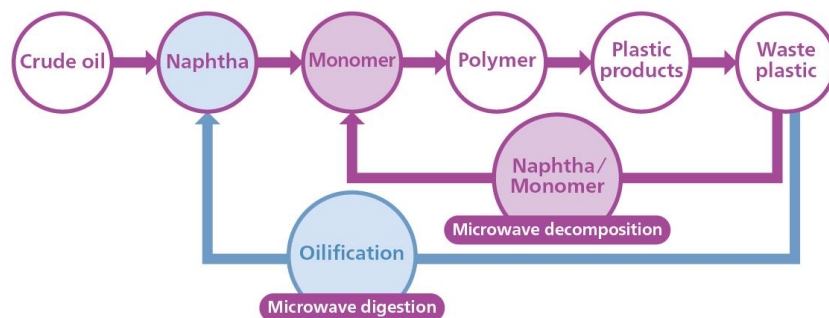
Solution

Establishment of more efficient chemical recycling technology using microwaves with low CO₂ emissions

Here's the Innovative Technology !

We are advancing innovative chemical recycling using microwaves — a technology well known from household ovens.

- 1 Using renewable electricity as an energy resource to reduce CO₂ emissions to zero.
- 2 By recycling at local collection points, the entire recycling chain can be improved, especially transport efficiency.
- 3 By selectively heating target materials, microwaves enable precise control over transmitted energy and facilitate the production of diverse products.

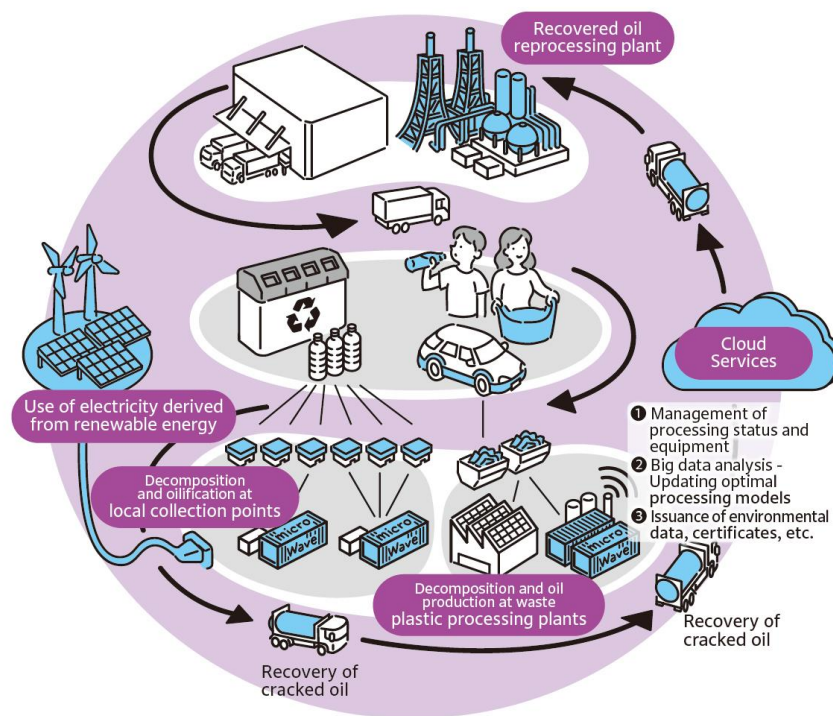


Microwaves can transmit energy directly and selectively to substances, and the amount of energy transmitted can be flexibly and quickly controlled, making it possible to create different products.

How might the spread of

this innovative technology transform future society !?

Using renewable energy and eco-friendly plastics, a smooth resource circulation system can be realized.



Provision of Technical Information / List of exhibitors for Futre Life Experience

Company Name		Technical Field
1	・Kansai Catalyst ・Bigvan	Renewable Energy
2	・Renaissance Energy Research	
3	・Sumitomo Electric Industries ・MUIC Kansai	CO ₂ capture
4	・Smert Design	Energy management & Energy Saving
5	・TIGER CORPORATION	
6	・MIRAKOTO	
7	・Green Methanation Research ・SHINGU ENERGY ・T N Plan	Hydrogen
8	・MIRAIT ONE ・KINKIDENKI	
9	・Koushi Chemical Industry	Recycling
10	・Microwave Chemical	