

Carbon Neutrality Special

Examining how companies, governments and academia are working toward emissions reduction and environmental preservation



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GETTY IMAGES

SOLAR HORIZON



Solar panels and wind turbines in the village of Rokkasho, Aomori Prefecture, in May JJI

Economist looks at future of solar power in Japan

University of Tokyo VP urges more investment to mitigate tech-driven electricity demand amid struggle to decarbonize

Is Japan on the right track toward decarbonization? What are the obstacles to accelerating its efforts? In a recent interview with The Japan Times, University of Tokyo Vice President and economics professor Hiroshi Ohashi offered his views on these questions.

He started by acknowledging the prevailing view that energy demand will increase due to factors like the rise of generative AI, data center construction and industrial electrification aimed at reducing carbon emissions. However, he pointed out that demand has not been increasing in recent years — a trend that may continue as mitigating factors such as population decline and energy-efficiency advancements take effect.

On the other hand, various decarbonization efforts have been underway, including the installation of solar power facilities. Japan boasts the highest solar power capacity per square kilometer among major countries, and twice as much as Germany in terms of flat land.

The first Global Stocktake at the 28th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP28) in Dubai, in 2023 reviewed progress made toward achieving the goals of the Paris Agreement. Japan revealed that its carbon emissions reduction efforts were on track to achieve its 2050 carbon neutrality target, demonstrating relatively better progress than many other countries.

However, Ohashi cautioned there were some underlying concerns regarding the trajectories for energy demand and decarbonization. One thing he pointed out was that industrial activities in Japan are declining as companies move their manufacturing bases to countries with looser regulations, ducking the pressure to reduce emissions.

“Will this truly lead to the desired carbon neutrality?” he asked.

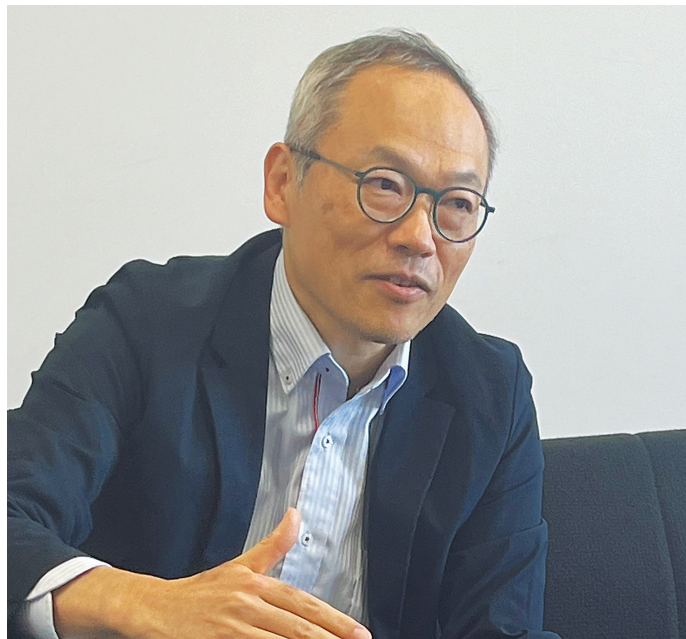
He also highlighted the need to further promote investments in decarbonization technology.

Ohashi thinks that a clear road map for future growth and return on investment is a prerequisite for scaling up investments and enhancing price competitiveness to accelerate industrial green transformation.

That is why it is important to create a market for decarbonization, he said.

“Traditionally, capitalist economies are driven by market demand. However, in the context of green transformation, a new market for decarbonization needs to be created, which requires government policy to play a crucial role,” Ohashi argued.

The government liberalized Japan’s retail electricity market in 2016, leading to greater price fluctuations.



Vice President and economics professor at the University of Tokyo Hiroshi Ohashi

“In this context, it makes sense to adjust demand based on supply,” Ohashi said, emphasizing that introducing a carbon tax would further incentivize these kinds of adjustments.

He also mentioned the use of electricity aggregators as a key strategy.

“For example, Energy Pool Japan is an electricity aggregator based in Tokyo. These aggregators have access to operational data from their clients’ factories. By analyzing this data and considering real-time fluctuations in electricity supply and demand, these aggregators can optimize electricity consumption. This may involve adjusting the operational schedules of factories to align with periods of lower demand,” Ohashi said.

Although this method has not yet been fully applied to domestic electricity use, Ohashi argued that there is considerable potential for using this technique to cut household energy consumption. Coupling household-focused aggregation services with automation technologies can encourage increases in demand during periods of abundant supply, such as the daytime, when solar generation is high. The widespread adoption of home storage batteries and heat pumps can make using solar power even more efficient.

Ohashi also said it was important to maintain residential solar panels to make the most of their potential.

The feed-in tariff scheme (and a precursor launched three years earlier) was introduced in 2012 to encourage household adoption of solar panels by giving owners the right to sell any power generated to their utilities at fixed prices higher than the market rate for 10 years. This was made possible by the government passing on the cost of buying that power to consumers.

Given that the initial solar contracts began expiring several years ago and that purchase rates have reportedly dropped to less than a fifth of the initial rate, many homeowners

have lost the incentive to continue selling and are using the excess themselves.

Ohashi emphasized that aggregators can help make use of surplus electricity generated by homeowners. “While each output may be modest, the aggregated volume has the potential to meet at least a portion of the local electricity demand,” he said.

He suggested that the maintenance of residential solar systems be carried out by local infrastructure companies. “These operators are firmly established within local communities. They will be able to play multiple roles in the electricity sector that requires stability and trust from local businesses and communities,” he said.

To bring costs down, Japanese companies can try making solar cells from domestically sourced materials, Ohashi said.

“Efforts have been made to replace imported silicon, which is conventionally used for producing solar cells, with domestically produced perovskite,” he said. Iodine is the primary material for producing perovskite cells, and Japan is the world’s second-largest producer of iodine. Ohashi said companies like Sekisui Chemical and Kaneka have been actively pursuing this possibility because perovskite cells are light, thin and flexible, allowing them to be installed on a broader range of surfaces.

However, Ohashi noted that Japan faces another big hurdle in promoting the installation of solar panels: the high installation cost.

“While we have observed a significant decrease in the prices of these devices, the installation costs remain double the global standard. This is a challenge shared with other types of power generation facilities, such as wind and offshore wind power plants,” he said. This is partly due to the labor shortage in the construction industry. Ohashi said that addressing this impediment should remain a top priority.

From a medium-term perspective, Ohashi said it will be important to decarbonize exist-

ing power plants in the near future.

“Increasing criticism toward coal power generation has resulted in the closure of some of the older thermal power plants, but losing them altogether will cause a power supply crisis,” Ohashi said.

“There are various approaches that power plants can take to achieve decarbonization. For instance, coal power plants can transition to ammonia. Liquefied natural gas-fired power plants can be modified to combine hydrogen with natural gas, gradually increasing the hydrogen content until it fully replaces natural gas,” he said.

Despite the challenges associated with hydrogen, including the cost and logistical constraints, its use is gradually expanding. Ohashi noted that the Tokyo Metropolitan Government is using fuel cell buses and signed an agreement with Yamanashi Prefecture in 2022 to promote its “green hydrogen” produced with renewable energy. The capital is also collaborating with H2 Global Foundation on a plan to establish a hydrogen trading market. In the meantime, Yamanashi and beverage company Suntory are collaborating to install a system at Suntory’s Hakushu whisky facilities in Yamanashi to produce green hydrogen.

He also touched on several private-sector initiatives to promote the gas, including a hydrogen-powered coffee roaster used by UCC Ueshima Coffee, JR East’s Hybari hydrogen train, Japan Post’s fuel cell trucks and Iwatani Corp.’s development of hydrogen production and related technologies.

There is also a method for reducing carbon dioxide emissions by capturing and storing them underground known as carbon capture and storage. A plan is underway to initiate CCS in seven locations in Japan by 2030.

Ohashi emphasized the importance of learning from the past and preserving diversity in education, training and research institutions to support the future of the energy industry.

“CCS requires geological expertise, a field that weakened in Japan with the decline of the mining industry. A similar trend has been observed in the fields of oceanography and shipbuilding. We are also facing a shortage of electrical engineers and human resources in the nuclear power sector.”

Academia must anticipate future needs for specific expertise in this rapidly evolving energy landscape to reverse this trend, he added.

To mitigate the potential impacts of energy scarcity on businesses and people, Ohashi said that a balance will need to be struck between maintaining jobs and pursuing Japan’s environmental goals.

“It is necessary for Japanese manufacturers to maintain employment and focus on domestic production in compliance with Japan’s decarbonization policies, which will contribute to achieving the global carbon neutrality,” he said.

STEPS TOWARD 'GX'

Shifting to clean energy via 'green transformation'

Takatsugu Ryuzaki

DIRECTOR-GENERAL FOR GREEN TRANSFORMATION PROMOTION, MINISTRY OF ECONOMY, TRADE AND INDUSTRY



As of April 2024, 146 countries accounting for over 90% of the world's gross domestic product have committed to carbon neutrality, making decarbonization a global movement. In October 2020, Japan

declared that it aims to achieve carbon neutrality by 2050.

We have entered an era where the success or failure of efforts toward "green transformation" (GX), the shift from a fossil fuel-centered industrial and social structure to one focused on clean energy without carbon dioxide, will significantly impact the competitiveness of companies and nations.

GX 2040 Vision

Japan's GX plan aims to simultaneously achieve economic growth and industrial competitiveness while reducing CO2 emissions and creating a stable energy supply. At the end of last year, we presented a draft of the GX 2040 Vision. Given the increasing uncertainties in the business environment due to factors such as Russia's invasion of Ukraine, escalating tensions in the Middle East, U.S.-China friction and rising electricity demand driven by digital transformation (DX) and electrification, it is crucial to provide a medium- to long-term outlook. To this end, we have compiled a vision looking toward 2040, and based on this we aim to enhance predictability and expand investment to accelerate GX in the public and private sectors.

We believe that the efforts toward GX present a significant opportunity to break Japan's economic stagnation, which has lasted for 30 years. In the GX 2040 Vision, we present our goal of an advanced industrial structure where new GX businesses utilizing innovative technologies emerge one after another, and entire supply chains are created based on decarbonized energy and DX. The key to these new investments will be decarbonized power sources, which could lead to a clustering of new industries in their vicinity. Currently, significant investments are already underway in fields such as semiconductors and batteries, leading the way in both GX and DX. In the future, we will work to solidify this trend by promoting corporate investments and considering policies that support the development of decarbonized power sources in various regions.

We are already advancing upfront investment support of around ¥20 trillion over 10 years to achieve GX, using income from GX economy transition bonds. This includes the conversion of raw materials, fuels and production processes in industries where CO2 reduction is difficult, as well as the formation of supply chains in next-generation renewable energy fields, such as perovskite solar cells and water electrolysis devices.



The path to carbon neutrality is likely to be a winding one, with adjustments needed at each ridge and valley along the way.

MINISTRY OF ECONOMY, TRADE AND INDUSTRY

In December 2023, we established the Sector-Specific Investment Strategy focusing on 16 prioritized areas, such as steel, chemicals, life-related industries and aviation, as part of our support policy. At the end of last year, considering the discussions at the Working Group of Experts for the Realization of GX, we revised our strategy to include newly built net-zero energy houses and next-generation geothermal power in the scope of up-front investment support.

Emissions trading system

We will continue to promote investments that contribute to emission reductions and the enhancement of industrial competitiveness, aiming to realize over ¥150 trillion in public and private GX investments over 10 years.

At the same time, we are developing carbon pricing, which is crucial to realizing GX. The issuance of GX economy transition bonds to provide upfront investment support is underpinned by the revenues to be generated by the introduction of carbon pricing. The emissions trading system, which has been trialed within the voluntary framework of the GX League, will be fully launched in fiscal 2026. This system will set limits on CO2 emissions for each company, allowing for the trading of the surpluses and deficits between participants. This approach aims to encourage concentrated and efficient emission-reduction efforts, while using market mechanisms, among companies that emit CO2 above a certain threshold.

Transition finance and GX

Private financial institutions play a crucial role in realizing the more than ¥150 trillion in GX investments. The decarbonization of most production processes requires innovative technologies, which take a long time and

great expense to develop, especially in sectors where reduction is difficult to achieve.

Japan has led global discussions on transition finance, highlighting the importance of supporting these sectors. To further familiarize and expand transition finance, we issued the world's first sovereign transition bonds in February 2024. We chose this format to not only promote the transition of our economy, but also to spur the transition of the world.

Another vehicle that will appeal to private financial institutions is the GX Acceleration Agency. Having started its financial support operations in July, the agency will facilitate financing for corporate decarbonization efforts by using measures such as debt guarantees to help address risks that cannot be managed by private financial institutions alone.

Circular economy

The realization of a "circular economy" will also significantly contribute to the promotion of GX by reducing CO2 emissions in the manufacturing and waste disposal processes. In recent years, the transition toward this concept has progressed globally, notably via the strengthening of market-creating regulations in Europe. It is essential to respond to these trends. At the same time, if Japan, a small country with limited natural resources, continues to rely solely on the import of raw materials amid soaring resource prices, there is a risk of accelerating the outflow of national wealth. Therefore, we aim to establish a robust domestic supply chain by leveraging Japan's advanced resource recycling technologies and aspire to create a strong circular economy. We are working on this transition based on three pillars: collaboration among industry, government and academia; technological development and capital investment support; and the establishment of systems and regulations.

Regarding the collaboration pillar, we have established a "Circular Partners" initiative and are deepening discussions with over 600 partners to identify resource circulation obstacles for specific products and materials, and to develop a road map for achieving resource circulation.

In terms of technological development and capital investment support, we have been using the aforementioned GX bonds to provide consistent government support throughout, from research and development to demonstration and implementation, with a commitment of ¥10 billion over three years since fiscal 2024.

As for the regulations, we have outlined the following directions: mandatory planning and regular reporting on the use of recycled materials by manufacturers, and the establishment of a certification system to promote

environmentally friendly designs. By accelerating these initiatives, we aim to realize a Japanese model for a circular economy and strive for further growth.

Asia Zero Emission Community

Many countries in Asia share industrial and energy structures that are similar to Japan's, with a heavy reliance on thermal power generation and significant emphasis on manufacturing to drive their economies. This means sharing the same challenges Japan faces in its efforts to achieve decarbonization.

In this context, there are several fields where Japanese companies possess strengths, particularly in decarbonization-related technologies. By leveraging these technologies, we can accelerate efforts toward achieving GX, which is expected to significantly contribute to decarbonization in Asia and worldwide. Simultaneously, this can create new industries and markets in the decarbonization sector, potentially serving as a catalyst for economic growth throughout the Asia region.

To advance these efforts, we will promote policy coordination, including rulemaking with partner countries in line with the Action Plan for the Next Decade agreed upon at the Second AZEC Leaders Meeting held in Laos last year. This includes encouraging initiatives such as transition finance and the visualization of greenhouse gas emissions throughout the supply chain, thereby creating a positive cycle that generates further decarbonization projects. At the end of last year, we released our new emission reduction target proposals that aim to reduce GHG emissions by 60% in fiscal 2035 and 73% in fiscal 2040, compared with fiscal 2013 levels. Regarding the current fiscal 2030 target of 46%, Japan has made steady reductions so far, while some countries and regions may not have been doing as well. We will continue to promote GX further and contribute to global GHG reduction.

World expo looks to future

The 2025 World Expo will be held in Osaka this year from mid-April to mid-October under the theme "Designing Future Society for Our Lives." Based on the concept of "People's Living Lab," cutting-edge technologies in the GX field will be implemented at the expo site, including experience-based activities such as a sightseeing tour of a hydrogen-powered ship, and an explainer on "direct air capture" — a process that removes CO2 from the atmosphere — enabling visitors to experience what the future may hold. In addition, there will be a variety of attractions and experiences, including shows on future food experiences at company pavilions. We invite everyone to visit the expo.



Economy, Trade and Industry Minister Yoji Muto (left) and Prime Minister Shigeru Ishiba (seventh from left) attend the opening of the AZEC Leaders Meeting in Vientiane, on Oct. 11. JJI

Storage and transmission solutions for the transition

FPS offers custom strategies for client energy needs, giving a cost-efficient path to renewable energy

To promote the use of renewable energy in Japan, it is essential to ensure a balance between supply and demand, according to Soma Ito, director of the Renewable Energy Division at FPS Inc., which specializes in supplying renewable energy and providing clean energy solutions.

In a recent interview with The Japan Times, Ito said Japan is still transitioning to renewable energy sources, and the existing infrastructure is not making full use of the solar power being generated.

“The expansion of solar power generation in Japan has been notable, even in comparison with other countries. However, there is a geographical imbalance in the distribution of solar power generation facilities, with some regions, such as Kyushu and Hokkaido, having a significantly higher concentration of these facilities than others,” Ito said.

While areas like Tohoku and Hokkaido offer ideal conditions for wind power, the major cities, particularly Tokyo, have the highest energy demand. To bridge this gap, developing a robust power transmission infrastructure is essential. FPS tackles this challenge by providing technical support for companies to accelerate the introduction of renewable energy.

The initial challenge in increasing the rate of renewable energy use in companies is where proactive engagement is being observed in this area. Ito highlighted that while environmental sustainability may not be a top priority for many businesses yet, globally active companies in sectors like food manufacturing and cosmetics are accelerating their transition to renewable energy. This shift is driven by factors such as growing consumer demand and regulatory pressures, especially from the European market, which has stringent environmental standards.

While there is a possibility that other companies will eventually follow the leaders, Ito sympathized with those hesitant to accept the potentially higher costs to survive harsh competition.

However, he highlighted that the long-term benefits of transitioning to renewable energy cannot be overlooked.

“In the context of a 10- or 20-year time frame, with persisting concerns about rising fuel and electricity costs, providing a stable, direct supply of electricity using renewable energy will be effective risk management strategy,” he said.

FPS offers four distinct plans for introducing companies to solar power. One is the self-consumption plan, whereby electricity is generated on-site by a company-owned facility.

Alternatively, the on-site facility may be owned by a third party who supplies power to the company under a power purchase agreement. This kind of arrangement also works when the facility is situated off prem-



FPS offers storage batteries that allow power to be used, traded or sold through its aggregation service.

ises, changing it to an off-site PPA. FPS also provides services that include various operations, such as supply and demand management to support companies that build power plants on their own land to generate renewable energy.

One potential challenge with solar power is the possibility of an imbalance between supply and demand. This is because solar panels may create more power than needed during the day. However, FPS addresses this issue with its virtual PPA solution, which enables the sale of surplus electricity on the market and the issuance of environmental value certificates.

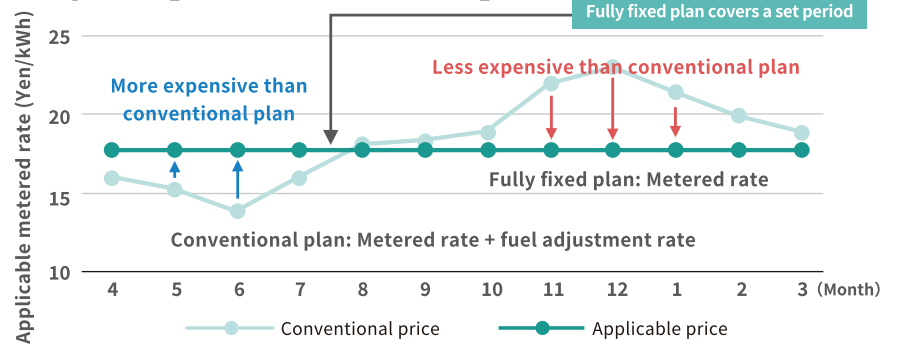
The company also offers a battery storage management service to ensure optimal use of surplus electricity. Battery power can be

‘Currently, our customers are mainly manufacturing companies on the stock market, but we are able to tailor our solutions to businesses in various industries.’

used during shortages, traded, or sold to electricity users through the renewable energy aggregation service. The company also performs the complex regulatory and operational tasks required of renewable electricity producers. These services are made possible by the extensive experience FPS has in navigating the electricity market. “Our supply and demand management team is responsible for monitoring daily market prices to determine the optimal prices at which electricity should be purchased and sold. Additionally, there is a specialized team that focuses on trading electricity futures. This team is dedicated to generating profit through short- to medium-term investments. This comprehensive approach enables us to assist our clients in generating additional revenue beyond their core business operations,” Ito said.

In some cases, companies may need to purchase electricity to supplement on-site generation during periods of high demand or insufficient sun. Some companies may have opted to source all or a portion of their electricity from external suppliers by default. In such cases, the most efficient and cost-effective method for procuring electricity will vary

Fully fixed plan vs. conventional plan



SOURCE: FPS



FPS Renewable Energy Division Director Soma Ito

from one company to another, depending on the specific circumstances and objectives.

FPS offers three distinct approaches to procurement. The first method is the conventional approach, whereby the price is subject to monthly fluctuations in line with fuel prices and rates on the electricity spot market. This approach can expose businesses to price volatility.

The second option is to have the unit price of the metered charge change every 30 minutes in line with wholesale market prices. This is also highly volatile, but it can be an optimal choice for companies that use a considerable amount of electricity during periods when market prices are unlikely to be high, or for companies that can regulate their usage in line with market fluctuations. The third option is to fix the unit price for the agreed-upon contract period, regardless of fuel prices or market prices, which provides stability and predictability.

With these diversified solutions and approaches, FPS is able to cater to the specific needs of companies that are exploring the use of renewables or trying to increase their usage ratios.

“Currently, our customer base is mainly composed of manufacturing companies listed on the (Tokyo Stock Exchange’s) prime market, but we are able to tailor our solutions to businesses across various industries,” Ito said.

For instance, a Japanese subsidiary of a

major shipping company has decided to gradually introduce renewable energy in accordance with demand when using off-site power purchase agreements. This will be efficient for the company as any excess electricity will be purchased by FPS.

“In another instance, a manufacturer of agricultural machinery approached us with an idea to install a tilted solar power generation system on fields where crops are grown. This would allow for more effective use of farmland. The generated electricity will be sent to their factories and offices,” Ito said.

FPS’ parent company GLP, a global builder and operator of warehouses and other logistics real estate, also makes use of existing resources to generate renewable energy. Solar systems are installed on the roofs of each large warehouse to generate power for itself, with any surplus purchased by FPS for distribution within the group or to external customers.

To expedite the deployment of solar power, Ito suggests that government policies be implemented to reduce transmission charges during daytime peak generation periods. He is also an advocate of negative pricing systems like those used in Germany, where power prices can fall below zero during periods of oversupply. These measures would incentivize the adoption of storage batteries, ultimately contributing to an overall increase in the renewable power ratio.

Optimizing the creation and use of electricity requires a multifaceted approach that entails monitoring and keeping up with policy changes and regulations, evaluating and balancing the facilities available, and identifying ways to promote the adoption of renewable energies.

In addition, a number of scenarios must be considered, including the potential for on-site generation and appropriate ways to manage periods of shortage and surplus.

“It would be a significant financial burden for companies to handle this internally. By leveraging the extensive experience of FPS’ experts in the electricity sector, companies can simplify this complex process while saving money,” Ito said.

FPS remains committed to helping companies develop and implement economically viable decarbonization plans and create balanced portfolios of different power sources that align with each company’s business profile.

This article is sponsored by FPS.

Possible road map to achieving 100% renewable energy

Phase	Procurement method	Renewable energy ratio	Power generation scale and installation costs	Summary
Phase 1 (~2025)	① On-site PPA ② Off-site PPA (Physical PPA)	10%	Small to medium scale	① Install solar panels on its own premises. ② Procure electricity from solar power from existing power stations, mainly newly built.
Phase 2 (~2026)	① On-site PPA ② Off-site PPA (Physical PPA + Virtual PPA)	25%	Medium to large scale	The amount of electricity that can be covered by solar power is procured from offsite sources in line with peak electricity consumption.
Phase 3 (~2030)	① On-site PPA ② Off-site PPA (Physical PPA + More Virtual PPA)	100%	Medium to large scale	Achieving 100% renewable energy by combining Virtual PPA, which does not require simultaneous procurement of equal amounts.

KANEKA

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Plastic alternative that offers carbon dioxide fix

Chemical maker harbors high hopes Green Planet polymer can reduce plastic pollution and cut harmful emissions

Kaneka Corp. is a chemical manufacturing company established in 1949 that provides solutions in the fields of chemicals, functional polymers, electronics, synthetic fibers, pharmaceuticals, medical devices, supplements and foods.

One of the environmental issues the company aims to address through its business is microplastic pollution. In a recent interview with The Japan Times, Shunsuke Sato, head of the CO2 Innovation Laboratory, talked about Green Planet, a biodegradable polymer that has the potential to help the environment while maintaining the convenience people enjoy from plastic.

Green Planet is a plant-based alternative to plastic that is made from vegetable oils and used cooking oil. It is used to replace plastic products such as straws, bags, cutlery, hotel amenities and films. Products made from Green Planet have physical properties similar to petroleum-derived plastics, and consumers may have encountered them in convenience stores or coffee shops without even realizing it.

Kaneka uses some vegetable oils that have been certified by the Roundtable on Sustainable Palm Oil as raw material, which attests to their sustainable sourcing of raw materials. The RSPO is a nonprofit organization dedicated to promoting sustainability and global standards across the palm oil supply chain. The company also maintains close ties with collectors of used cooking oil.

"The first sizable order of Green Planet products came from France over a decade ago, following the implementation of a new European Union regulation concerning the use of plastic materials. Supermarkets in France were obliged to identify alternative products that could replace fruit and vegetable bags made from conventional plastic," Sato said. Kaneka responded to their needs by providing compostable bags made from Green Planet.

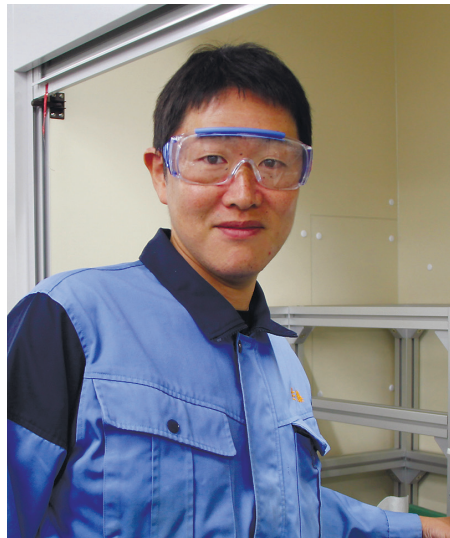
He added that plastic bags were lightweight and thin, which was ideal for weighing fruits and vegetables, but they could be easily torn, were only strong enough for a single use and could cause environmental harm if disposed of inadequately.

Foam packing materials pose similar problems, he said.

"Polystyrene foam is also lightweight and can be easily broken and carried away by the wind. This can result in a significant number of small pieces of foam ending up in the sea," Sato said.

Green Planet, however, presents a potential solution to this problem as it can also be made into foam. "Recently, Sony has started to use Green Planet foam for packing some of its products," he said.

Kaneka has also developed seedling pots using Green Planet. According to Sato, these



Shunsuke Sato is the leader of Kaneka Corp.'s CO2 Innovation Laboratory. KANEKA CORP.

pots don't have to be removed when planting seedlings, providing not only convenience, but also protection as roots are often damaged when attempting to remove plants from pots.

The use of Green Planet in manufacturing coffee capsules and pods is also gaining traction in Europe.

"Composting has become a standard practice in many European countries, with separate trash cans for different types of garbage, including compostable, burnable, nonburnable and recyclable materials in public spaces," he explained, noting that coffee capsules and pods made of Green Planet can be composted directly, eliminating the need to separate the grounds from the containers or burn them with the wet contents inside. "Our objective is to address the issue of 'not being able to separate' by utilizing a 100% biodegradable material," he said.

The biodegradation rate is affected by various factors, including surface area, temperature, available nutrients and number of microorganisms.

"Maintaining the material in an environment where microorganisms are active will accelerate the biodegradation process," Sato explained. Green Planet's high degradability, coupled with the company's expertise in state-of-the-art synthetic biology, molding and processing technologies, allows it to be made into a variety of shapes suitable for applications across the globe.

In fact, Green Planet is already being used extensively in the EU, the United States and Japan.

"More than 50% of Green Planet products are exported. We are anticipating an increase in its international sales, particularly in countries such as the United States, where there is a significant demand for plastics for packaging snacks and fast food," Sato said.

"Numerous products are used and discarded without any awareness of their plastic content," Sato explained. For instance, the insides of paper cups are typically covered with plastic waterproof films. Kaneka aims to expand the use of Green Planet to replace these unrecognized plastic elements and items.



Kaneka Corp. aims to replace traditional plastic products, including PET bottles, with those made from Green Planet. PATDANAI, SHUTTERSTOCK

At present, eco-friendly products are gaining ground in shopping bags, followed by straws and cutlery. The company's objective is to apply Green Planet to a broader range of packaging solutions for foods and beverages.

"The item we have yet to trial with the highest priority is PET (polyethylene terephthalate) bottles. A vast number of PET bottles are manufactured and utilized globally, becoming a primary contributor to marine plastic waste. We are aiming to replace PET bottles with those made from Green Planet," Sato said.

The company initiated the development of biodegradable polymers in the early 1990s. In those days, the term "marine plastic waste" was not yet common. The environmental issues of concern at the time were different from today's.

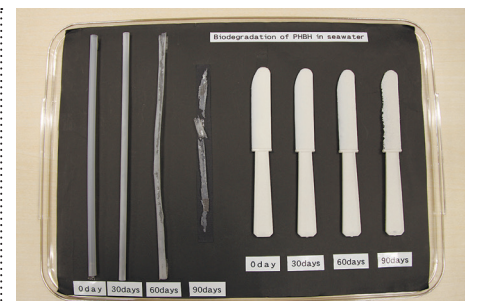
In the '90s, waste was typically either incinerated or used for landfill. But it was the growing concern over the environmental impact of landfill sites that caught the company's attention. "That was the initial motivation for our research and development of biodegradable polymers," Sato explained.

A vast number of PET bottles are manufactured and used globally, becoming a primary contributor to marine plastic waste.'

The focus of the debate, however, soon shifted to the climate threat posed by the carbon dioxide from the incinerators. So the company is taking on that challenge via Green Planet as well. "Our current research is focused on the use of carbon dioxide as a raw material for Green Planet production," Sato said.

This is done through microorganisms known as hydrogen-oxidizing bacteria, which can transform carbon dioxide into organic substances. "These bacteria have existed on Earth since microorganisms first appeared, which is why our planet is now home to a vast array of organic substances," Sato explained. Kaneka is attempting to extract and use materials contained in these substances to make Green Planet.

"This technology will make Green Planet not only biodegradable, but also 'circular' in terms of sustainable production. This is because the carbon dioxide emitted during the disposal of used Green Planet products can be fixed during the manufacturing pro-



A display shows how long it takes utensils and other items made of Green Planet to degrade in seawater. KANEKA CORP.

cess, returning the carbon to an organic state," he said.

Sato revealed the technology has proven viable at the experimental level and that the next phase will see it applied to industrial production. He highlighted that the primary challenge is to develop a stable method for cultivating a large quantity of hydrogen-oxidizing bacteria in a hydrogen gas environment.

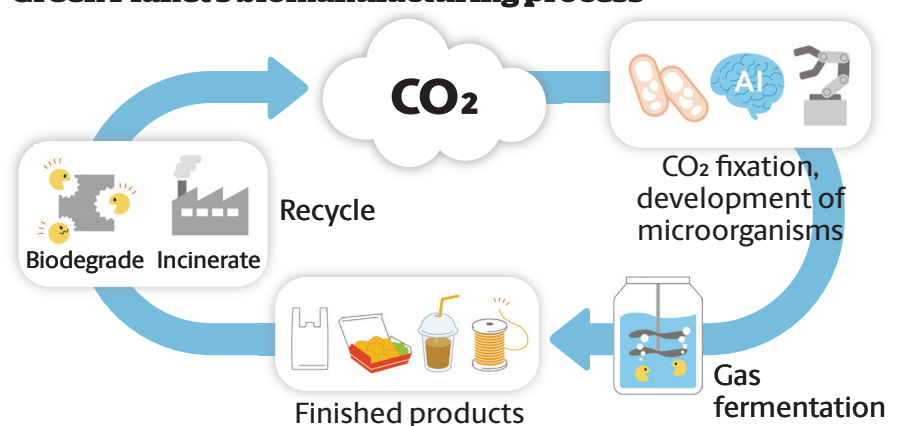
"It is also essential that we work closely with hydrogen gas providers to establish a reliable value chain in a market where the technology to develop a hydrogen supply infrastructure is still evolving," he said. Despite the challenges, the company is targeting commercialization of carbon dioxide-derived Green Planet by 2030.

The company's efforts to evolve Green Planet will not end there. Sato explained that Kaneka will continue to explore new substances from which to produce Green Planet, with a view to diversifying the raw materials used and ensuring stable production. "I believe there are numerous other potential raw materials that could be utilized, as long as they can be metabolized by microorganisms and are fossil-free. The diversification of materials, including the use of carbon dioxide, will help avoid the depletion of raw materials," he said.

"We are seeking solutions to the question of what we should use to create the everyday goods people use to achieve higher levels of sustainability in society," Sato said. While going back to pre-Industrial Revolution lifestyles is one way to achieve sustainability, he believes it is necessary for people to realize a "circulatory society" by using the science and technology that humanity has worked so hard to advance. "This is also our responsibility as a chemical manufacturing company," he said.

This article is sponsored by Kaneka Corp. Visit <https://www.kaneka.co.jp/en/solutions/phbh/index.html> for more information.

Green Planet's biomanufacturing process



SOURCE: KANEKA CORP.

JAPAN TIMES GRAPHIC



Green Planet is primarily produced at Kaneka's plant in Takasago, Hyogo Prefecture. KANEKA CORP.

TANAKA PRECIOUS METAL TECHNOLOGIES

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Ready to catalyze shift to a hydrogen society

As Japan's leader in fuel cell catalysts, Tanaka is expanding production for the energy transition to greener power sources

Precious metals represent a key facet of the hydrogen society to come. Platinum-based catalysts, for example, are essential to building fuel cells — a core hydrogen technology. Tokyo-based Tanaka Precious Metal Technologies Co. has been developing fuel cell catalysts since the 1980s and is a global player in the drive to make the planet more sustainable by utilizing the unique properties of platinum and other precious metals.

Platinum-grade foresight

Founded 139 years ago during the Meiji Era (1868 to 1912), Tanaka was originally a money exchange. It then began dealing in platinum, later becoming the first in Japan to succeed in manufacturing catalytic platinum mesh. Today, Tanaka stands as a leader in precious metal products with three primary business pillars: advanced materials for industrial use, asset products such as bullion and coins, and jewelry.

Tanaka's branches and affiliates cover countries and territories ranging from the United States and Germany to Asia, including Singapore, Malaysia, Thailand, China, South Korea and Taiwan. The company offers total solutions for bullion procurement as well as development and manufacturing, sales and recycling through its advanced technologies and international network.

A dedicated development department set up about 30 years ago led to Tanaka launching its FC Catalyst Development Center in 2013 to set up a mass production framework. In 2018, the growing call for a true hydrogen society spurred Tanaka to expand production. Next on the agenda is overseas production bases, with fuel cell electrode catalyst production due to begin in China in 2026 for the Chinese market.

"We started out making materials for catalysts, and then moved on to developing combustion catalysts and fuel cell catalysts ourselves," said Tanaka's Chief Operating Officer Tomoyuki Tada, who's been focused on fuel cell development and hydrogen since the early days.

"Investing in the hydrogen field was at that time an adventure, but we anticipated the arrival of the hydrogen society."

Around the same time, Tada noted, Tanaka's science and technology team dove into finding ways to use precious metals in cancer

drugs and other pharmaceuticals. Fueled by the ambition of one day becoming a catalyst manufacturer that could "contribute something to people's health and lives," the company took its first step on the long journey to materials development for a hydrogen society.

Core tech with clean output

Fuel cells — formally known as polymer electrolyte fuel cells — emit only water as a byproduct, meaning their output of carbon dioxide and other pollutants is zero.

Platinum-based catalysts are crucial to PEFC performance.

"A catalyst is something that facilitates change without changing itself," Tada explained. "PEFCs need to react at low temperatures, and to make that reaction happen, we need a highly active catalyst like platinum. While other catalyst materials — including nonmetallic ones — are being researched, their performance pales compared to that of platinum."

What turned Tanaka into Japan's undisputed leader in fuel cell catalysts is its platinum-ruthenium catalyst for Japanese Ene-Farm home-use fuel cells.

"This was the turning point that led to us dominating the Japanese market," Tada said. "If we had not developed this catalyst, Ene-Farm might not have been realized. It was also the trigger that gave us the confidence to expand overseas." Tada explained that while all companies use platinum and carbon for fuel cell catalysts, Tanaka has a key advantage: a sophisticated technology that evenly disperses platinum onto carbon.

Ahead of the game

Although other companies are catching up with Tanaka's dispersion technology, the company has the added strength of being a pioneer.

"Customers process our catalyst, which is a nanoscale powder, into layers," Tada said. "Since we were one step ahead in making and selling quality catalysts, their processing 'recipes' are tailored to the properties of our products so it would be difficult to switch to other suppliers."

The company has succeeded in advancing its technology by connecting with global developers and openly sharing its expertise



Platinum-based catalysts are instrumental in the transition to a hydrogen society. TANAKA

— a process now known as "open innovation." Tanaka has openly provided its know-how to customers as well.

"I went to clients' offices and showed them how to process the catalyst with a proper recipe so that they can experience the expected performance of the product," Tada said. By supporting customers with product development, receive feedback and apply that knowledge to the improvement of its own products.

Hydrogen society trials

Sourcing hydrogen and addressing its sustainability and high costs are thorny challenges in achieving a hydrogen society, he said.

"Hydrogen is a secondary energy source," Tada said, "and unlike fossil fuels such as oil, it needs to be made from something. And producing hydrogen using natural gas or fossil fuels as fuel, or by electrolyzing water, requires huge amounts of money and time. So does procuring hydrogen from overseas. The infrastructure, such as hydrogen stations and supplying hydrogen to them, is not there yet either."

One issue is how to switch from "gray" hydrogen — which is derived from carbon dioxide-emitting fossil fuels — to "green" hydrogen, which is derived from renewable energy sources.

Polymer electrolyte membrane water electrolysis (PEMWE) is the simplest solution, but also one of the most expensive.

"We're also developing electrode catalysts for PEMWE," Tada explained. "But the process uses a precious metal called iridium, which is a limited resource and costs about ¥20,000 per gram, so we need to consider how to use it effectively."

Tanaka is installing a 500-kilowatt fuel cell system at its main precious metal recycling business site in Shonan, Kanagawa Prefecture, to help demonstrate the potential of hydrogen energy. Scheduled to go online in 2026, the fuel cell system will be one of the largest private-use systems of its kind in Japan and generate 25% of the electricity used at the plant.

Since precious metals are scarce, recycling has long been a part of Tanaka's DNA. The

company is determined to create a resource circulation system that covers all stages from procurement and manufacturing to sales and recycling. To ensure its supply of the metals, Tanaka also plans to deepen its procurement relationships with mines.

Beyond that, Tanaka collects these metals from scrap, second-hand products and equipment and recycles them at its own plants. It also works incessantly to improve performance, durability and dispersion to reduce platinum usage and costs.

Mining for the future

When it comes to materials development and research, Tanaka keeps its eyes focused on the horizon and avoids the temptation of jumping onto industry trends and fads.

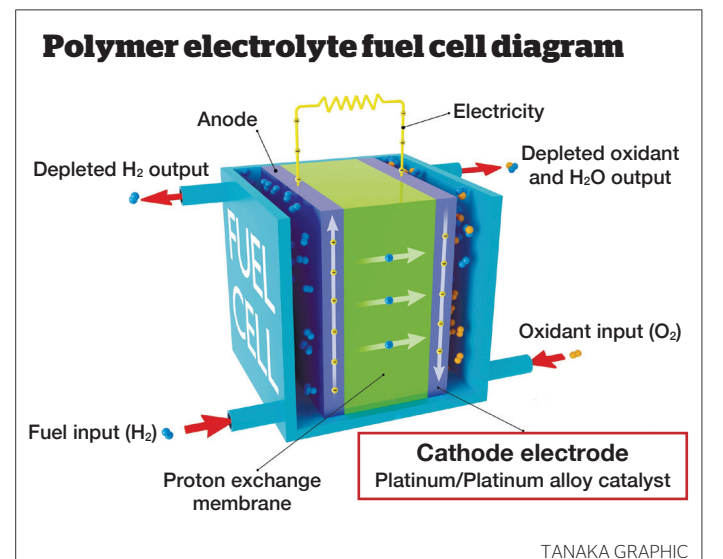
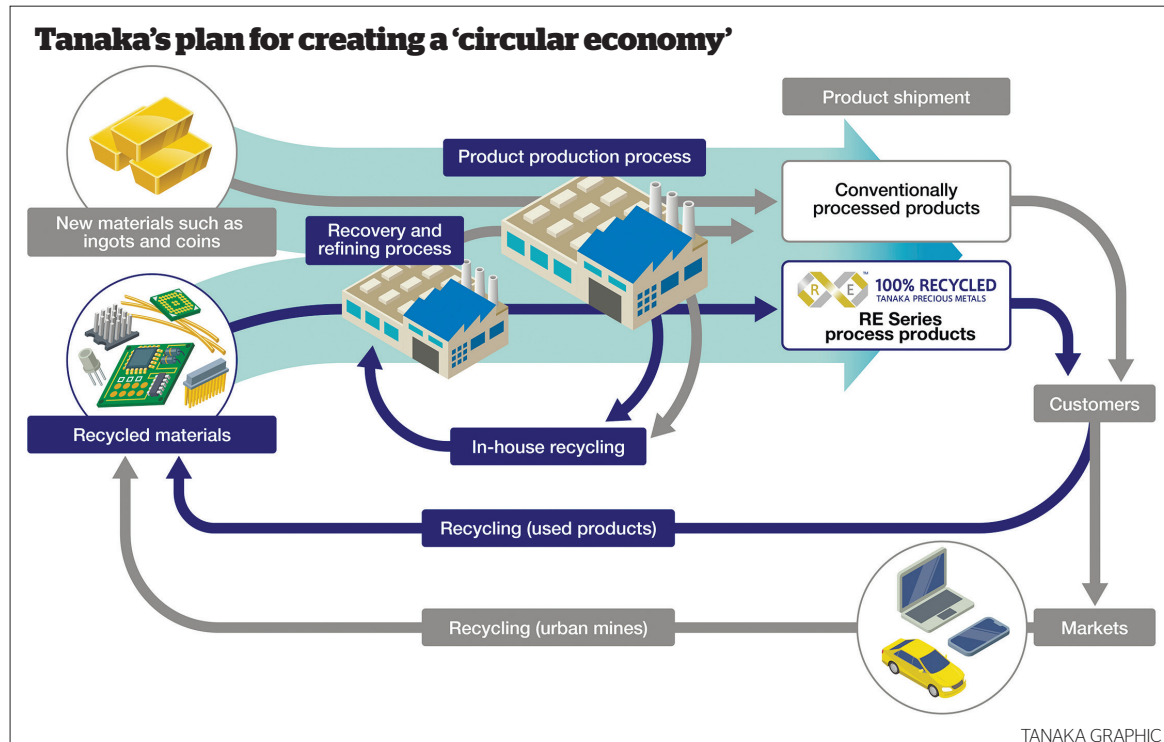
"We don't let big stories from others sway us," Tada said. "We support the market's growth in a strategic, long-term manner, with a calm perspective. We can do this because we're a market leader that can see the entire market. We also have a strong will to continue until the hydrogen society is realized."

"We fully understand that attainment of a hydrogen society is not easy," Tada said. "Even if the achievement of our goal takes another 10, 20 or even 30 years, we are resolved, determined and willing to invest as much time as is necessary in research and development."

This article is sponsored by Tanaka Precious Metal Technologies Co. (<https://tanaka-preciousmetals.com/en/>)



Tomoyuki Tada, COO of Tanaka Precious Metal Technologies Co. TANAKA



YANMAR

(Sponsored content)

Innovations, technologies for a sustainable future

Yanmar unveils products and solutions to reduce greenhouse gases and protect the environment

Yanmar was established in 1912 by Magokichi Yamaoka, who was driven by a mission to ease the burdens faced by farmers. At a time when the rising demand for food was making manual labor increasingly challenging for the agriculture industry, Yamaoka was determined to modernize crop production. His vision led to the development of Yanmar's compact and efficient diesel engine, a groundbreaking innovation that transformed farming practices.

Even as times have changed, Yanmar has stayed committed to its core mission of serving people by providing solutions that address societal needs. Now, over 110 years since the machinery maker's founding, the global demand for sustainable solutions continues to grow.

In line with its brand statement, "A Sustainable Future — New Value through Technology," Yanmar believes a new form of prosperity emerges when both nature and humanity thrive together. By deeply considering customers' needs and creating unexpected new value, Yanmar endeavors to provide solutions and contribute to the creation of a more prosperous society. To enhance the efforts being made by the entire group, the company has established the Sustainability Promotion Division. This division is led by Mariko Shirafuji, who was appointed to the new position of chief sustainability officer in July.

Prior to this post, Shirafuji served as the representative director of Yanmar Symbiosis Co., a company that employs individuals with disabilities through a range of business activities, including a farm with activities for tourists, cleaning services and back-office support for other group companies. She has also been instrumental in promoting diversity and inclusion based on the company's founding concept of *hanasaka* (blooming flowers), which represents the root of the founder's spirit and vision of believing in people's potential and encouraging them to take on challenges.

"Our brand statement emphasizes creating value that enhances people's lives while protecting nature," Shirafuji said. The Yanmar Green Challenge 2050 initiative, launched in 2022, serves as a road map for this vision.

Consisting of three focused "challenges," the company has been following the road map by taking concrete steps and practical measures to drive progress toward the 2050 goal.

Challenge 1 focuses on reducing greenhouse gas emissions across the company's entire value chain to contribute to achieving carbon neutrality by 2050. About 90% of the company's total emissions result from the use of its products. To address this, the company has been working to improve the efficiency of its products while maintaining user convenience. It has developed a wide range of products and prototypes, including new types of engines for alternative fuels and fuel cell systems, as well as agricultural and construction machinery that runs on a variety of eco-friendly energies.

"In Europe, we have developed three models of compact, battery-powered construc-



The Yanmar Clean Energy Site is a demonstration facility showcasing next-generation energy equipment.

tion equipment," Shirafuji said.

In August 2023, the company supplied its newly commercialized maritime hydrogen fuel cell system to the passenger ship Hanaria that operates out of Kyushu. This is Japan's first hybrid passenger ship with an electric propulsion system based on hydrogen and biodiesel.

It has an integrated power system developed by Yanmar that consists of batteries, biodiesel generators, two fuel cells, a power management system, propulsion equipment, remote monitoring and other features. The ship is capable of achieving zero emissions when operating on the fuel cells and batteries.

"The elimination of exhaust gas odors and the reduction of vibration and noise levels make the system particularly well-suited for passenger ships," Shirafuji said.

For larger vessels, the company is developing engines powered by hydrogen, methanol, ammonia and other alternative fuels.

In September 2023, the company established the Yanmar Clean Energy Site, a demonstration facility for hydrogen power systems and other technologies that contribute to decarbonization. It is equipped with clean-energy devices centered around hydrogen systems and will continue to facilitate research and development in this field.

Challenge 2 is to achieve zero environmental impact from corporate activities. The company aims to approach this from various angles, such as by reducing waste volume and water usage, minimizing the use and discharge of hazardous substances in all corporate processes, and achieving a circular economy for its products.

The company has been working to reduce its environmental impact while tackling challenges within its factories. For instance, certain plants have implemented specialized racks to secure parts during transport, significantly reducing the need for packing materials, saving space and lowering disposal costs.



Chief Sustainability Officer Mariko Shirafuji

Additionally, to conserve water, some facilities have introduced water-saving faucets and use collected rainwater for irrigation.

Challenge 3 entails the provision of solutions that assist customers in achieving negative greenhouse gas emissions and the circulation of resources in their business activities. These new solutions go beyond the framework of conventional corporate activities.

Group company Yanmar Energy System Co. has developed a system that creates biochar from rice husks. Disposal of the enormous quantity of rice husks generated following annual harvests has long been a challenge for rice farmers.

"Discarded rice husks can generate methane gas and other gases that have a stronger greenhouse effect than carbon dioxide," Shirafuji explained. The system can produce biochar, which is expected to improve soil quality without adding harmful substances. The biochar is returned to the farms, thereby reducing greenhouse gases generated from rice farming.

The company also offers a wide range of solutions aimed at conserving and restoring the natural environment through food production.

"The YC100 biocomposter is designed to decompose crop residue and food waste into fertilizers. It is currently used by municipali-



The YC100 composter is used in Japan to recycle food waste as part of resource-recycling initiatives.

ties, golf courses, shopping malls and restaurants," Shirafuji said, noting that the fertilizer is either used to grow crops or distributed to farmers in the neighborhood. The biomass gasification system employs a similar method to convert crop residue and food waste into reusable energy.

The company is also engaged in international initiatives aimed at promoting the sustainability of agriculture. It has entered into an agreement with Faeger Corp., a Japanese company specializing in the creation and sale of agricultural carbon credits, in a bid to reduce methane emissions from rice paddies in the Philippines using the water management method known as "alternate wetting and drying." By periodically drying the rice paddies and supplying oxygen to the soil, it can inhibit the activity of methane-producing bacteria. This process also reduces the generation of methane, one of the most powerful greenhouse gases.

The results of these efforts will be converted to carbon credits under the Joint Crediting Mechanism, a system that Japan's farm ministry is promoting to members of the Association of Southeast Asian Nations.

The company carried out demonstrations in November with the objective of advancing decarbonization and contributing to developing economies on a broader scale.

Another example of the company's commitment to sustainable agriculture on a global scale is its newly developed autonomous YV01 spraying robot. The YV01 has been specifically designed for use in vineyards, which are often on steep slopes, making maintenance and cultivation dangerous and time-consuming.

"The robot is capable of crawling on steep hills via remote manipulation, ensuring precise and targeted application of agricultural chemicals," Shirafuji said. This can reduce the overall volume used, which will lessen the environmental and health impacts while increasing efficiency and productivity.

"The YV01 has already been deployed mainly in vineyards in France," she said.

In 2022, the company launched an internal competition to identify new and inspiring ideas from employees.

"This initiative exemplifies our company's founding spirit of *hanasaka*, which reflects our dedication to fostering human potential and motivating individuals to embrace new challenges. We look forward to working with our employees, communities and partners to address various challenges and create a sustainable society," Shirafuji said.

This article is sponsored by Yanmar.

A SUSTAINABLE FUTURE
— New Value through Technology —

Circulate resources towards becoming a greenhouse-gas-free company with zero environmental impact.

Challenge 1

Realize zero GHG emissions from corporate activities

Challenge 2

Realize zero environmental impact from corporate activities by circulating resources

Challenge 3

Contribute to customers' negative GHG emission and resource circulation

SOURCE: YANMAR GREEN CHALLENGE 2050 JAPAN TIMES GRAPHIC



Left: Yanmar makes a variety of battery-powered construction equipment. Right: The YV01 spraying robot is designed for vineyards, which often have steep slopes that make cultivation dangerous.



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