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Issue

09

Feature

Power of Renewal



**Everything Can
be Reborn.
Between Waste
and the Future
Is My Life.**

issue **09**

Power of Renewal

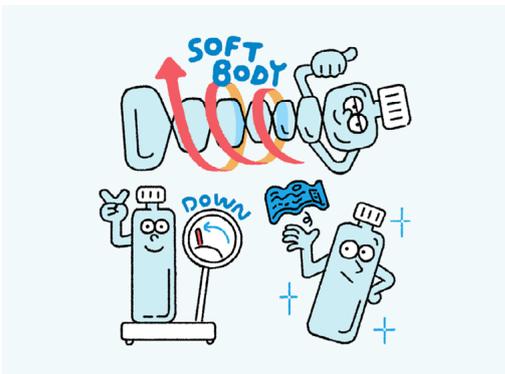
Feature



Designing Homes with Their “Eventual Disposal” in Mind: Learning from an Architect with a Decomposer’s Perspective on Circularity

Have You Ever Imagined the Day Your Home Becomes Waste? We visited architect Fuminori Nousaku, who designs with a vision of transformation.

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Invisible PET Recycling Revolution: On Convenience Store Shelves and Beneath Our Feet

Endlessly recyclable PET bottles “HERIX” and industrial waste-repurposed “New Track” – exploring the forefront of evolving PET material recycling.

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Designing Homes with Their “Eventual Disposal” in Mind: Learning from an Architect with a Decomposer’s Perspective on Circularity



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When considering the transition to a circular society, “housing” is a crucial factor. The process of rebuilding or demolishing homes generates an enormous amount of waste. Ideally, homes should be cherished and passed down through generations, even as occupants change. However, in Japan, new detached houses are often preferred over older ones, unlike in many Western countries. While the number of young people purchasing second-hand homes has been rising in recent years, the market for pre-owned houses is still underdeveloped. Additionally, many municipalities face challenges in dealing with vacant homes left unoccupied after their owners pass away. Amid these circumstances, innovative approaches are emerging to reduce housing-related waste from a different perspective.

In a residential neighborhood in Shinagawa, Tokyo, a striking yellow building catches the eye. This is Holes in the House, the home and office of architects Fuminori Nousaku and Mio Tsuneyama. Originally a second-hand house, it has been transformed through an extensive renovation into a hybrid space combining an architectural office, guest rooms, and a residence.

At first glance, this may seem like a typical renovation project, but it is far from ordinary. What makes it remarkable is that it was designed with its eventual disposal in mind. However, this concept is not a negative one. Instead, the architects have actively incorporated reused materials throughout the building to contribute to the cycle of reuse. At the heart of their approach is a philosophy they call “Urban Wild Ecology,” which provides valuable insights into realizing a truly circular society.



Fuminori Nousaku and Mio Tsuneyama’s home and office, Holes in the House (Photo: Jumpei Suzuki)



Learning About Circulation Through the Life Within a Compost System

What exactly is the vision behind Urban Wild Ecology? We spoke with one of its proponents, Fuminori Nousaku, to learn more.

“The term ‘urban’ refers to artificial environments, while ‘wild’ represents untouched, natural states. The goal of Urban Wild Ecology is to take a step back from overly artificial surroundings and create spaces that coexist with the power of ecosystems and the untamed forces of nature.”



Fuminori Nousaku

Nousaku, who speaks passionately about Urban Wild Ecology, has installed a compost system near his office as part of this philosophy. Inside, worms and microorganisms thrive, creating a small ecosystem of their own.

“When food scraps are placed in the compost, worms and microorganisms consume and break them down, producing waste. That waste is further decomposed by microorganisms, turning into nutrient-rich compost. What society considers waste can actually be repurposed and integrated into a system of coexistence—this is my vision of a circular society.

These days, the idea of a circular society is often framed as something fashionable. However, I believe that true ecology reveals itself when we embrace the ‘dirty’ realities within compost systems—an ecosystem that is not necessarily clean or beautiful but is fundamental to the cycle of life.”



Digging into the compost reveals numerous lively worms—a sign of nutrient-rich soil.



Designing Homes Through the Eyes of a “Decomposer”

Starting with *Holes in the House*, Nousaku and Tsuneyama have worked on numerous projects that repurpose discarded materials as valuable resources, including Fudomae House (Tokyo) and Takaoka Guesthouse (Toyama).

“We actively think about circular societies, but our approach feels different from the commonly heard concept of upcycling. Instead, we see ourselves as ‘decomposers’ within the ecosystem—closer to the worms in a compost system.”

Nousaku likens his role as an architect—incorporating waste materials into new buildings—to the work of worms and microorganisms in compost, breaking down fallen leaves and animal waste to enrich the soil.



Takaoka Guesthouse (Photo: Jumpei Suzuki)

The origins of Nousaku’s approach can be traced back to Takaoka Guesthouse in Takaoka City, Toyama Prefecture. Originally a 40-year-old wooden house where his grandmother lived, the building underwent renovations under Nousaku’s design from 2010, gradually transforming over six years into a home, a dining space, and a guest room.

“When designing, I struggled with how to preserve family memories and the town’s landscape. Using brand-new materials wouldn’t retain the essence of the original house, so I repurposed elements like shoji screens and ranma panels. This experience made me realize the importance of preserving old materials and memories. From there, I expanded my perspective, recognizing that buildings, too, are part of the material flow—the cycle of matter. We gather materials, construct a building, and eventually, that building decays and becomes waste. This awareness of material circulation grew stronger within me.”

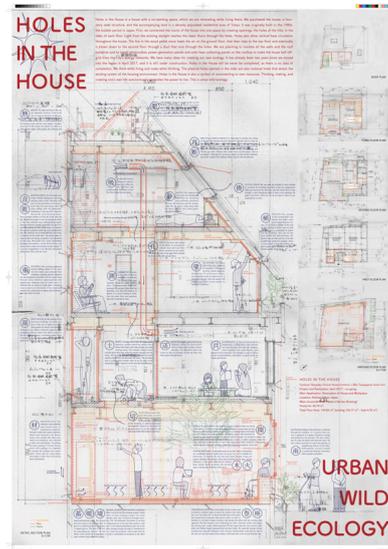
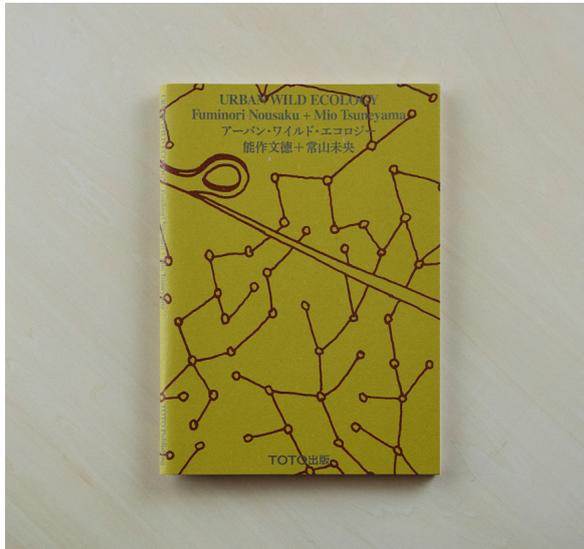
His commitment to using biodegradable materials in renovations also stems from this consciousness of material flow. Biodegradable materials are those that can be broken down by microorganisms, such as wood and straw.

“Rather than having materials reach the end of their lifecycle as waste, I want to use materials that will eventually return to the earth. This mindset makes me more selective in material choices, often leading me to plant-based materials. Even when designing new buildings, I now prioritize soil-conscious environments and the integration of biodegradable materials.”



Building a Circular Home with Our Own Hands: Holes in the House

In January 2024, Nousaku and Tsuneyama co-authored *Urban Wild Ecology* (TOTO Publishing). The book serves as a record of the various projects they have worked on, including, of course, *Holes in the House*.



Left: *Urban Wild Ecology*, co-authored by Nousaku and Tsuneyama. / Right: A floor plan of *Holes in the House* from the book. Unlike conventional architectural drawings, it highlights key aspects of circulation, making it accessible even to non-architects. (Courtesy of Fuminori Nousaku Architectural Design Office.)

“The name *Holes in the House* comes from the vertical opening that runs from the basement to the fourth floor in one corner of the building. This hole allows natural light to pour in from the rooftop window and helps circulate warm air throughout the entire structure.”



Continuous series of openings extends from the ceiling of the first-floor office to the skylight on the fourth floor. (Photo: Ryogo Utatsu)

Holes in the House also serves as a testing ground, incorporating various ideas for a circular society. The experiences gained here inform other projects, while insights from previous projects are adapted and applied. We asked about some of the sustainable practices being implemented in space.

“We keep costs low by doing as much of the renovation work ourselves. The flooring and wall materials on the first floor were repurposed from scrap cedar and cypress used in an exhibition we participated in. For insulation, we used compressed wood fiber made from wood shavings. When we asked a supplier if they had any discontinued insulation materials, they offered to give them to us for just the shipping cost.

Ordinarily, insulation is made from petroleum-based materials, but that wouldn't align with our goal of using materials that return to the earth.

The legs of our sofa-side tables are also made from reclaimed wood. Near Mio Tsuneyama's family home, a row of cherry trees was scheduled to be cut down, so we took some logs before they were incinerated.

There are countless other small details, like using leftover fabric for the staircase handrails and fitting shoji screens onto the windows as interior insulation.”



Left: A wall insulated with wood fiber. / Center: A table with legs made from reclaimed cherry wood. / Right: Shoji screens installed as interior windows to improve heat efficiency.

On the first floor of Holes in the House, a pellet stove reflects Nousaku's commitment to sustainable choices. Unlike traditional wood-burning stoves, pellet stoves use compressed wood pellets made from sawdust and produce significantly less smoke. Nousaku specifically chose a model that does not require a chimney extending to the roof.

“In terms of pure energy efficiency, air conditioners might be superior to stoves. However, much of the electricity we use daily is generated by burning fossil fuels. When I consider that reality, I feel a certain resistance to relying too heavily on air conditioning. For the same reason, we are also experimenting with self-sustaining energy through solar panels.”



The pellet stove. Warm air rises and travels through the open vertical shaft, reaching the second and third floors.



A Circular Society Begins by Seeing “Unwanted Things” as Allies

From simple DIY interior windows to other easy-to-implement ideas, *Holes in the House* is filled with practical solutions that can be adopted right away. For beginners without DIY experience or architectural knowledge, it offers an accessible starting point.

“We’re not doing anything particularly difficult. Everything we do is something anyone can try as long as they have the motivation. We aim to propose ideas that sit somewhere between amateur and expert, making them approachable and practical.”

Nousaku also emphasizes two key points for maintaining momentum in taking action.

“The first is to enjoy the process. Enjoyment is the most important factor in moving things forward.

The second is making time. Without enough time, it’s hard to sustain any effort. When you engage in projects like this, you inevitably encounter “troublesome things,” so creating time to deal with them is essential.”



For Nousaku, the most challenging elements are soil and fire. Maintaining soil requires constant weeding and mixing, while the pellet stove demands regular cleaning after every use—tasks that can be quite labor-intensive. At times, he even has to weigh these maintenance duties against his professional work. Still, he consciously makes time to manage them, understanding that these “troublesome things” are essential to a sustainable lifestyle.

“For busy modern people, maintenance-free solutions may seem appealing. However, if we prioritize efficiency too much, we risk losing our ability to create and repair things on our own.

Maintenance isn’t just a tedious chore—it is an act of engaging with and coexisting with the wild.”

“The longer you care for soil and fire, the more you develop an attachment to them—it’s strange how they start to feel like companions. In this perspective, humans are not at the center; rather, soil, plants, and worms are our allies. I believe this mindset is essential for sustaining ecosystems.”

Nousaku envisions a house not as something permanent, but as something that will one day be discarded and reborn into something new. His approach, deeply intertwined with nature, extends beyond architecture and can be applied to all forms of craftsmanship.

It offers an intriguing perspective—one that encourages designing for the continuous circulation of materials and resources, shaping a truly sustainable future.



Associate professor at Tokyo Science University

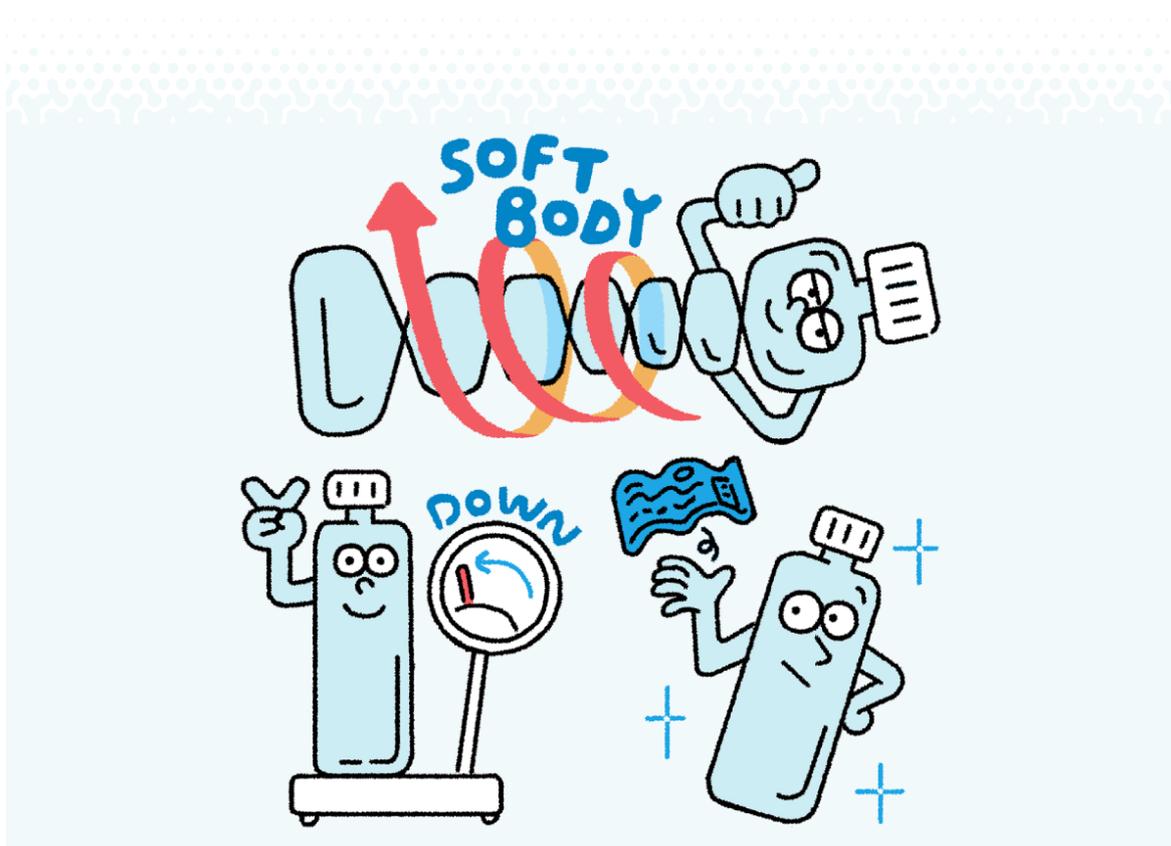
Fuminori Nousaku

Born in Toyama Prefecture in 1982, Nousaku graduated from Tokyo Institute of Technology in 2005 and completed his master's degree at the same university in 2007. In 2008, he trained at Njiric+ Arhitecti in Croatia. In 2010, he established Fuminori Nousaku Architectural Design Office. He earned a Ph.D. in Engineering from Tokyo Institute of Technology in 2012 and later served as an assistant professor at the same institution from 2012 to 2018. He then held the position of associate professor at Tokyo Denki University (2018–2021) and Tokyo Metropolitan University (2021–2024). In 2023, he was appointed as a visiting associate professor at Columbia University and a guest professor at the Technical University of Munich. He is currently an associate professor at Tokyo Science University (formerly Tokyo Institute of Technology).

Photo: Shigeta Kobayashi / Top Photo: Ryogo Utatsu



Invisible PET Recycling Revolution: On Convenience Store Shelves and Beneath Our Feet



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PET bottles are deeply embedded in our daily lives, so much so that there's hardly a day we go without using one. Yet behind the scenes, significant changes are taking place. Revolutionary advancements in recycling technology are emerging.

With chemical recycling technology, recycled PET resin called "HELIX™" enables repeated recycling without degradation. Meanwhile, "New Trac" reinforces Japan's roads by recycling PET materials that are otherwise difficult to reuse.

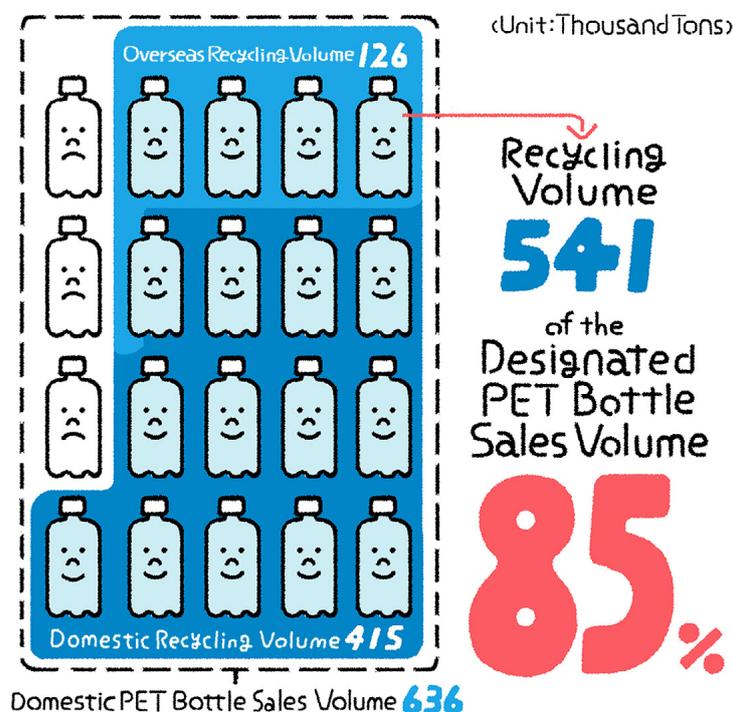
Join us as we explore the fascinating forefront of PET recycling innovations.



Label-Free and Lightweight: The Evolving PET Bottle

PET (polyethylene terephthalate) is a petroleum-derived synthetic resin widely used in PET bottles, food packaging, clothing, and more. While PET bottles have become an essential part of our daily lives, have you ever wondered how many are distributed each day and how many of those are actually recycled?

According to data from the PET Bottle Recycling Promotion Council, approximately 630,000 tons of designated PET bottles were sold domestically in 2023. This is equivalent to roughly 31.5 billion 500ml PET bottles. Of these, around 540,000 tons were recycled. In other words, an impressive 85% of the vast number of PET bottles used are collected and recycled.

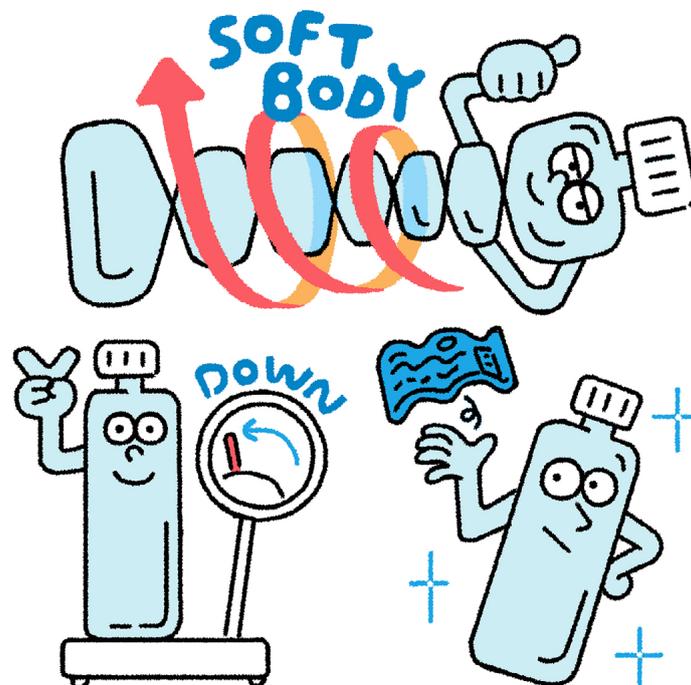


This recycling rate is remarkably high even when compared to Western countries. The key to achieving such a high recovery rate lies in the recycling infrastructure that has been developed since the 1990s. Various collection routes have been established, including

municipal sorting systems, collection boxes at supermarkets, and bins placed beside vending machines.

Alongside these recycling initiatives, PET bottles themselves have continued to evolve. One prominent example is the increasing presence of “label-free bottles.” Not only do they eliminate the hassle of removing labels, but they also do away with the adhesives used on labels, allowing for higher-purity recycling.

Many people may have also noticed that PET bottles have become lighter in recent years. When PET bottles first became widely available in the 1990s, a 500ml bottle weighed approximately 40 grams. Today, that weight has been reduced to around 20 grams. This reduction conserves resources and contributes to lower CO₂ emissions during transportation. More recently, PET bottles have become softer and easier to crush, improving the efficiency of collection and transportation. This change has also streamlined the recycling process, making the material easier to handle during processing.



However, not all collected PET bottles are reborn as new PET bottles. The proportion of PET bottles recycled back into new bottles, a process known as “bottle-to-bottle” recycling, remains at around 30%. The primary reason for this is the presence of “impurities.” Even PET bottles that appear clean may contain tiny, invisible pigments or metals. Despite careful washing at home, it is difficult to completely remove these impurities. PET bottles with a high level of impurities significantly reduce the quality of recycled products, making it difficult to reuse the material multiple times.



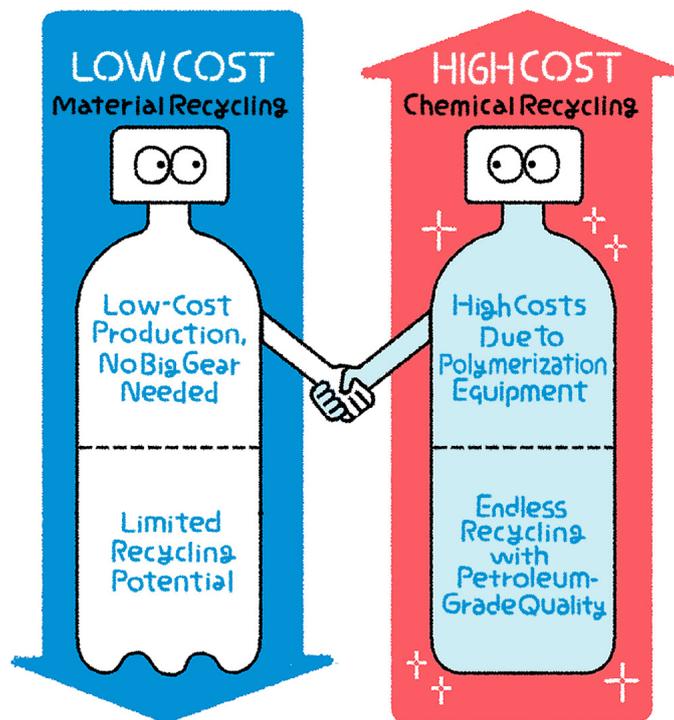
How Many Times Can a PET Bottle Be Recycled?

Used PET bottles are generally recycled through two main methods: “material recycling” and “chemical recycling.”

Material recycling is the most common method currently used in Japan. In this process, PET bottles are finely crushed, melted down with heat, filtered to remove larger impurities, and then solidified back into resin. While this method can eliminate visible impurities, smaller contaminants such as pigments often remain.

Chemical recycling, on the other hand, breaks down PET at the molecular level to remove impurities. Plastics are composed of over ten thousand molecules (polymers) linked like a long chain. Chemical recycling cuts these chains through chemical reactions, breaking them down into smaller units called monomers. This process effectively removes impurities, leaving behind purified material that can be used to produce PET resin of the same quality as petroleum-derived PET. As a result, this method enables PET bottles to be recycled repeatedly without degradation.

However, chemical recycling is more costly compared to material recycling. To achieve successful “bottle-to-bottle” recycling, combining both material and chemical recycling methods is essential.





HELIX: The Infinitely Recyclable PET Resin

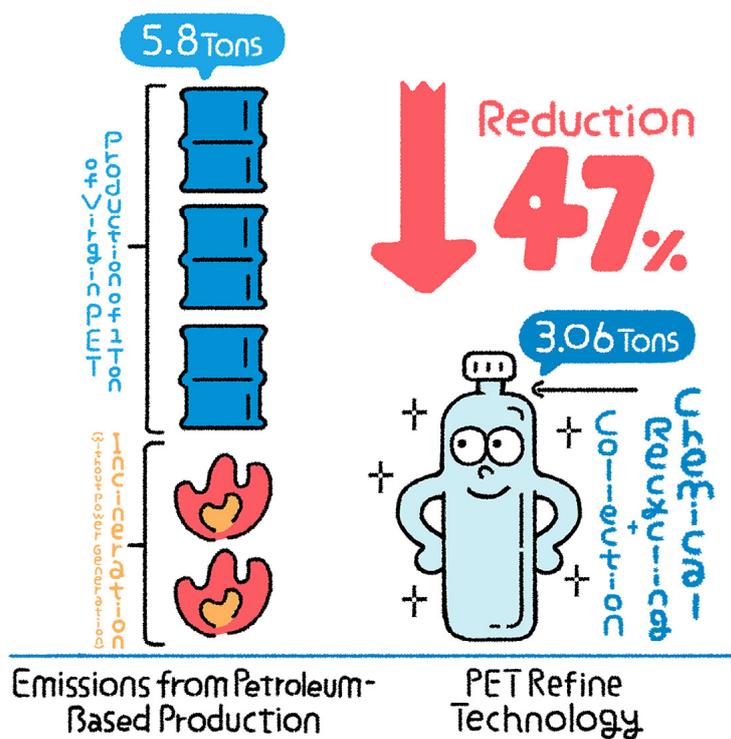
In 2024, PET Refine Technology Co., Ltd., the only company in Japan operating a commercial-scale chemical recycling plant, launched its brand of recycled PET resin called “HELIX.” The name “HELIX,” meaning “spiral” in English, symbolizes the company’s goal of achieving technology that allows PET bottles to be recycled repeatedly in a continuous loop.

The process of recycling used PET bottles into HELIX involves two main steps. The first step is breaking down the used PET bottles at the molecular level to remove impurities. The second step involves reconnecting the purified molecules to regenerate PET resin once again.



The greatest feature of the recycled PET resin produced through this process is its ability to maintain quality even after repeated recycling, thanks to the removal of impurities. Additionally, the production process for HELIX achieves a 47% reduction in CO₂ emissions compared to conventional petroleum-based production.

(For more details, visit [JEPLAN Sustainability](#))



The foundation of this technology was established about 20 years ago. However, there were two major hurdles to overcome before operating a plant on a commercial scale.

The first challenge was mass production. While the technology worked on a small scale, scaling up PET resin production presented numerous technical difficulties. “There were times when the plant’s pipes would get clogged, forcing us to shut down the factory,” recalls Daigo Iga, President and CEO of the company, reflecting on the struggles faced during the early development phase.

The second hurdle was cost. Chemical recycling consumes significant energy during the production process, making it more expensive than conventional material recycling. Although the technology itself was feasible, ensuring economic sustainability proved to be a major obstacle.

A turning point came in 2018 when beverage manufacturers began setting ambitious targets to use “100% environmentally friendly materials by 2030.” As environmental concerns gained greater social attention, the value of chemical recycling was reevaluated. By forming partnerships with beverage manufacturers, who agreed to partially shoulder the costs, economic sustainability was achieved, accelerating the development and adoption of the technology.

As a result, chemical recycling now accounts for 10% of the total bottle-to-bottle recycling process, equivalent to 22,000 tons per year – roughly 1 billion 500ml PET bottles.

Today, HELIX is produced using 72% recycled PET bottles and 28% petroleum-derived materials. According to Iga, this is not due to technological limitations but rather a consideration of plant production efficiency. In fact, they have successfully produced 100% recycled products in the past and plan to gradually increase the proportion of recycled materials moving forward.

In the future, HELIX is expected to expand beyond PET bottles to a wider range of products, including cosmetic containers and industrial goods. The day when true “continuous recycling” becomes a reality may be just around the corner.



New Trac: Bringing Hard-to-Recycle PET Materials Back into the Loop

PET materials are used in many fields beyond beverage bottles. In everyday life, they are found in cosmetic containers and textile fibers, while in industrial applications, they are used as protective films for electrical and electronic components. Just like beverage PET bottles, these PET materials are also recycled, quietly supporting our daily lives in ways we may not notice. One notable example is their use as a material that strengthens roads.

In 2021, Kao developed an asphalt modifier called “New Trac,” which enhances the durability of asphalt pavement. This innovative product utilizes hard-to-recycle PET materials as its raw material, marking a significant breakthrough in recycling technology.



Top left: Fishing nets used as raw material for New Trac / Top right: New Trac / Bottom: Construction site (Image courtesy of Nippon Road Co., Ltd.)

The raw materials used for New Trac include industrial films and PET fishing nets used in the fishing industry.

Approximately 40% of New Trac's raw materials are recycled.

Industrial films are challenging to recycle due to their coatings and special treatments. Additionally, about 1,000 tons of fishing nets are discarded annually across Japan. These nets are often contaminated with salt or dyed black, making them unsuitable as raw materials for typical recycled products. As a result, they were previously disposed of through incineration or landfill. However, Kao found a new purpose for these difficult-to-recycle materials by utilizing them in asphalt modifiers.

Asphalt mixed with New Trac has proven to be significantly more durable than conventional pavement. Experimental results show that adding just 1% of New Trac to asphalt mixtures can increase durability by approximately five times compared to asphalt without the additive.

In Japan, 95% of roads are asphalt-paved. However, during the summer heat or under the weight of heavy vehicles, these roads are prone to deformation. Such deformation increases the risk of traffic accidents and requires frequent repairs. More frequent repairs lead to traffic congestion, which in turn raises CO₂ emissions.

By improving asphalt durability and promoting PET material recycling, New Trac addresses both challenges simultaneously, contributing to environmental impact reduction. Notably, New Trac will also be used at the site of Expo 2025 Osaka, Kansai. This initiative offers a meaningful opportunity for people to recognize how PET materials, though invisible to the eye, continue to support our everyday lives.



Focusing on the 'Invisible Revolution' That Supports Our Lives

PET Refine Technology has developed a groundbreaking method that breaks down and regenerates PET at the molecular level, completely removing impurities that could not be eliminated through conventional methods. This enables PET bottles to be reborn repeatedly with no loss in quality. Meanwhile, Kao has pioneered a new form of resource circulation by repurposing previously hard-to-recycle materials such as fishing nets and industrial films into road paving materials.

However, the efforts of both companies go beyond technological innovation. Achieving sustainable resource circulation requires building a system that involves society as a whole. PET Refine Technology collaborates with over 40 municipalities across Japan to promote the circular use of PET bottles collected from local communities. Kao has set an ambitious goal of achieving "waste negative" status by 2050 – meaning the company aims to contribute to recycling more plastic than it generates through its own packaging. By driving initiatives at the industry level, Kao is taking significant steps toward a more sustainable future.

Yet, these efforts alone are not enough. The active participation and mindful actions of each one of us are crucial to making these goals a reality. The PET bottles we use daily, the roads we walk on – we may rarely give them a second thought. But behind the scenes, an "invisible revolution" is taking place, steadily pushing society forward.



President and Executive Officer PET Refine Technology Co., Ltd.

Daigo Iga

Born in 1977 in Kumamoto Prefecture. In 2010, Iga joined Japan Environment Planning Co., Ltd. (now JEPLAN, Inc.). He was involved in the launch and operation of a bioethanol production plant that utilized cotton fiber. In 2017, he played a key role in establishing the Kitakyushu Hibikinada Plant, where he served as the plant manager, overseeing operations that produced recycled PET resin from collected clothing. In 2020, Iga was appointed President of PET Refine Technology Co., Ltd., a JEPLAN Group company. In this role, he has been promoting the "bottle-to-bottle" initiative, which produces new PET bottle raw materials from used PET bottles using chemical recycling technology.



**Eco Infrastructure Leader, Functional Materials Business Division,
Chemical Business Sector, Kao Corporation**

Akihiro Nagasawa

During his university years, Nagasawa studied abroad in Brazil as part of his soccer experience. Embracing the motto of "competing on a global stage," he has been actively involved in expanding Kao's chemical business worldwide since joining the company. Drawing on five years of experience working in the United States, he now leads the global expansion of Kao's asphalt business, working closely with his team to drive progress forward.

Photo courtesy of: PET Refine Technology Co., Ltd. / Kao Corporation