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## Special Report

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# Living Sustainably Through Circular Economy

FENC is the leading force in developing green PET materials and promoting the circular economy. Based on its production capacity, it is estimated that the Company transformed over 22 billion PET bottles it recycled into brand-new products in 2023. According to the Plastic Waste Makers Index 2023 published by the Minderoo Foundation in Australia, FENC stood out among 400 global corporations with its remarkable efforts in the circular economy, ranking no. 1 in the global petrochemical industry with its Circularity score, and taking the lead in various categories. FENC has shown the world its unparalleled strength in promoting circular economy.

FENC is maximizing its leadership role in the industry. With an innovative spirit as the building block for technological research, development and advancement, the Company is co-constructing a sustainable supply chain with major brands, making green products an integral part of life and creating a paradigm of sustainability.

《Plastic Waste Maker Index 2023》

## Timeline of Advancement in FENC's Global rPET Production Capacity

- Production is scheduled to begin at the rPET plant in Vietnam and the plant in the Kansai region, Japan.
- The expansion of production capacity at Phoenix Technologies' rPET plant will be completed during the first half of the year.
- The groundbreaking ceremony for the rPET plant in Malaysia was held, and production is scheduled to begin in 2025.

2024

- Production began at the rPET plant in the Philippines.

2023

- Resin production began at Plant 2 of Oriental Green Materials Limited.
- The production capacity of Phoenix Technologies International, LLC was expanded.

2022

- FIGP built the second production line.

2021

- FENC acquired the rPET manufacturer, Phoenix Technologies International, LLC.

2019

- Production began in Oriental Green Materials Limited's Plant 2 in Taiwan. Manual bottle recycling is now replaced by machines, which expands the processing capacity to over 50% of waste PET bottles in Taiwan.

2016

- Far Eastern Ishizuka Green PET Corporation (FIGP) was established in Ibaraki Prefecture, Japan, specializing in the production of rPET.

2012

- FENC expanded green production into mainland China, launching rPET production at FEIS.

2010

- FENC invested in building the first PET bottle remanufacturing plant in Taiwan, initiating circular economy production model with waste recycling and reuse.

1988

## Milestones of Collaboration Between FENC and Major Brands

- Supplied rPET to Coca-Cola Taiwan, which introduced the first 100% rPET water bottle produced in Taiwan - bonaqua.
- Development of shrinkable film products containing 50% rPET and the world's first Scientific Certification Systems (SCS) certification with Kao.
- Production of tennis clothing for Australian Open using fabrics made of captured waste gas with adidas.

- Pioneered the first FIFA World Cup national team uniform with the recycled polyester filament manufactured from ocean waste PET bottles.
- Supplied rPET to Suntory PepsiCo Vietnam Beverage, which released Vietnam's first soft drink bottle made of 100% rPET.
- Textile-to-textile recycling system with IKEA.
- Promotion of the circular economy and closed-loop recycling system with Uni-President Enterprises Corporation.

- Pioneered the low-carbon polyester fabric made of waste gas with lululemon.
- Developed the tire cord fabric made of recycled polyester yarn with Continental AG, an industry breakthrough.

- Developed chemical recycling for polyester with Coca-Cola Bottlers Japan Inc. and launched the world's first commercialized PET bottle with chemically recycled content.

- Developed the 100% PET Closed Loop model with Coca-Cola and 7-ELEVEN in Japan.

- Transformed waste PET bottles from the ocean into new consumer products with adidas and Parley for the Oceans.

- Created recycled polyester filament from post-consumer PET bottles, which debuted at FIFA World Cup as national team uniforms.

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## Making Full Circularity a Reality

Having dedicated over 30 years to the cultivation of circular economy, FENC has developed exceptional recycling and remanufacturing know-how and accrued extensive experience. Aside from applying its core competencies to the development of recycling technologies and their innovative applications, FENC also strives to promote inter-disciplinary technological partnerships. The Company has successfully developed technologies that recycle and remanufacture waste from the land, ocean and air, providing cutting-edge solutions that enhance the circular economy. While contributing to environmental protection, FENC has transformed waste into products with economic values, creating the model of a sustainable business.

### Advanced Deployment With Technological Breakthroughs

#### Commercializing chemical textile recycling

Polyester textiles account for 2/3 of all polyester applications. To address the difficulty of recycling textile waste, FENC focuses its R&D efforts on the development of textile recycling technologies. By incorporating both chemical and mechanical recycling, the Company developed the recycled fiber, FENC®TOPGREEN®rTEX. Chemical recycling, a recycling approach with high technological thresholds, is effective in processing waste textiles containing a complex mix of materials and colors. A 2023 collaboration between FENC and Yuan Ze University led to the development of a smart textile sorting system powered by AI. The system quickly identifies the content of waste textiles by integrating its automated facilities with AI models, which further increases the efficiency of textile recycling. The pilot plant for the chemical recycling segment of FENC®TOPGREEN®rTEX is scheduled to be completed in 2024. Its commercialization and applications will be expanded to meet customer needs and sustainability development goals.



#### Developing and scaling 100% rPET tire cord fabrics

OTIZ focuses on the manufacturing of automotive products. As the world focuses intently on the carbon and environmental issues, the plant is also taking aggressive strides by developing low-carbon automotive yarns and tire cord fabrics. The joint labor of the research and technical teams have borne fruit, delivering high-performance tire cord fabrics using 100% rPET, a product unmatched in the industry. The dimensional stability of the tire cord fabric is recognized by Continental AG in Germany, thus forming a strategic partnership with OTIZ to commercialize the fabric. The new tire cord fabrics perform as well as those made of virgin materials, and more significantly, they cut carbon emissions by 28%. Mass production began in August 2022, and the production and delivery continued to grow in 2023. This innovative and sustainable product has been attracting global attention, pulling in international partnerships with major tire manufacturers from Germany, Italy and Japan. These collaborations are underway and heading towards commercialization. While the product generates corporate profits, it is taking FENC closer to its sustainable development goals.

### Unrivaled Globally in Waste Regeneration

#### Ocean recycled anti-bursting jerseys, a sensation at international games

Marine plastic pollution is a matter of serious global concern. Back in 2016, FENC began a collaborative endeavor with adidas and the NGO, Parley for the Oceans, to convert ocean recycled PET bottles into brand-new products. FENC pioneered the world's first sports jerseys made of its recycled ocean polyester filament, and the jerseys have been worn by the national teams competing in FIFA World Cup. The Company's proprietary weaving technology creates the most ideal fabric structure that is more malleable and stretch resistant. This eco-friendly and high-performance jersey was chosen by nine national teams at the FIFA World Cup, including the champion team, Argentina. In 2023, FENC's ocean recycled anti-bursting jerseys once again became the focal point at international sports events, including UEFA Champions League and FIFA Women's World Cup. Athletes from 16 national teams competed on the fields wearing the newly upgraded ocean recycled anti-bursting jerseys, including the reigning champion of FIFA Women's World Cup, Spain. During the same year, FENC's rPET chips made of ocean recycled PET bottles was certified by the Ocean Bound Plastic Recycling Standard (OBP). This is a testament to FENC's high-quality standards. Such emphasis on quality also attracted partnership opportunities with additional international brands, including Helly Hansen, the well-known manufacturer and retailer of wear and gear for outdoor activities such as sailing and skiing. The brand is expected to take advantage of FENC's recycled ocean polyester filament for specific sports events, and team up with FENC's downstream textile businesses to develop sustainable products that meet the market demand.



### Trendsetting with Green Fashion

#### Winning Red Dot with waste gas recycling technology

FENC manufactures low-carbon polyester using captured waste gas with its groundbreaking technology. The waste gas captured from steel mills is first turned into ethanol through microbial fermentation during a special bio-treatment, and then transformed into PET products. In 2022, FENC®TOPGREEN®Bio3 PET, a product made of recycled waste gas, caused an international sensation, and was recognized with awards such as the Sustainability and Innovation Award from International Textile Manufacturers Federation (ITMF) and the Best Product award from the ISPO Textrends Award. In 2023, FENC was chosen out of over 100,000 global competitors as the Product Design Winner in the Red Dot Design Award, a competition with less than 2% chance of winning. The award-winning design is an innovation inspired by green fashion. With 3D knitting and ingenuity, the fabric creates the effect of sunlight being reflected on the sea. Aside from using waste gas as the material, a water-conserving dyeing technology is incorporated during the production. Both the raw material and production technology are ingrained with the sustainable DNA. This innovation also echoes the concept of sustainable fashion. The quality and sustainability of this green fashion product has attracted brands such as ZARA, H&M and Craghoppers, which have been introducing dresses, functional sportswear and thermal tops made of this material. A partnership with adidas also showcased products made of this material during international sports events, such as tennis apparel for the Australian Open. FENC has set a new benchmark of sustainability in the industry.



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## Advancing Circular Economy in Taiwan

As FENC propels Taiwan onto the international stage with its superb recycling and remanufacturing technologies, it is infusing international momentum that boosts the circular economy in Taiwan. The Company has taken significant strides towards industry upgrade and transformation while protecting the environment, continuing to hone the power of circular economy in Taiwan.

### Introducing Taiwan's first bottled water in food contact rPET through brand collaboration

The Taiwanese government has permitted and established the application procedure for the production of rPET food contact materials using recycled PET bottles. FENC is the first in Taiwan to obtain the letter of no objection from Taiwan Food and Drug Administration to produce rPET food contact materials. It is also dedicated to promoting the applications of such materials. In March 2023, Coca-Cola Taiwan launched bonaqua, the first bottled water sold in a 100% PET bottle produced in Taiwan, and the material is supplied by FENC. Additionally, FENC collaborated with food packaging businesses and developed packaging materials that contain 30% rPET. These materials are used to produce food containers for convenience stores, such as salad boxes, providing consumers with green solutions essential to environmental sustainability.



### Implementing PET Closed Loop in Taiwan

Since 2022, FENC has teamed up with the President convenience store chain, 7-ELEVEN, and President Packaging Ind. Corp. on an exclusive partnership to promote the use of Efficient Smart Recycling Machines in northern Taiwan and convert PCR PET bottles into rPET. As of the end of 2023, FENC has helped 7-ELEVEN process over six million waste PET bottles. The application of this innovative model is still growing. Among them, in November 2023, FENC joined forces with Zhubei City Office and additional businesses to implement a project that facilitates zero emissions and smart environment. The Company turns waste PET bottles collected from smart recycling machines installed in the Zhubei region into rPET, helping the government foster the circular economy and reducing environmental pollution. Through collaboration with downstream businesses such as bottling and sheet production plants, FENC is turning waste PET bottles into new products that comply with the food safety regulations, which are then looped back to the retail locations as green products, and back into people's lives.



### Establishing the first closed-loop textile recycling system in Taiwan

Since 2022, FENC has been collaborating with the Industrial Development Administration of Ministry of Economic Affairs and IKEA on the development of the first closed-loop textile recycling project in Taiwan. IKEA collects and sorts expiring products from its retail locations. FENC then applies its textile recycling technology, transforming waste textiles into recycled fiber after crushing, melting, palletizing, spinning and false twisting. The entire recycling process is free from the use of any chemical solvents and decolorization process, and the fabric production does not involve dyeing, which cut energy and resource consumption significantly. In 2023, IKEA produced handbags from recycled fabric as gifts with purchase for its members, completing the IKEA-to-IKEA closed loop. Through collaborative efforts, FENC has turned its entire industry chain into a circular supply chain, creating a win-win that balances economic growth and environmental protection.



### Recycling and processing over 50% of waste PET bottles in Taiwan

FENC's circular economy journey began in 1988 with the establishment of Taiwan Resources Recycling Corporation, the first PET bottle recycling plant in Taiwan. The plant has been renamed Oriental Green Materials Ltd. (OGM). After its founding, the business suffered over 20 years of losses due to the lack of matured technology and market. As the co-founders and shareholders pulled out, FENC persisted. Bolstered by its belief in environmental protection and sustainability, FENC fueled the operation with even more investments. Today, OGM is the largest PET bottle recycling business in Taiwan, recycling over 50% of the total transparent PET bottles. This accomplishment in boosting the circular economy has won wide acclaims. In the fourth quarter of 2023, FENC received a series of recognitions, including the 2023 Excellent Enterprise Award from the Department of Economic Development of Taoyuan City Government, and the Circular Economy Outstanding Enterprises Award from the Resource Circulation Administration of the Ministry of Environment.



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# Environmental Achievements Driven by Green Momentum

## Production Sites



Current production sites:  
Taiwan, Mainland China, Japan, U.S.,  
Vietnam, Philippines

Future expansion: Malaysia

## rPET Industry Scale



World's **No.1** in Food-Grade rPET  
World's **No.1** in Recycled Polyester  
Filament  
World's **No.2** in rPET

## Product Certification

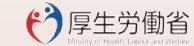
Recycled Content  
Certification



Green  
Mark



Food-Grade  
Approval



## Waste Reduction

FENC's contribution to waste reduction annually :  
**22 billion** PET bottles, which may circle  
the earth **126** times.

As of the end of 2023, FENC has prevented over **15,000** metric tons of plastic waste from  
polluting the ocean, and upcycled the waste into **82 million** pairs of high-end athletic footwear  
and **50 million** pieces of functional apparel.

Note:

1. The estimate is based on FENC's 2023 rPET production capacity.
2. The data collection period ends in 2023.



## GHG Reduction

rPET resins cut GHG emissions by **↓ 63%**  
FENC's contribution to carbon reduction annually : **↓ 650,000** tCO<sub>2</sub>e  
Equivalent to carbon absorbed by **66,000** hectares of forests.  
Equivalent to annual carbon emissions from **430,000** households.

Note:

1. The comparison is made between PET resins sourced from recycled PET bottles and fossil fuels using the product life cycle assessment report. The data is verified externally by TÜV Rheinland. The estimate of annual carbon reduction is based on FENC's 2023 rPET production capacity.
2. According to the 2021 Taiwan Greenhouse Gas Inventory Report, the carbon sequestration rate of each hectare of forest is 9.8 tCO<sub>2</sub>e. According to the Ministry of Economic Affairs' plan for 6.5 GW of installed solar capacity by 2020, the annual electricity consumption for each household is 3,504 kWh. The electricity carbon emission factor is 0.495 kg CO<sub>2</sub>e/kWh.



## 2023 Recognitions



Global Views ESG Corporate  
Sustainability Award  
**Outstanding Project-  
Low-carbon  
Operation-  
First Prize**



Taiwan Corporate  
Sustainability Awards (TCSA)  
**Circular Economy  
Leadership Award  
Seven consecutive years**



Munderoo Foundation, Australia  
**No. 1 in Circularity  
Plastic Waste Makers  
Index 2023**



INDEX™ 23, Geneva  
**INDEX™ Innovation Award for  
Raw Materials or Components**



reddot winner 2023  
materials and surfaces design

Red Dot Design Award,  
Germany  
**Product Design Winner**



ISPO Textrends  
**Top 10  
and Selection**



The Excellent Enterprise Award  
in Taoyuan City  
**The Environment Award**



Circular Economy  
Outstanding Enterprises Award  
**Silver Award, Resource  
Circulation Division**

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## Creating a Bright Future With Sustainable Mindsets

FENC is the developer of pioneering recycling technologies and a diverse lineup of green products. It is also a devotee of external engagement, strengthening multi-lateral partnerships and increasing sustainability awareness through exchanges, exhibitions and international exposures. It is FENC's goal to continue its influence to foster sustainability and promote the circular economy. By sharing its experience in recycling and remanufacturing, FENC is creating a bright sustainable future with its supply chain partners and the world.

May 11, 2023



### Speaker at Business Weekly Live Stream Program

FENC was invited to the live stream program of the magazine, Business Weekly, and shared the topic, "Waste to Green Gold from the Land, Ocean and Air," with over 300 viewers online. The talk featured FENC's sustainable undertakings, such as its comprehensive lineup of recycling and remanufacturing technologies, global deployment and low-carbon transition. The audience of this program is comprised mostly of mid- and high-level executives. FENC took the opportunity to discuss how the Company grew with the customers and evolved into the go-to partner for major brands to reach their green goals. By sharing its field experience, FENC also helped the public gain a deeper understanding in FENC as a green and sustainable corporation.

May 29, 2023



### Participating in 2023 Resource Circulation International Conference

To keep the resource circulation policies in Taiwan aligned with the international standards, the Ministry of Environment co-hosted the 2023 Resource Circulation International Conference with the European Union. The conference focuses on resource circulation policies, plastic resource circulation, eco-design and business models of sustainable products, and waste-to-energy technologies. FENC was invited to speak at the conference on "Sustainable Materials and Circular Economy at FENC." The Company introduced its recycling and remanufacturing technologies targeting waste from the land, ocean and air, as well as how it built a life of sustainability and circularity with international brands through projects such as "PET Closed Loop." During the conference, FENC presented its sustainability endeavors to the world, helping Taiwan form international partnerships to promote resource circulation.

June 1-2, 2023



### Attending Taoyuan Resource Circulation Expo

OGM was invited to the Taoyuan Resource Circulation Expo held by Taoyuan City Government. With "the circular industry supply chain" as the theme, OGM joined its peers in the resource recycling and treatment industry and presented its technological innovation, design technology and sustainable development in the circular industry. The expo attracted nearly 600 participants. The focus of OGM's exhibits included rPET made of ocean recycled PET bottles as well as functional sports jerseys and athletic footwear made of recycled ocean polyester filament. They affirmed FENC's success in integrating the circular economy and promoting partnerships across the circular industry chain, working together towards a life of sustainability and circularity.

June 8, 2023



### Hosting Product Launch for Sustainable rPET

At the end of 2022, Taiwan established the application procedure for the use of rPET in food contact materials, and since then, FENC has been taking progressive steps to expand the applications of recycled food contact packaging. The Company collaborates with the Plastics Industry Development Center (PIDC) on the promotion and certification of recycled materials and eco-friendly products, aiming to achieve sustainability and circularity while safeguarding food safety, a key consumer concern. FENC commissioned PIDC to organize the product launch of its sustainable rPET. The event was held on June 8, 2023 and representatives from companies in the beverage and food packaging sector were invited, including Coca-Cola Taiwan and President Packaging Ind. Corp. During the event, FENC presented the recycling and remanufacturing technologies that went into the production of recycled food contact materials, and built a solid bedrock for future collaboration with its supply chain partners to accelerate the sustainable development of food contact packaging materials in Taiwan.

December 20, 2023



### Speaker at TAISE Sustainable Environmental Excellence Enterprise Sharing Session

FENC was awarded the Circular Economy Leadership Award from the 2023 TCSEA, taking the top spot among its peers in the manufacturing and energy sectors. This award marks the seventh consecutive TCSEA recognition for FENC's brilliant performance in promoting the circular economy, and the Company was invited to speak at the TAISE Sustainable Environmental Excellence Enterprise Sharing Session on "Building a Life of Sustainability Through Circularity." During the session, FENC highlighted the close connection between PET manufacturing and the circular economy as well as the Company's sustainable business model, which incorporates 3Rs (recycle, redesign, reduce) and 2Es (ecosystem, education) to balance corporate growth and the transition to net zero. FENC also looks forward to engaging with various stakeholders on a wider level, and working together towards an ecosystem of circularity.