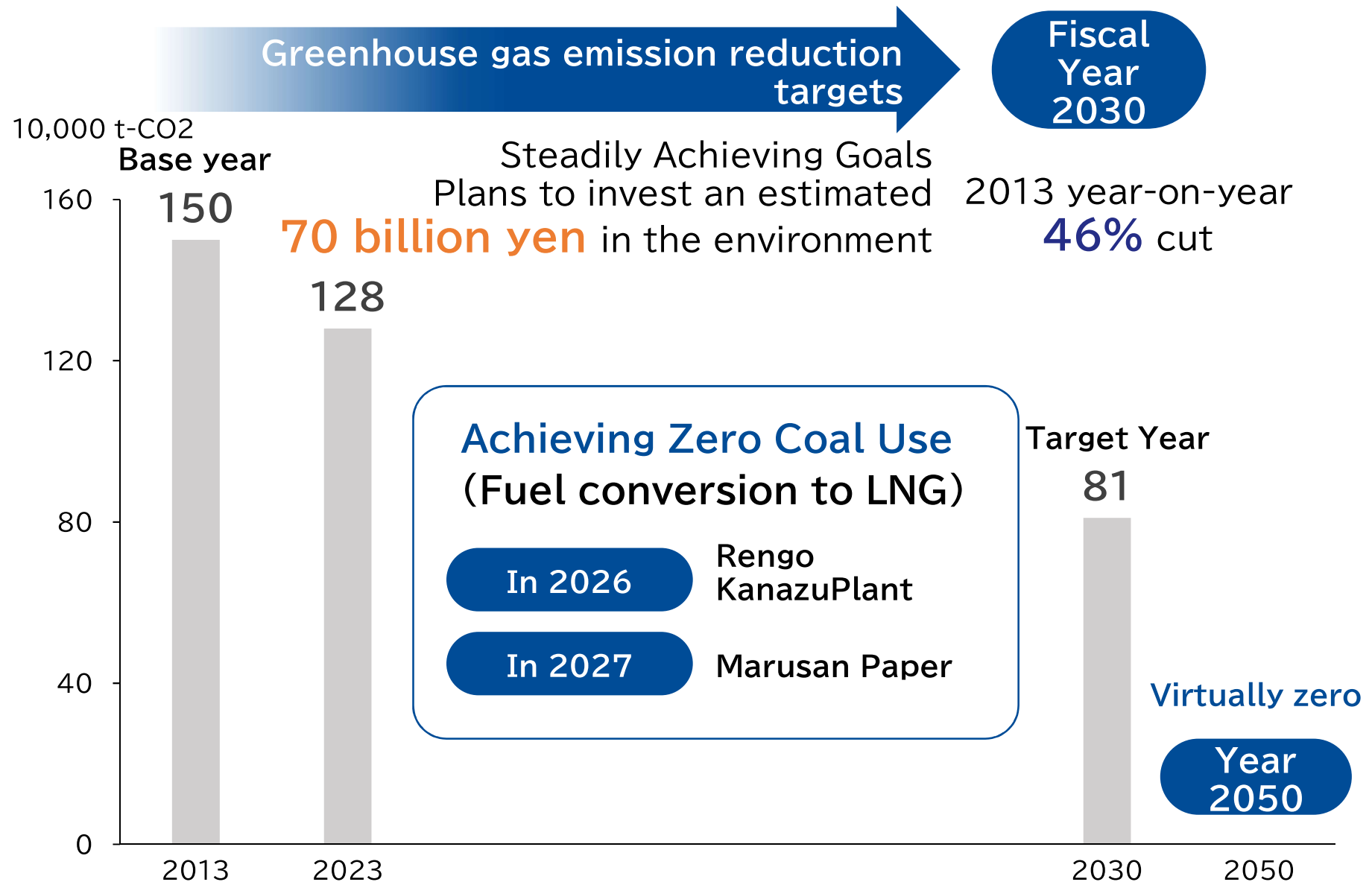


The Rengo Group's Decarbonization Initiatives

==Production of bioethanol for SAF==



Rengo Group's efforts against climate change



Boiler fuel conversion

- Realization of coal phase-out
- Construction of a new biomass boiler

From coal to biomass



▲ Rengo Kanazu Plant
(underconstruction)

From city gas to biomass



▲ Rengo Yashio Plant

From LNG to biomass



▲ Rengo Tonegawa Plant

Expanding the use of renewable electricity

- Introduction of solar power generation equipment



▲ Rengo New Kyoto Office



▲ Kato Corrugated Cardboard



▲ Rengo Ehime Toon Plant

Creation of new value as a package provider

Demand for ethanol for SAF is expected to grow. The Rengo Group is capable of producing ethanol using raw materials such as construction waste and corrugated waste paper.

THE COMPANY AIMS TO PRODUCE 20,000 KL/YEAR OF ETHANOL

板紙・紙加工関連事業

次世代原紙の開発



事業環境と見通し

環境意識の高まりを受けて、省資源・GHG排出削減につながる、付加価値の高い原紙のニーズがますます大きくなる見込みです。

グループの取組み

LCC原紙*に続く、軽量・高強度な段ボール原紙の開発に取り組んでいきます。

*LCC原紙: Less Caliper & Carbon containerboard

板紙・紙加工関連事業

RFIDによる原紙管理システムの普及促進



事業環境と見通し

2024年度からのドライバーの時間外労働時間の上限規制導入に伴い、物流業務の負担軽減などドライバーの労働環境改善は継続的な課題となっています。

グループの取組み

製紙・段ボール業界において、RFIDによる原紙管理システムの普及を促進し、物流業務での標準化を図ります。

板紙・紙加工関連事業

バイオエタノール事業への参入



2027年度
年産目標

>>> **20** 千kL

事業環境と見通し

航空業界のGHG削減策としてSAF(持続可能な航空燃料)の使用が義務付けられる中、SAFの原料となるバイオエタノールの需要が拡大する見通しです。製紙の前工程のパルプから第二世代バイオエタノール(非可食バイオマス資源を原料としたエタノール)を生産する技術開発が期待されています。

グループの取組み

大興製紙(静岡県富士市)のパルプ生産設備とBiomaterial in Tokyo(福岡県大野城市)のバイオ技術を活用し、第二世代バイオエタノールの生産技術開発、商業生産・事業化を目指します。



大興製紙株式会社

TAIKO PAPER MFG., LTD

〒416-0942 Shizuoka Prefecture Fuji City
Kamiyokowari 10

- Industrial paper production
- Pulp production (300 tons/day)



Test Plants

Ethanol production: 45 L/day

Enzyme recovery equipment

Fully-automatic



Waste-derived chips

Collection volume: 200 tons/day

>>for ethanol

Regular Chips

Collected volume: 400 tons/day

"Mt. Fuji" in front of the factory



Annex Standard (D7655)

SAF via ethanol is Annex 5,
and SAF is manufactured from cooking fats and oils used in Japan. Annex2.

Annex	technology	Upper Mixing Rate (%)	raw material
Annex1	FT Synthesis	50	Organic matter in general
Annex2	Synthetic parafinkerosene purified by hydrogenation of vegetable oils (Bio-SPK or HEFA)	50	Bio-based oils
Annex3	Isoparaffin (SIP) derived from fermented hydrotreated sugars	10	Biomass sugar and paper waste
Annex4	Synthesis of alkylated aromatics derived from non-fossil resources Kerosene (SPK/A)	50	Organic matter in general
Annex5	Synthetic paraffin kerosi derived from alcohol to jets (ATJ-SPK)	50	Biomass sugar and paper waste,etc
Annex6	Catalytic Hydrothermolysis Jet (CHJ)	50	Bio-based oils
Annex7	Hydrocarbon-HEFA (HC-HEFA)	10	Microalgae

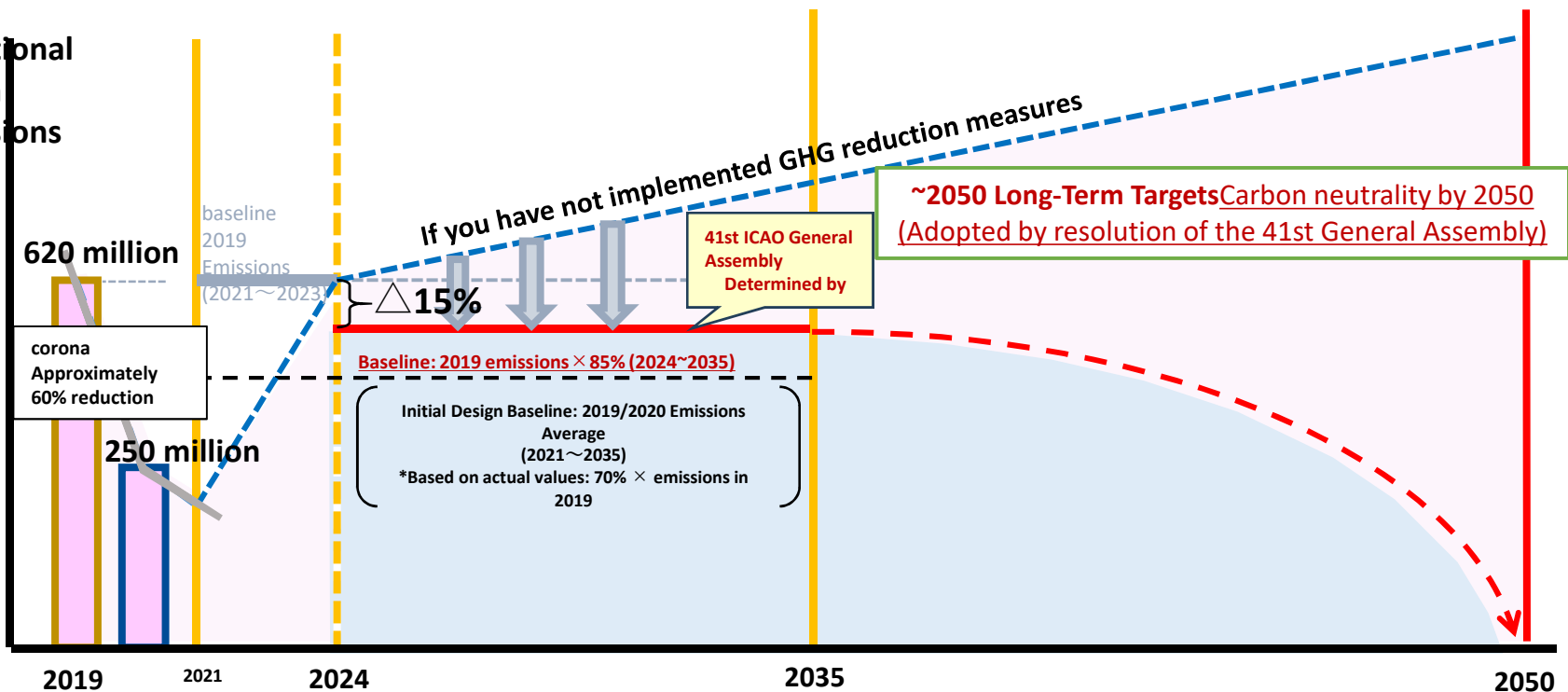
By 2035, GHG emissions will be 85% of 2019 levels.

SAF stands for Sustainable Aviation Fuel, which means sustainable aviation fuel. Compared to conventional aviation fuel, By using biomass and waste cooking oil as raw materials, it is expected to significantly reduce carbon dioxide emissions.

About baseline in CORSIA

Carbon Offsetting and Reduction Scheme for International Aviation

CO₂ from the
entire
international
aviation
Emissions



Source: November 7, 2022 Revised materials submitted by the Secretariat of the 2nd Public-Private Council for Promoting the Introduction of Sustainable Aviation Fuel (SAF) (Ministry of Land, Agriculture, Transport and Tourism)

Government Goals and Support

In May 2023, at the third meeting of the SAF Public-Private Council, the supply target and support were set at “2030 in Japan.

- The annual supply target is 10% of aviation fuel consumption.“>>>1,700,000KL/Y(SAF)

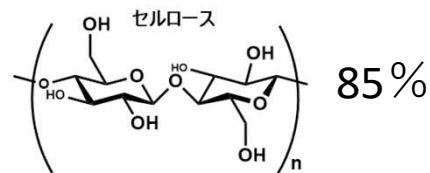
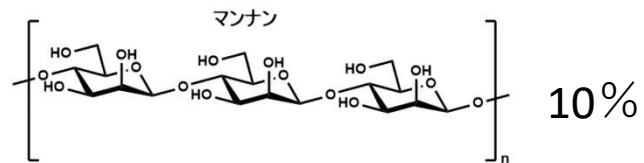
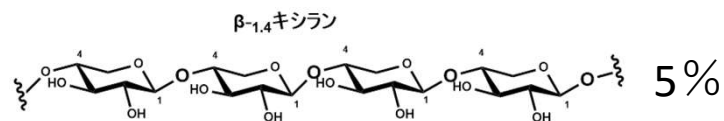
- Support for SAF produced in Japan.

The subsidy amount at this time is **30,000 yen (200USD)/KL**

- Up to **40%** of corporate tax can be deducted
(For semiconductors, the carry-over period is 3 years, and up to **20%** of corporate tax can be deducted.)

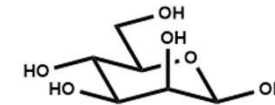
Pulp is made of "sugar"

The chips are converted into pulp, which is then broken down by enzymes into "sugars".
Sugars are converted to ethanol by yeast.



enzyme

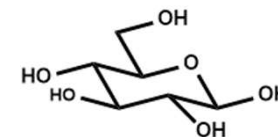
β -D-マンノース



β -D-キシロース



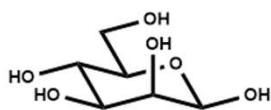
β -D-グルコース



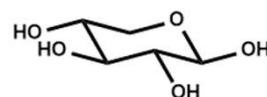
Corrugated base paper and ordinary paper are 85% cellulose (a polymer of glucose).
Cellulose is broken down by enzymes to become glucose.

Carbohydrates are converted to ethanol

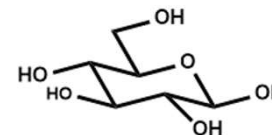
β-D-マンノース



β-D-キシロース



β-D-グルコース



Sugar concent : 20%

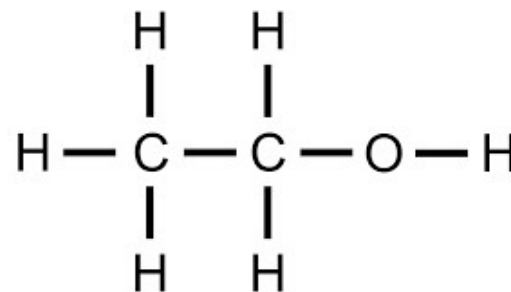


Yeast produces ethanol from sugars.



yeast

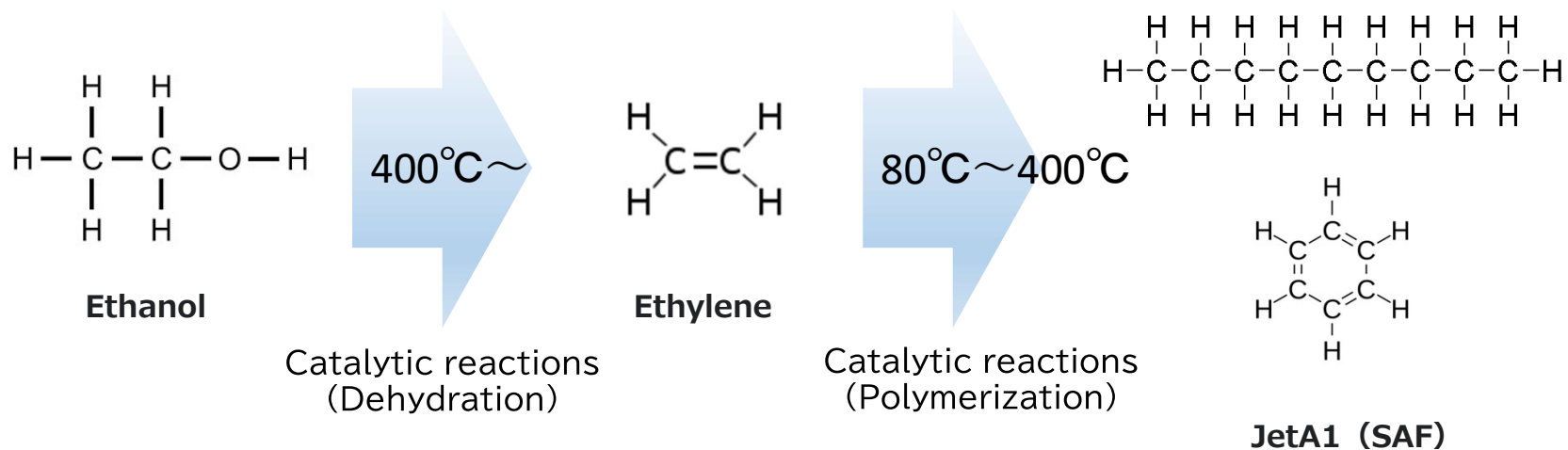
Ethanol concent : 10%



ethanol

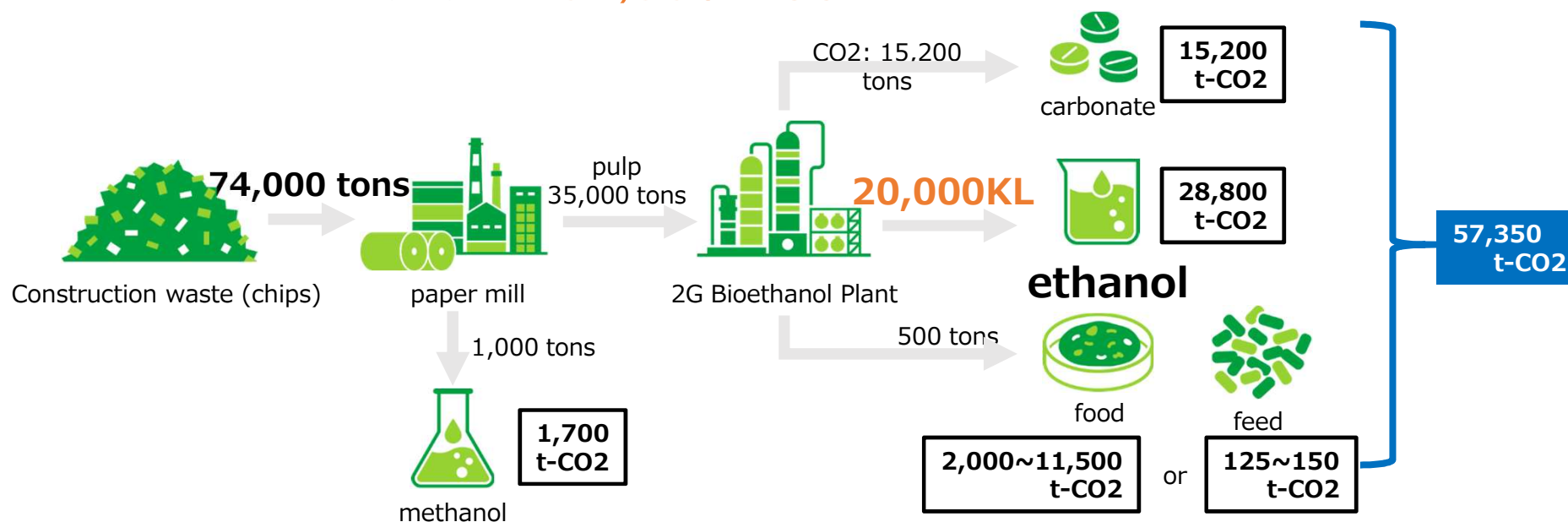
Synthesize SAF from ethanol

Ethanol is dehydrated and converted to ethylene.
Ethylene forms hydrocarbons (linear, benzene ring)



Taiko Paper: Overview of Business Plan(2023~)

- Obtained a subsidy of approximately **10 billion yen** with the support of NEDO.
- PRODUCES **20,000 KL/Y** OF ETHANOL
- GHG reduction is **57,350 t-CO2**



Expected CO2 reduction

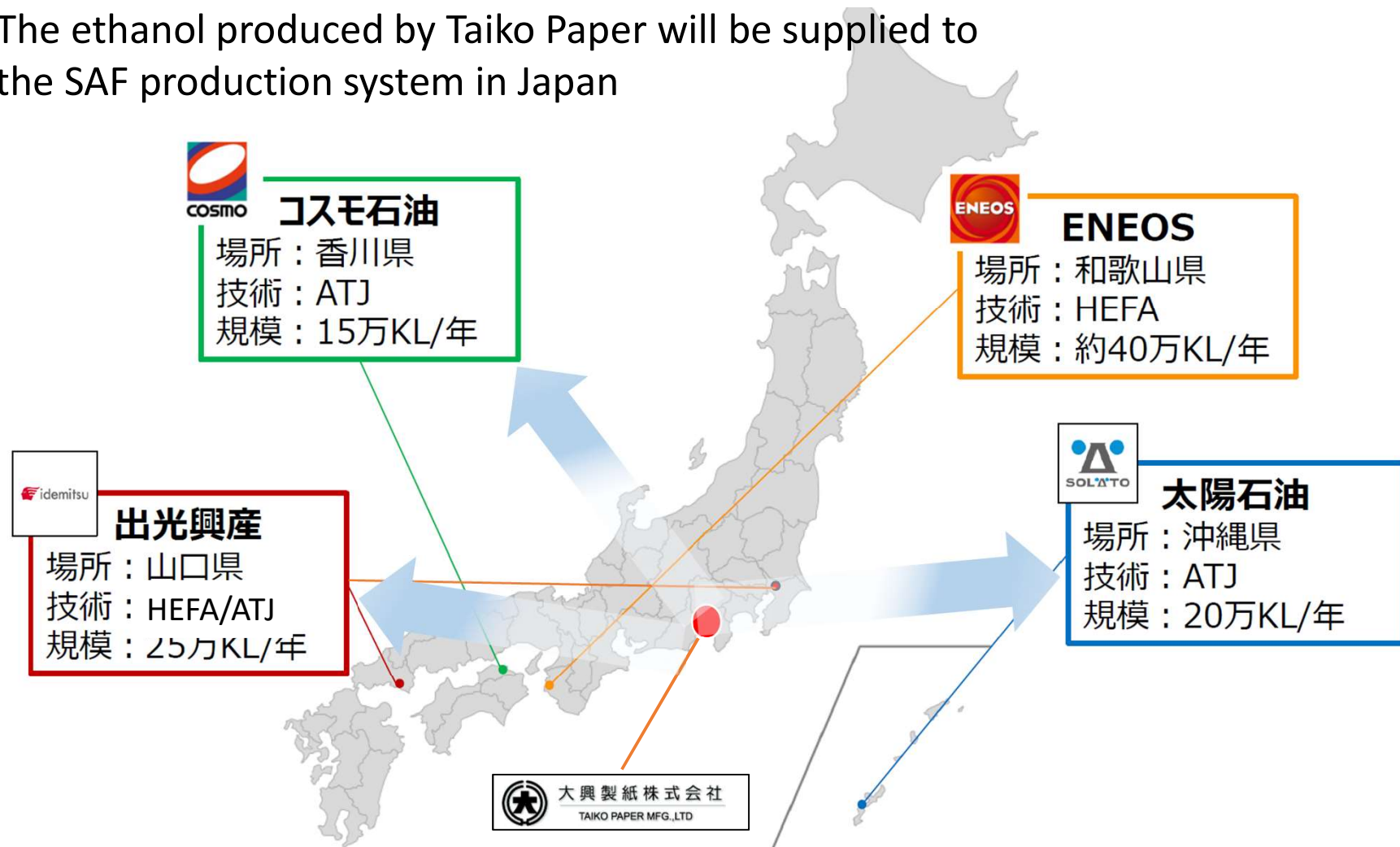
In addition to ensuring the CO2 reduction effect of bioethanol, which is the main product, We will research and develop a biomanufacturing system with a high CO2 reduction effect by using methanol as a by-product as a chemical product, carbonate carbon dioxide, and turning process bacterial residues into food and feed.

SAF supply and production system in Japan

Idemitsu Kosan, Cosmo Oil, Taiyo Oil
Installed ATJ (Alcohol-to-Jet) equipment

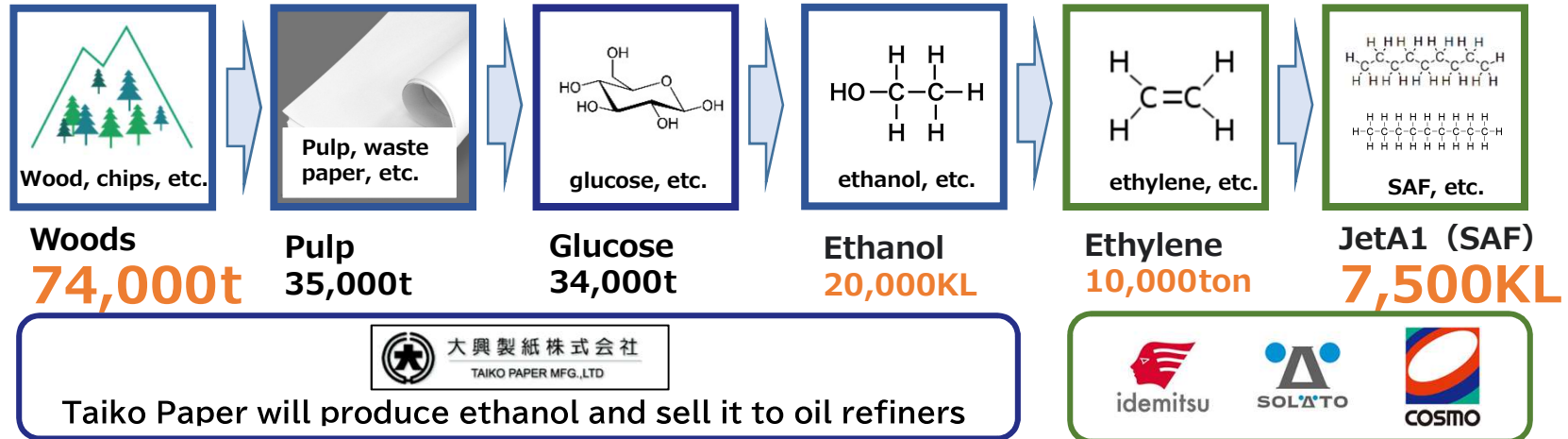
The demand for ethanol is about **500,000 KL/Y** for the three companies.

The ethanol produced by Taiko Paper will be supplied to
the SAF production system in Japan



Material balance in each process

74,000 tons of chips can produce 7,500 KL of SAF



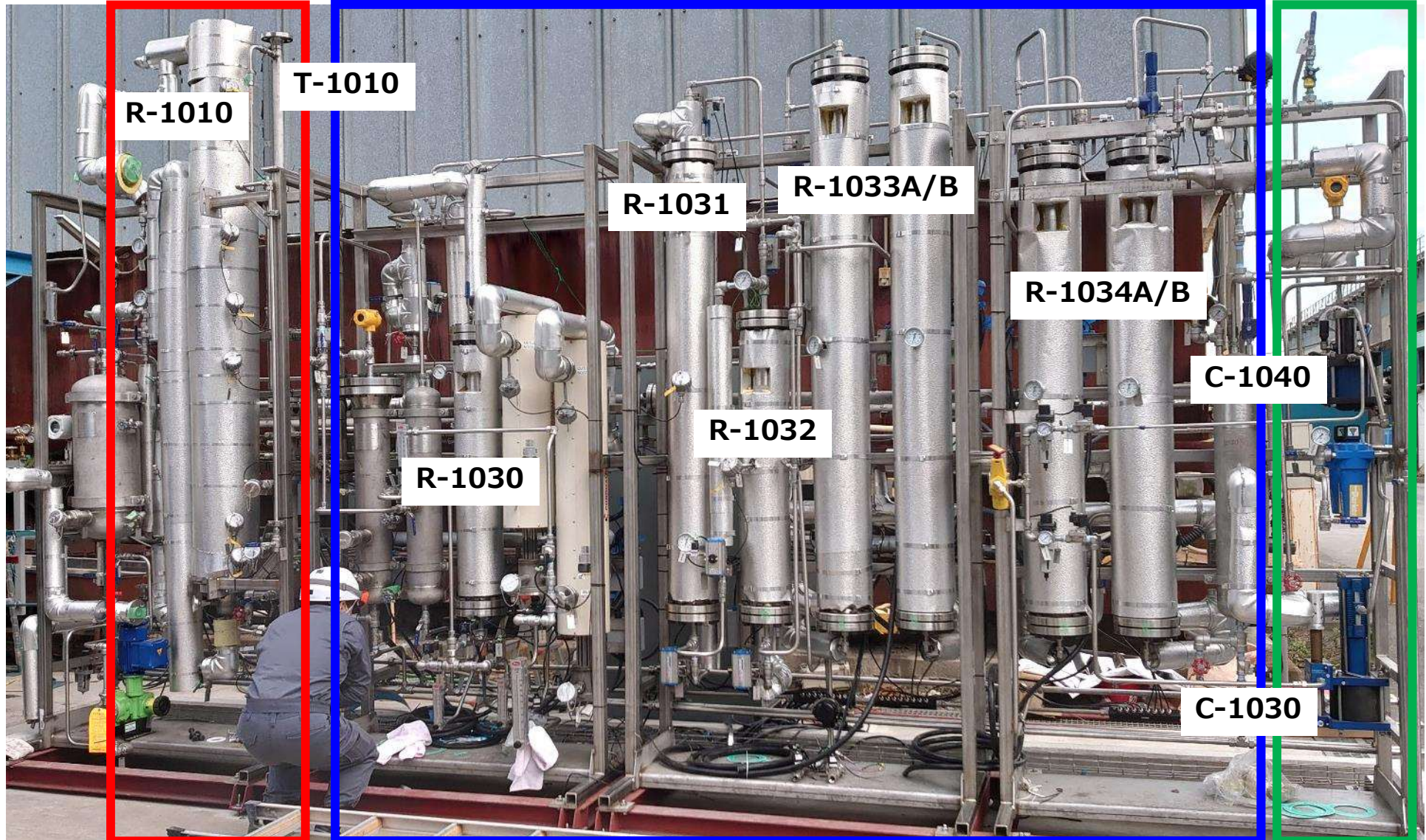
The Rengo Group has a test plan to produce SAF from ethanol. It is important to check the conversion efficiency of ethanol produced from chips and hips to SAF.

Ethylene production equipment (ethanol to ethylene reforming process, Petron)

Skid 1 (dehydration reaction)

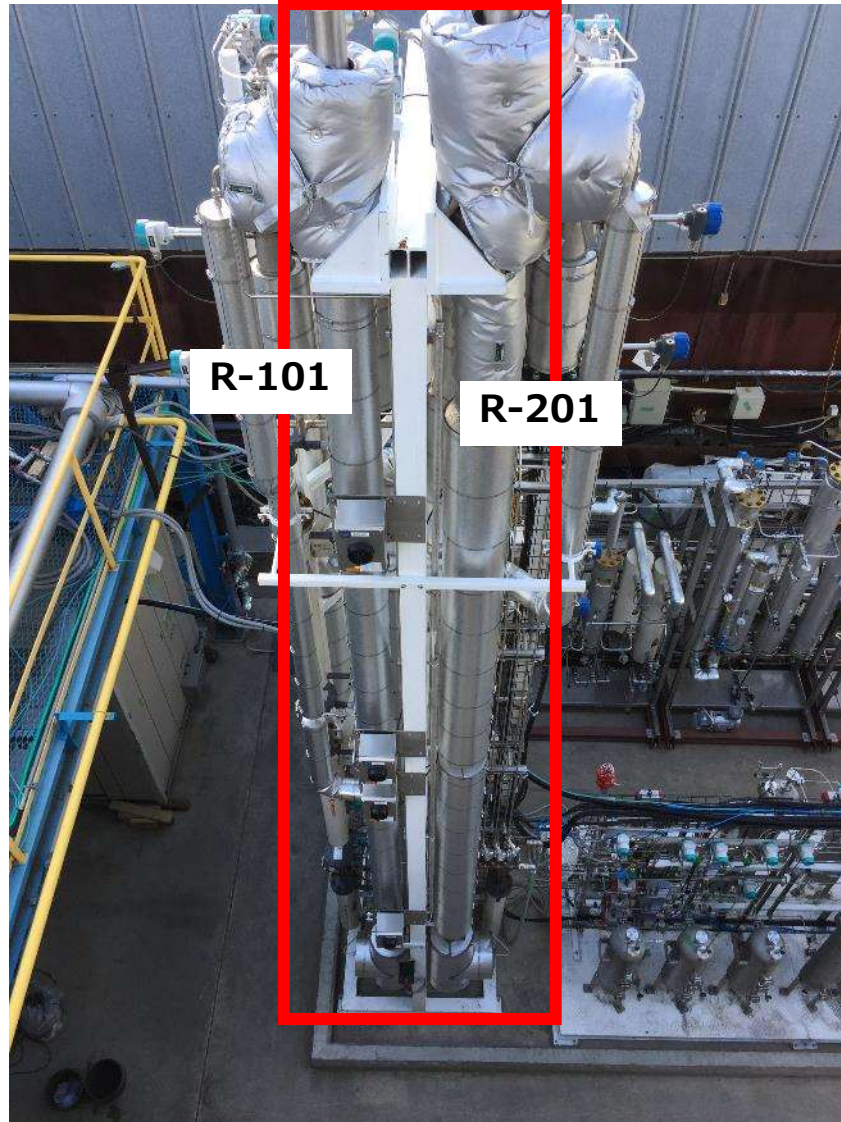
Skid 2 (impurity removal)

compressor

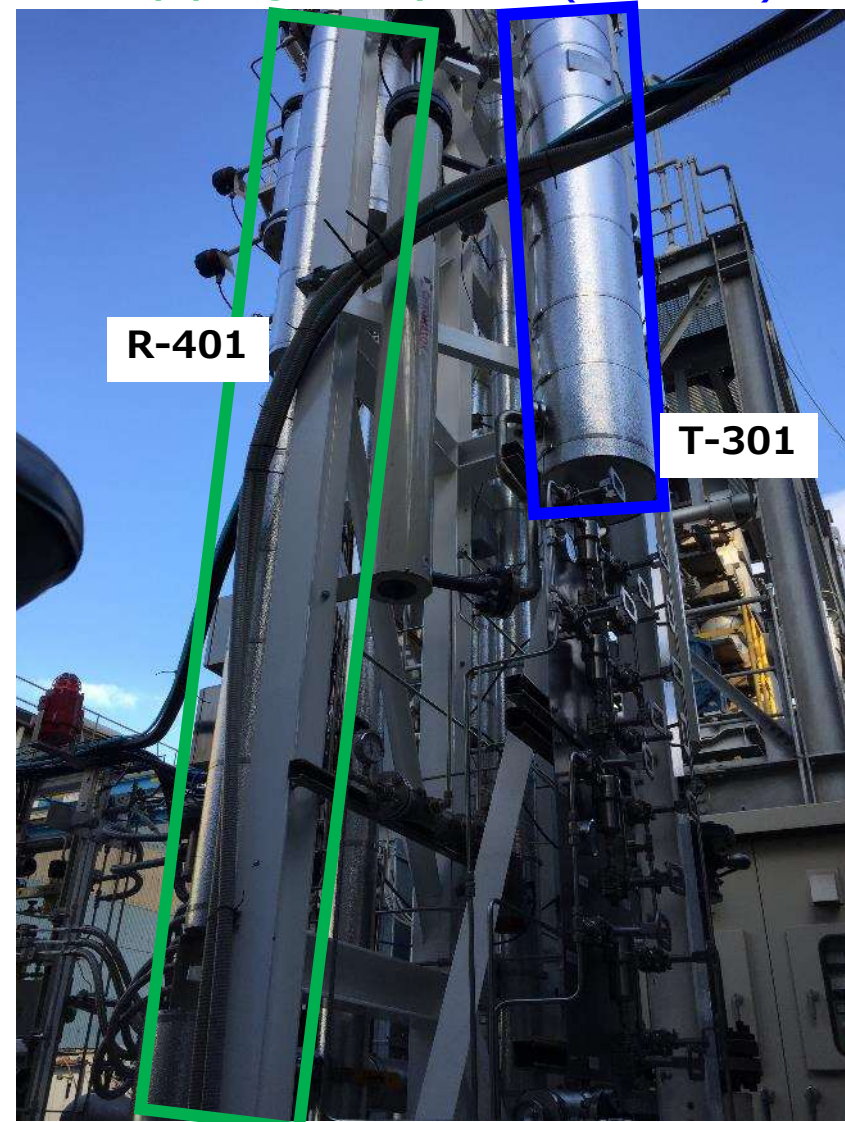


Jet fuel production equipment (ethylene to hydrocarbon reforming process, Byogy)

Skid 1
(oligomerization)

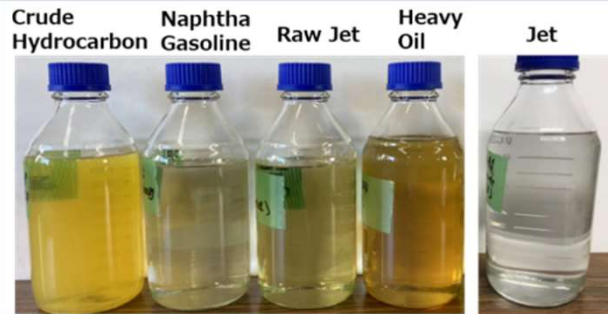
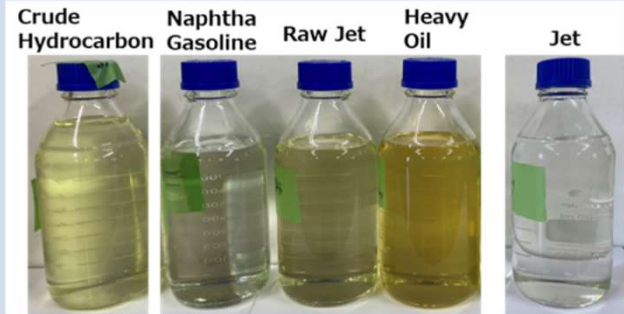


Skid 3
(Hydrogenation)



Material balance in each process

SAF can be produced using a self-made catalyst (recovery rate is still improving)

	Byogy Catalyst	Self-made catalysts(Davicat [®] 3111)
Amount of recovery	8.9~15.8 L/D	3.2~8.8 L/D
Conversion rate	31.3%	8.5~15.1%
Recovered Fuel		
Feature	<ul style="list-style-type: none"> • Jet: Nearly compliant with Annex 8 (ATJ-SKA) standard • Heavy Oil: Meets the quality requirements of Light oil (JIS K2204) Special No. 1~No. 3, Heavy oil (JIS K2205) Class 1 No. 1 	<ul style="list-style-type: none"> • The proportion of Aromatics in crude hydrocarbons is less than 10% → hydrogenation, • Likely to comply with Annex 5/8 • Analysis of Jet and Heavy Oil is currently underway

Summary

- The Rengo Group aims to reduce GHG emissions by **46%** by 2030 compared to 2013.
- Ethanol production at pulp& Paper and the use of by-products are expected to reduce CO2 emissions by **57,000 t-CO2**.
- Achieve **20,000 KL/Y** of ethanol production derived from non-edible raw materials (around 2027)
- Ethanol produced by the Rengo Group is applicable to SAF (Annex 5 and 8).
- SAF production technology has been acquired, but production efficiency needs to be improved.

Wood chips and pulp are used as raw materials for ethanol, so they are compatible with the ethanol business. Therefore, it is expected that the business will expand in the future. Not only as an environmental measure, but also to monetize the ethanol business.



FIN