

Use of NESTE RD Fuel (HVO) for Emergency Gas Turbine Generator

Regarding the above topic, there is a worldwide demand to achieve carbon neutrality to build a sustainable society. In this context, measures to reduce CO₂ emissions while maintaining the current internal combustion engines are being studied due to technical, operational, and cost issues. As one such measure, we introduce below the use of RD fuel in our emergency gas turbine power generating set, which minimizes costs and contributes significantly to GHG emissions reduction.

1. Carbon neutral fuel (NESTE RD fuel)

This fuel is manufactured from vegetable oils and waste animal fats, etc., which do not compete with food products, and has achieved a GHG emissions reduction of approximately 90% compared to petroleum-derived diesel fuel in terms of GHG emissions in life cycle assessment. It is expected to be a so-called "drop-in" fuel that can be used directly in existing systems, and is already widely distributed, mainly in Europe and the United States.

*For more information on NESTE RD Fuel, please refer to the attached document.

2. Engine test results

As part of our efforts, we conducted comparison tests between conventional petroleum fuel and NESTE's RD fuel on our gas turbine engine and confirmed that operation with RD fuel is stable from startup to rated load.

It is confirmed that there is no difference in the general performance (fuel consumption, exhaust temperature) of the gas turbine and emission characteristics of the exhaust gas.

As described above, we have confirmed the use of this fuel in our tests, but the actual operational results are still to be seen. Please contact us for more details.

We appreciate your consideration.



Renewable Fuels Business



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ITOCHU Energy Division

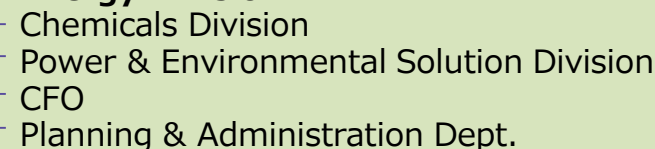
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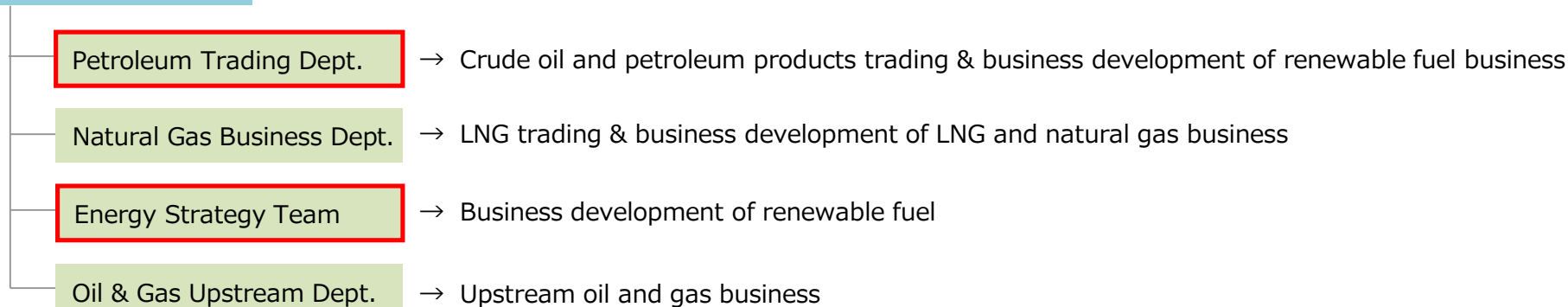
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What is Renewable Fuel?

➤ What is renewable fuel? :

It is a substitute for conventional fuel, which is fully compatible, mixable and interchangeable with conventional fuel.

It does not require any adaptation of aircrafts and automobiles (**drop in**).



- **Renewable Diesel (RD)** : Can be used as diesel for trucks and buses
- **Sustainable Aviation Fuel (SAF)** : Can be used as jet fuel for aircrafts

➤ Features of renewable fuel :



LCA CO2
up to 90% reduction



Sustainable Feedstock
Circular Economy



Just drop in and Go !
You can use from
tomorrow!



No need for additional
infrastructure



High quality fuels



Clean exhaust gas
PM(33%), NOx(9%), CO(24%) reduction

What is Renewable Diesel (RD)?

- RD is completely different from biodiesel (fatty acid methyl esters = FAME).
- RD is made from several feedstocks via Hydrotreatment and Isomerization.
- Biodiesel has to be mixed with conventional diesel, but RD can be used alone since the chemical composition is close to conventional diesel.
- SAF has to be mixed with conventional jet fuel and the maximum mixing ratio is 50% for now. Currently engine manufacturers are studying 100% SAF usage.



	FAME (EMAG)	EN 590 diesel	Neste Renewable Diesel (HVO)
Raw material	Vegetable oils & waste animal fats	Crude oil (mineral oil)	Vegetable oils & waste animal fats (including high free fatty acids)
Technology	Esterification	Traditional refining	Hydrotreating
End product	Ester	Hydrocarbon (gasoline, jet fuel, diesel)	Bio-based hydrocarbon (renewable diesel, jet fuel, bionaphta, biopropane)
Chemical composition	$\begin{array}{c} \text{O} \\ \\ \text{H}_3\text{C}-\text{O}-\text{C}-\text{R} \end{array}$	$\text{C}_n\text{H}_{2n+2} + \text{aromatics}$	$\text{C}_n\text{H}_{2n+2}$

Overview of Neste Corporation

- ❑ Neste Corporation("Neste") : **The largest producer of renewable fuels**
- ❑ Headquarter : No. of Employee : 4,400 (as of 2019)
 - ◆ Main business :
 - ① : Refinery (18milKL/yr)
 - ② : Production of Renewable Products (3.1milKL/yr)
 - ③ : Marketing and downstream business (appro.1,100 gas stations)
 - ◆ Finland, Netherland and Singapore refineries produce RD (brand name "NESTE MY") which can significantly reduce GHG emission compared to that of conventional diesel and get good mileage
 - ◆ At present, Neste supplies RD to areas where countries (state) have strict environmental regulatory rules such as Europe and California due to the limited production volume
 - ◆ Singapore plant will be expanded to 2.7milKL/yr by 2022, now it's under construction
- ❑ Renewable fuels production capacity for each plant
 - ◆ Finland : 0.5milKL/yr
 - ◆ Netherland : 1.3milKL/yr
 - ◆ Singapore : 1.3milKL/yr
 - ◆ <https://www.youtube.com/watch?v=P4ACk53nyyw>



ITOCHU's Major Records on Renewable Fuel

Early Adaptor of Renewable Diesel in US West Coast (2013-)

- ITOCHU started RD distribution business in California in 2013 as sole distributor of Neste's RD in southern California (this business is now transferred to another company).



SAF Import to Japan (2020)

- ITOCHU set up domestic supply-chain of SAF and supplied SAF to ALL NIPPON AIRWAYS (ANA) in 2020.
- This was the first time SAF was used for a commercial flight in Japan. ANA and ITOCHU are pioneering partners for developing SAF market in Japan.



Renewable Diesel Supply to FamilyMart (2021)

- ITOCHU supplied RD to FamilyMart, one of the largest convenience stores in Japan, for FamilyMart's delivery vehicles in Yokohama area, outskirts of Tokyo.
- This was the first RD delivery for commercial use of road transport in Japan.



SAF distribution in Japan (2022)

- ITOCHU and Neste have expanded their partnership, and ITOCHU acts as the sole branded distributor of Neste's SAF in Japan. Neste's SAF is available at the two largest Japanese international airports; Tokyo Haneda and Narita.

