The Neste Oil process: Biofuels for road transport and aviation

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Neste Oil in brief

A refining and marketing company focused on premium-quality traffic fuels

Refining capacity: 15 million t/a of petroleum products and 2 million t/a of renewable diesel

Net sales: €15 billion (2014)

Operations in 15 countries; employs approx. 5,000 people

Listed on the Helsinki Stock Exchange

Largest owner: the Finnish State (50.1%)
Annual production capacity of 2 Mt

All Neste Oil’s NEXBTL plants are ISCC-EU and EPA-approved

<table>
<thead>
<tr>
<th>Unit</th>
<th>Capacity</th>
<th>Year</th>
<th>Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland #1</td>
<td>190 000 t/a</td>
<td>2007</td>
<td>EUR 100 million</td>
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<tr>
<td>Finland #2</td>
<td>190 000 t/a</td>
<td>2009</td>
<td>EUR &gt; 100 million</td>
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<tr>
<td>Singapore</td>
<td>800 000 t/a</td>
<td>2010</td>
<td>EUR 550 million</td>
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<tr>
<td>Rotterdam</td>
<td>800 000 t/a</td>
<td>2011</td>
<td>EUR 670 million</td>
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Neste Oil’s aim is to increase production capacity by 15% to 2.3 million t/a by 2015.

ISCC-EU= International Sustainability & Carbon Certification; production volumes eligible for the EU biofuel market
EPA= Environmental Protection Agency; production volumes eligible for the US biofuel market
Renewable diesel capacity growing as demand for advanced drop-in solutions increases

Global HVO capacity

- NEXBTL is preferred solution for global renewable feedstock-based markets
  - Drop-in solution replacing fossil alternative as fuel or feedstock
  - Flexible technology maximizing use of waste and residue
  - Global supply chain and industrial scale
NEXBTL production process

Feedstock supply → Feedstock storage → Pretreatment

NEXBTL (Neste Oil’s HVO brand name) unit

Hydrotreatment → Isomerization → Renewable diesel stabilization

Renewable diesel storage

Hydrogen
Main product NEXBTL Diesel
Other product Biopropane

**Feedstock**

- Triglyceride, $R = n \times (CH_2)$

**Reaktions & Products**

- $R'-CH_2-CH_3 + 2 H_2O \rightarrow (A)$
- $R'-CH_3 + CO_2 \rightarrow (B)$
- $R'-CH_3 + CO \rightarrow (C)$

NExBTL renewable diesel, $R' = (n-1)C$

- $CH_3-CH_2-CH_3$ (Propane)

What makes the HVO drop-in quality

**HVO**
- isoparaffins
- normal paraffins

**DIESEL**
- isoparaffins
- normal paraffins
- naphthenes
- aromatics
- polyaromatics

**FAME**
- fatty acid methyl esters
NEXBTL product family – 100% bio-based

- NEXBTL renewable diesel
- NEXBTL renewable propane
- NEXBTL renewable aviation fuel
- NEXBTL for bio-based chemicals
NEXBTL renewable diesel

- The highest quality diesel in the world.
- Produced from vegetable oils and waste fats
- Using NEXBTL renewable diesel reduces greenhouse gas and tailpipe emissions significantly
- Compatible with existing distribution systems and engines
- Meets even the toughest manufacturer requirements
NEXBTL renewable aviation fuel

- Offers airlines an easy way to cut their emissions
- Compatible with existing jet engines
- High energy content (MJ/kg), no aromatics, reduces CO\(_2\) and sulphur emissions
- Complies with ASTM D7566 specification
- Already available at commercial scale

- Proven performance – the BurnFAIR project of Lufthansa
  - 1187 scheduled flights
  - 800 tonnes of biofuel
  - 1500 tonnes of CO\(_2\) reduction
- Now also soon low blend of on-road diesel quality
Applications for chemical industry

**NEXBTL renewable naphtha**
- Can be used e.g. as a bio-based gasoline component in blending gasoline, and in bioplastics production.
- Produced as part of the refining of NEXBTL diesel

**NEXBTL renewable isoalkane**
- Renewable alternative to traditional mineral oils and ideal for a wide range of chemical applications (paints, coatings, TPE additives, lubricants)
- Produced as part of the refining of NEXBTL diesel
...soon also biopropane
Drop-in solutions –
Added value to key target groups

**SOCIETY**

- Significant GHG reduction
- Reduced exhaust gas emissions
- Improved air quality
- An easy way to increase the use of biofuels in traffic

**DISTRIBUTION**

- Excellent blending properties; improves fuel quality as a biocomponent
- Compatible with existing distribution systems
- Stable product with no "best before" date
- Means to fulfil biomandate

**CONSUMER**

- Compatible with all modern diesel engines; requires no modifications (cars, buses, trucks, etc.)
- Superior quality compared to conventional biodiesel and fossil diesel
- Excellent cold properties (reliability during the winter)
HVO technology – a pivotal enabler

Enabling feedstock flexibility and R&D

- Microbes, algae
- Waste, residue
- Fuel crop
- Food crop

Enabling full compatibility with past and future uses

- Diesel
- Jet
- Naphtha
- Propane
- Alkanes
Targeting 100% waste and residue processing capability by 2017

**Actions to reach 100% capability**

- Further development of global supply chain
- Continuous R&D to evaluate new lower-quality feedstock
- Successful test runs with 100% waste and residue blends
- Debottlenecking processing constraints
Neste Oil also procures bio-based ethanol from the global market to be used as a bio-component in 95 E10 and 98 E5 gasoline.
Cutting-edge research

- Continuous research to expand renewable raw material base and further develop NEXBTL technology
  - 70% of R&D costs
- Cooperation with over 20 research institutions around the world
- Approx. 1,000 people working with research
Expanding the feedstock base

**SHORT-TERM**
- Waste animal fats, waste oils, residue and side streams
- Non-food vegetable oils

**LONG-TERM**
- Algae oil
- Harvesting residue and biomass
Global leader in renewable products

Flexible feedstock supply

Global supply chain

Drop-in solutions for customers
Kiitos.

Henrik Erämetsä, Head of US Federal Affairs

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