Aalto University

Energy Breakfast, 9th May 2019

Take-Off Time for Biofuels: A Sustainable Future for Aviation?

Kati Sandberg
Neste Corporation
R&D, Senior Associate / Aviation Fuels

Driven by our vision

WE ARE 5,500
dedicated professionals committed to our vision

OUR CUSTOMERS
reduced their GHG emissions by 7.9 million tons with our renewable products

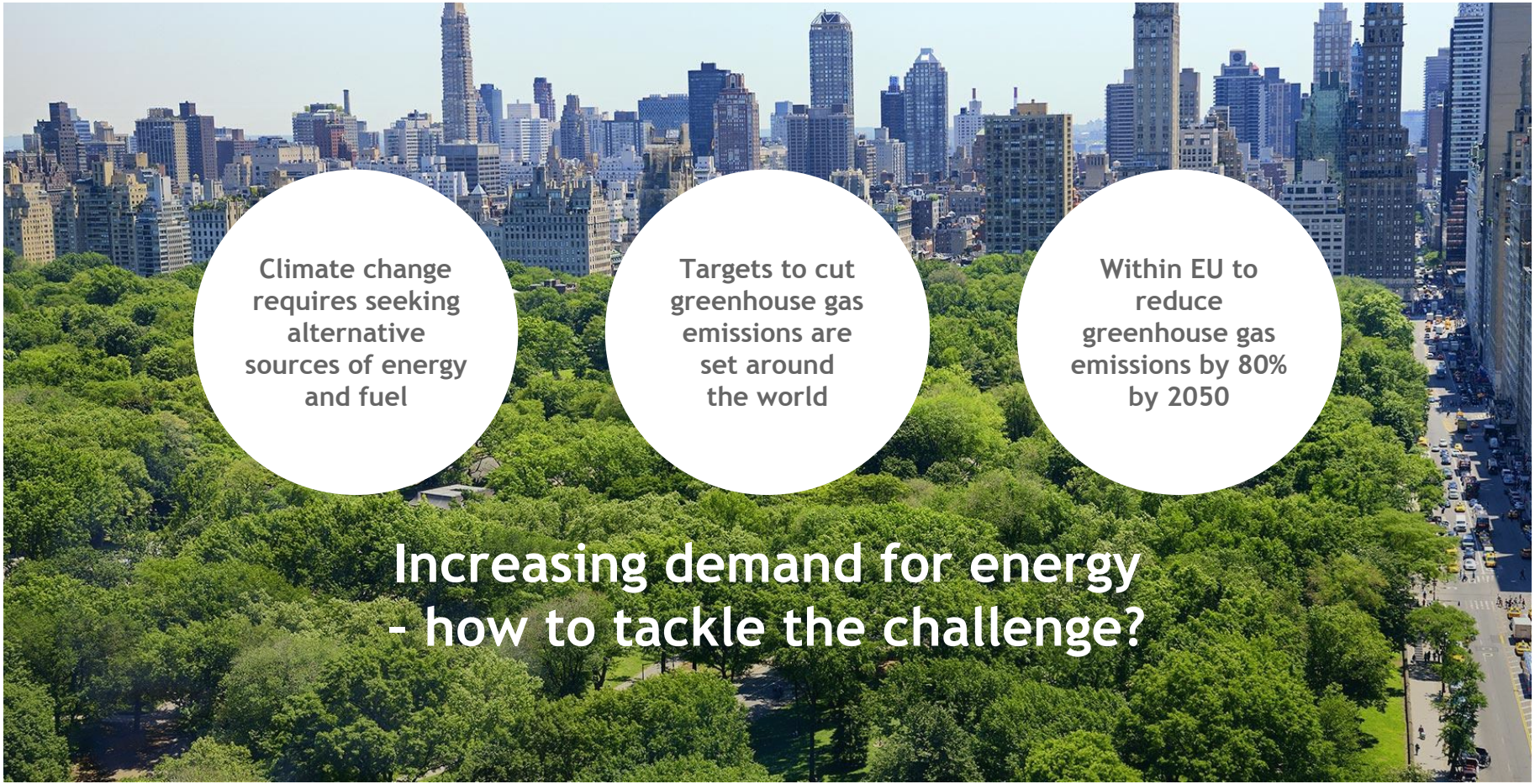
WE INVEST,
70% of our R&D budget on finding new raw materials

WE REACHED 1,422 M€
operating profit of which 70% came from our renewables

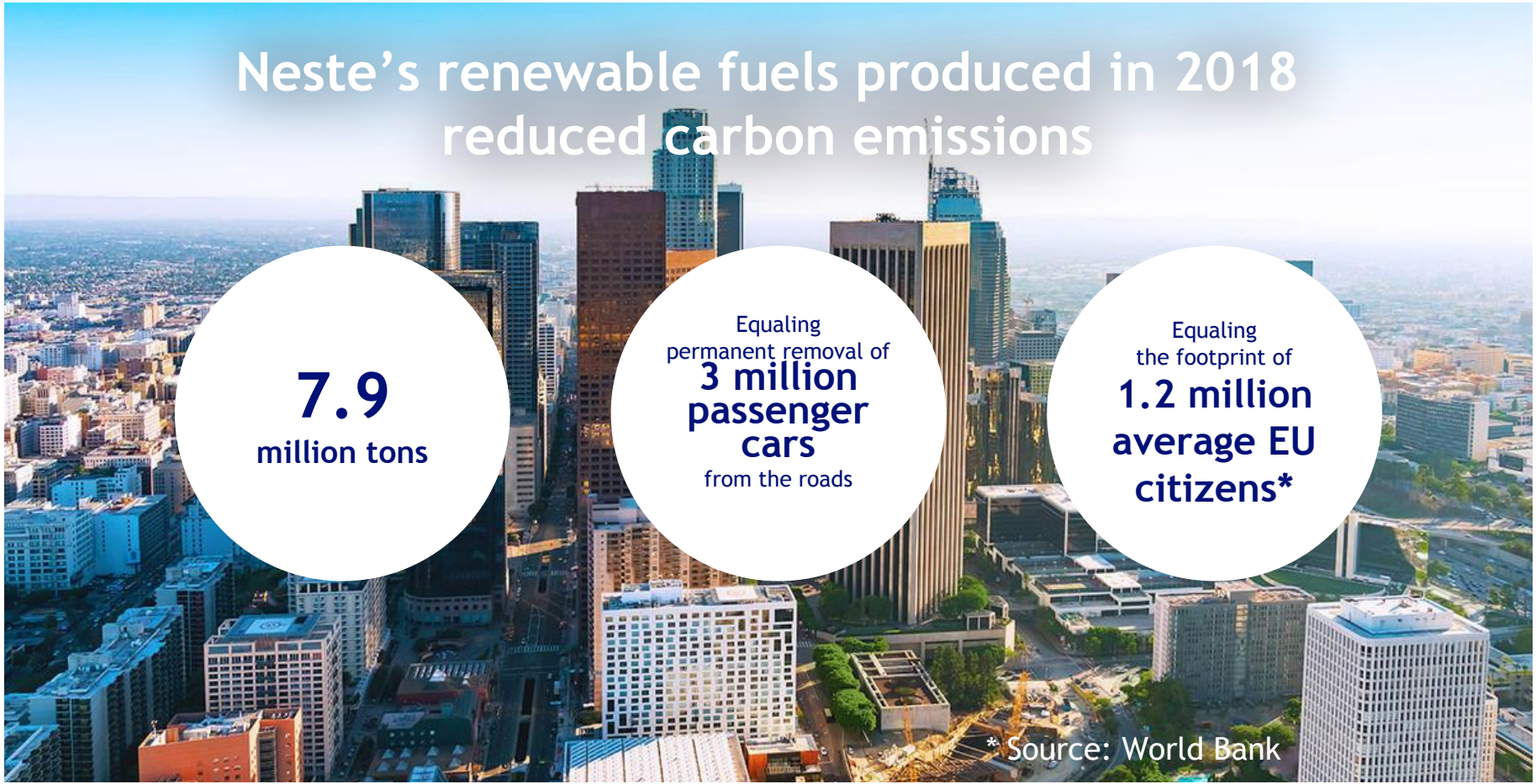
*Figures at year end of 2018.

NESTE


THE CHALLENGE:
In what condition do we leave this planet for the next generation?


Climate change requires seeking alternative sources of energy and fuel
Targets to cut greenhouse gas emissions are set around the world
Within EU to reduce greenhouse gas emissions by 80% by 2050
Increasing demand for energy - how to tackle the challenge?

Neste's renewable fuels produced in 2018 reduced carbon emissions



NESTE


Creating our own path with R&D and technology
48 M€ invested annually into R&D, primarily into raw material research and testing
Over 1,000 dedicated experts working every day to find responsible choices

Cutting-edge research

- Continuous research to expand renewable raw material base and further develop NEXBTL technology
- approx. euro 48 million of R&D costs in 2018
- Cooperation with over 20 research institutions around the world
- Approx. 1,000 people working with research and engineering

Flexible raw material mix

- The share of waste and residues is approximately 80% of our renewable raw materials
- Neste's renewable products can be produced flexibly from a mix of waste and residues as well as various vegetable oils
- The company is the only one in the world capable of producing renewable fuels from approximately 10 different raw materials
- The products have consistent high quality independent from raw material used

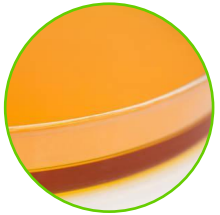
Broad range of renewable raw materials

Animal fat from food industry waste

Fish fat from fish processing waste

Vegetable oil processing waste and residues
(e.g. PFAD, PES, SBEO)

Used cooking oil



Technical corn oil

Crude palm oil

Rapeseed oil

Soybean oil

Camelina oil

Jatropha oil

Neste uses bio-based ethanol from the global market as a bio-component in 95 E10 and 98 E5 gasolines.
The company also uses tall oil pitch at its refinery in Naantali, Finland.

Annual production capacity of 2.9 Mt

Unit	Capacity	Year	Investment
Finland #1	200 000 t/a	2007	EUR 100 million
Finland #2	200 000 t/a	2009	EUR > 100 million
Singapore	1 200 000 t/a	2010	EUR 550 million
Rotterdam	1 300 000 t/a	2011	EUR 670 million

New capacity to be built to meet growing global demand for renewables in transport, aviation, polymers and chemicals

Three year project, investment approximately EUR 1.4 billion

Production capacity to be extended by up to 1.3 Mton/a

Total renewable products capacity close to 4.5 Mton/a in 2022

All Neste's renewable product plants are ISCC-EU and EPA-approved.

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

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Our renewable products

Neste Renewable Fuels

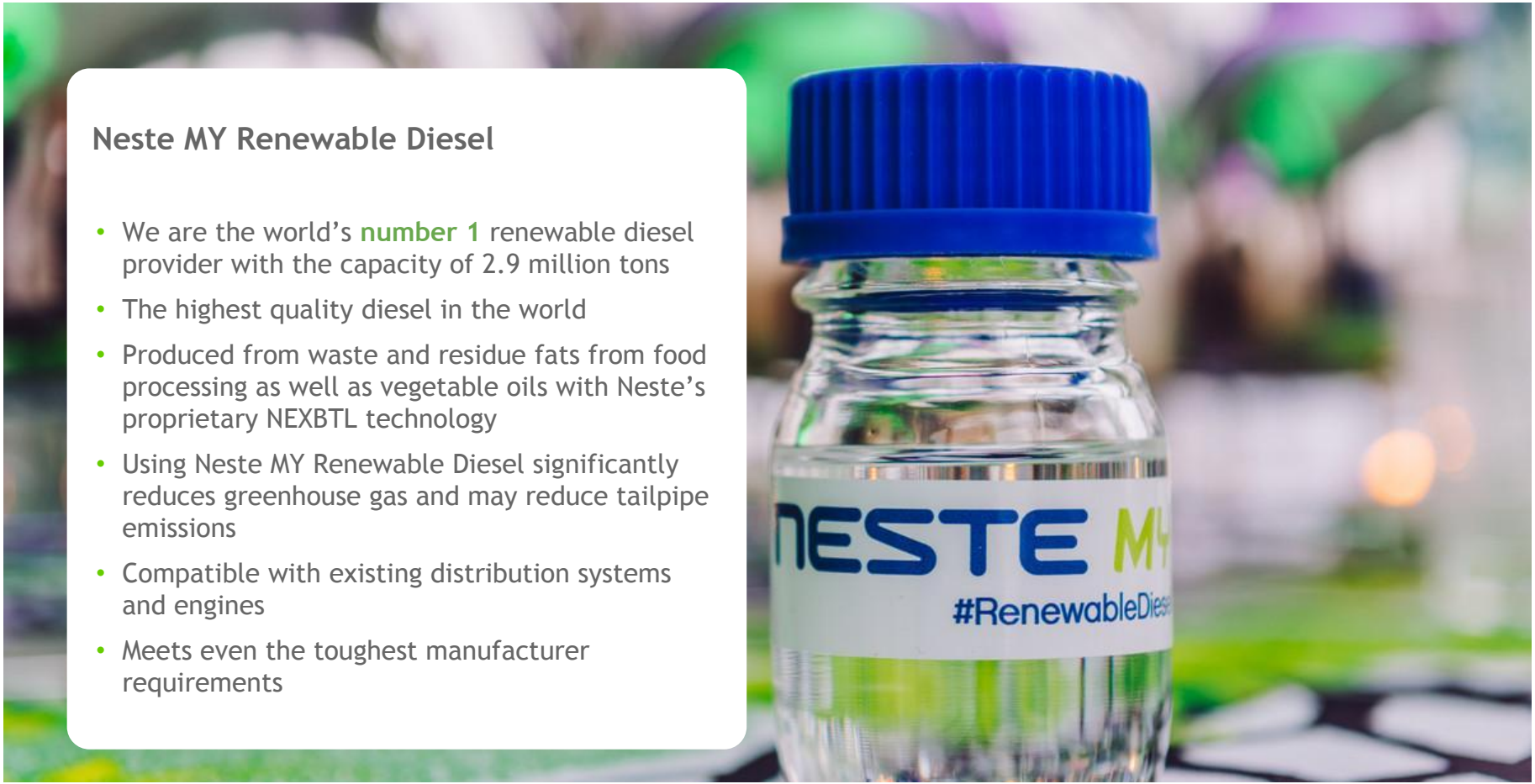
- Neste MY Renewable Diesel
- Neste MY Renewable Gasoline
- Neste MY Renewable Propane
- Neste MY Renewable Jet Fuel

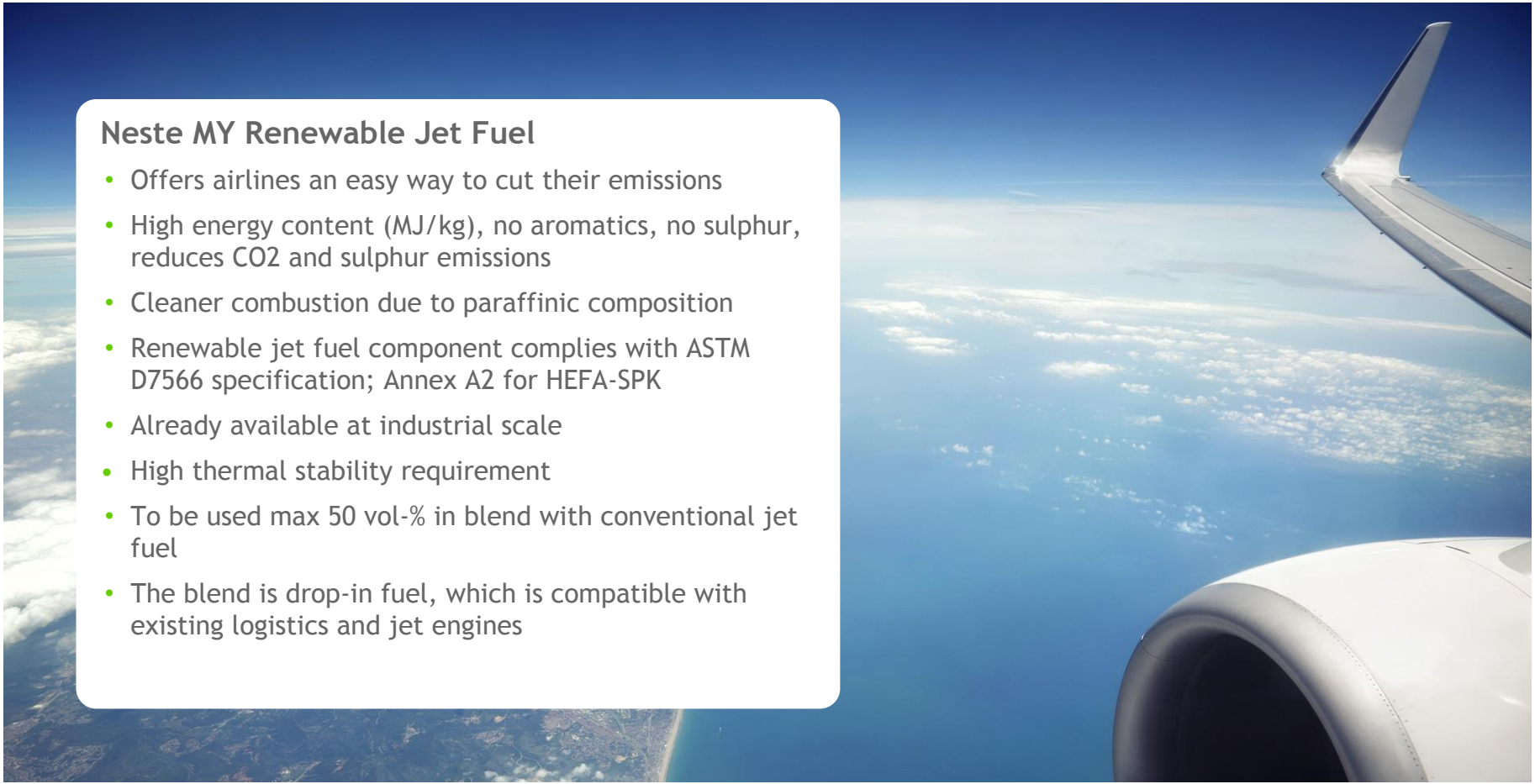
Neste Renewable Chemicals

- Neste MY Renewable Isoalkane
- Neste My Renewable Naphta
- Neste MY Renewable Propane

Neste MY Renewable Diesel

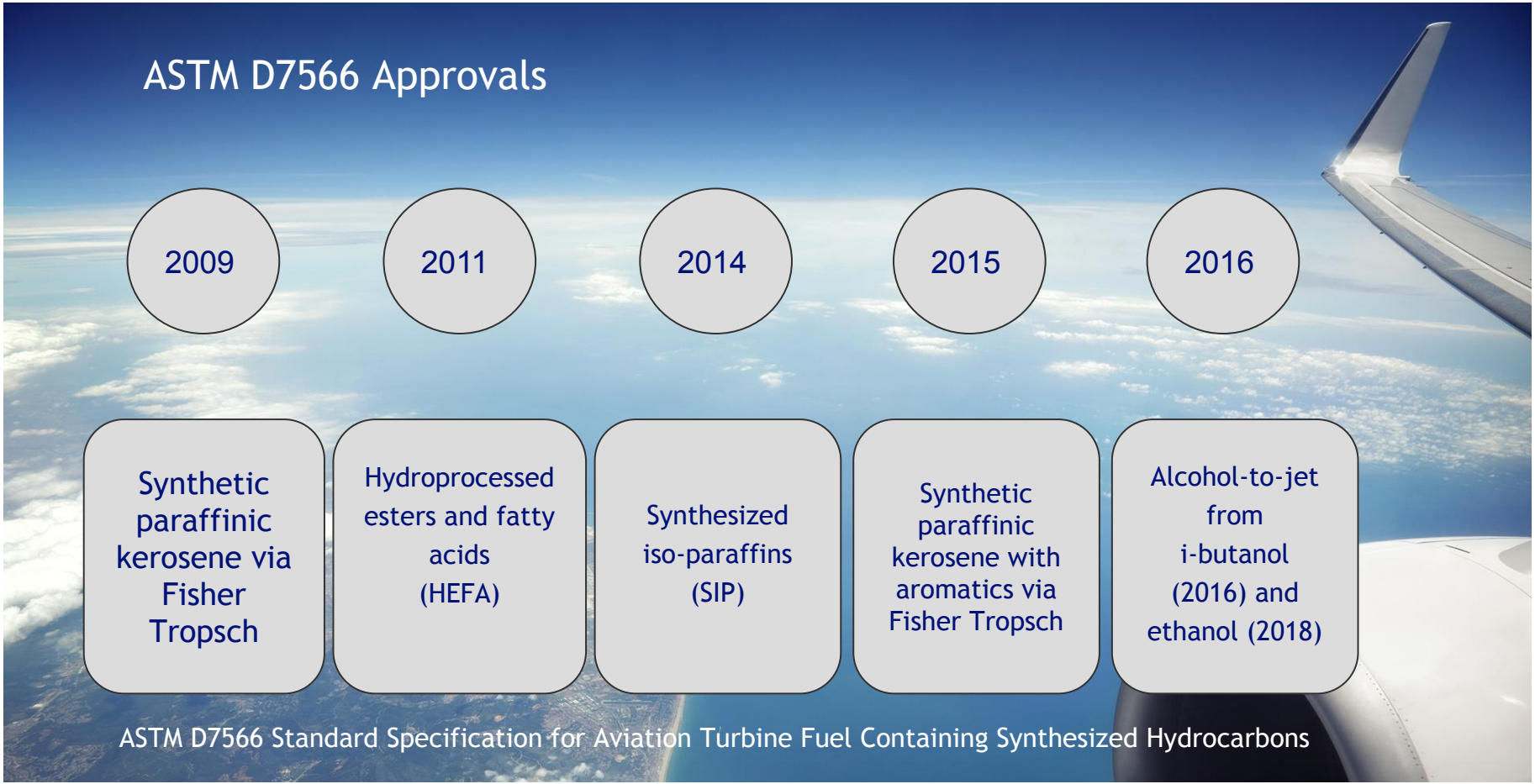
- We are the world's **number 1** renewable diesel provider with the capacity of 2.9 million tons
- The highest quality diesel in the world
- Produced from waste and residue fats from food processing as well as vegetable oils with Neste's proprietary NEXBTL technology
- Using Neste MY Renewable Diesel significantly reduces greenhouse gas and may reduce tailpipe emissions
- Compatible with existing distribution systems and engines
- Meets even the toughest manufacturer requirements



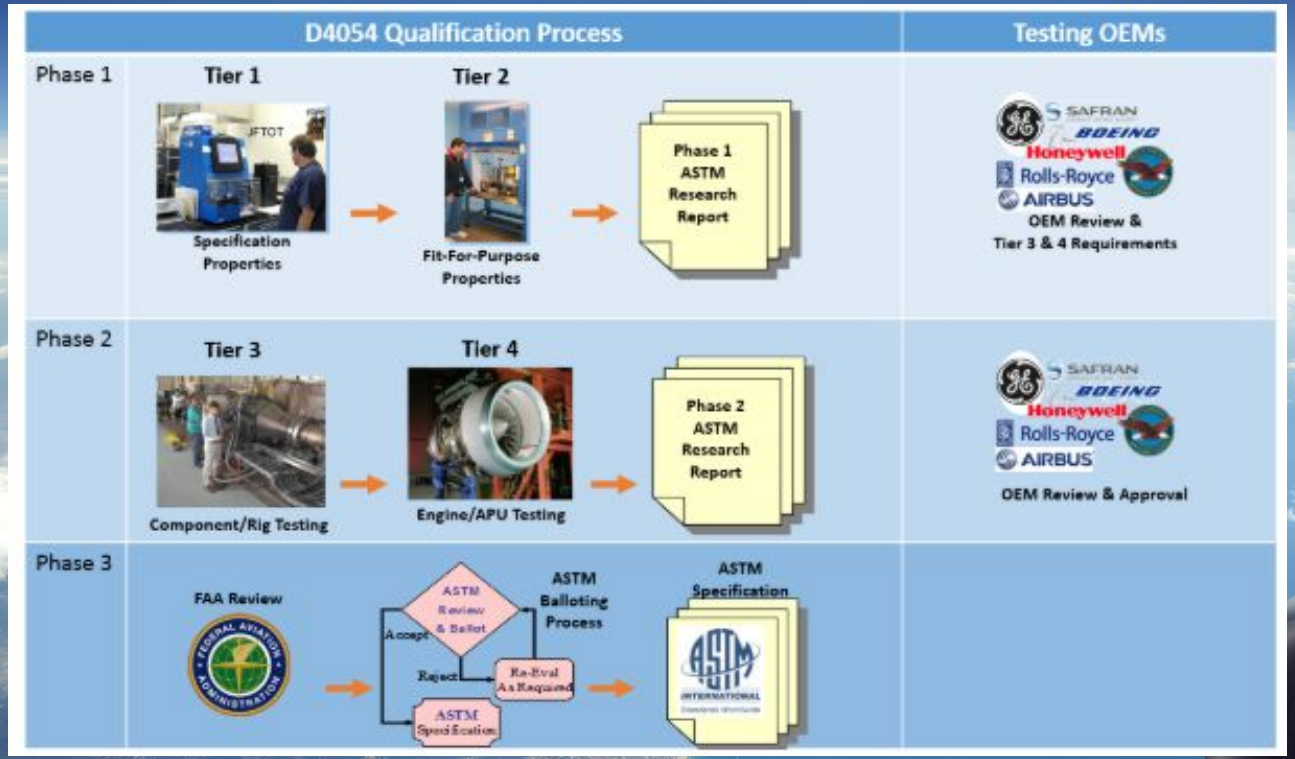


Neste MY Renewable Jet Fuel

- Offers airlines an easy way to cut their emissions
- High energy content (MJ/kg), no aromatics, no sulphur, reduces CO2 and sulphur emissions
- Cleaner combustion due to paraffinic composition
- Renewable jet fuel component complies with ASTM D7566 specification; Annex A2 for HEFA-SPK
- Already available at industrial scale
- High thermal stability requirement
- To be used max 50 vol-% in blend with conventional jet fuel
- The blend is drop-in fuel, which is compatible with existing logistics and jet engines


ASTM D7566 Approvals
2009
2011
2014
2015
2016
Synthetic paraffinic kerosene via Fisher Tropsch
Hydroprocessed esters and fatty acids (HEFA)
Synthesized iso-paraffins (SIP)
Synthetic paraffinic kerosene with aromatics via Fisher Tropsch
Alcohol-to-jet from i-butanol (2016) and ethanol (2018)
ASTM D7566 Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons

ASTM D4054 Standard Practice for Evaluation of New Aviation Turbine Fuels and Fuel Additives



http://www.caafi.org/focus_areas/fuel_qualification.html

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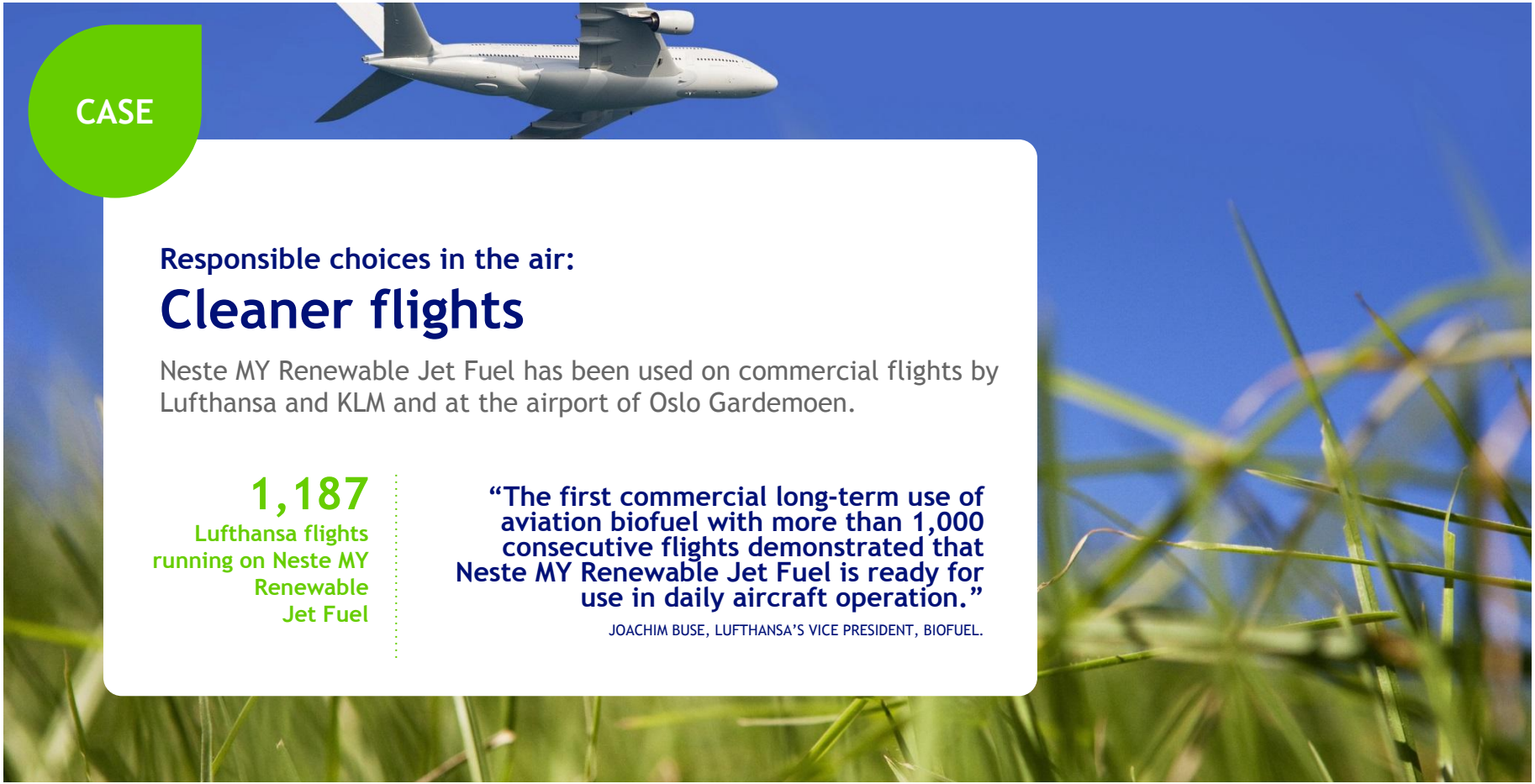
Proven high-level performance
1,187
Lufthansa flights
1,600 tons
of Neste Renewable Jet Fuel blend consumed (50% blend)
1,500 tons
reduction in CO2 emissions



CASE

Responsible choices in the air:

Cleaner flights

Neste MY Renewable Jet Fuel has been used on commercial flights by Lufthansa and KLM and at the airport of Oslo Gardemoen.

1,187

Lufthansa flights running on Neste MY Renewable Jet Fuel

“The first commercial long-term use of aviation biofuel with more than 1,000 consecutive flights demonstrated that Neste MY Renewable Jet Fuel is ready for use in daily aircraft operation.”

JOACHIM BUSE, LUFTHANSA’S VICE PRESIDENT, BIOFUEL.

*The tests, where the reduction of 1,500 tonnes in CO2 emissions was achieved, were carried out by Lufthansa in 2012 on a total of 1,187 flights between Frankfurt and Hamburg and one intercontinental flight between Frankfurt and Washington D.C.

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CASE

Responsible choices in the air:

Cleaner flights

San Francisco International Airport (SFO) has signed a Memorandum of Understanding with a group of eight airlines and fuel producers. Neste together with other industry stakeholders will continue to actively work together to increase sustainable aviation fuel supply at SFO airport.

As a result of this collaboration nearly **4,8 million metric tons** of GHG emissions can be reduced per year

"We are proud to be the first airport to sign a truly holistic agreement on the use of Sustainable Aviation Fuels. By including the entire supply chain process, from producer to end user, this agreement has the power to drive a truly meaningful reduction in aviation-related greenhouse gas emissions."

IVAR C. SATERO, AIRPORT DIRECTOR AT SFO

NESTE

CASE

Responsible choices in the air:

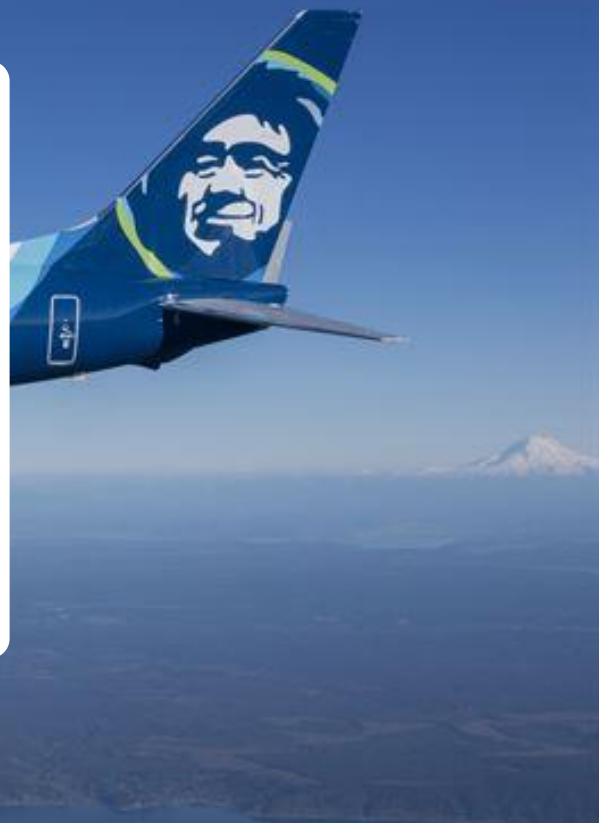
Cleaner flights

As part of Alaska Airlines' ongoing efforts to fly greener and expand the use of sustainable aviation fuels, Neste and Alaska Airlines have signed a Memorandum of Understanding (MOU).

Neste and Alaska Airlines work for the wider adoption of renewable fuels within the airline industry

"We are proud to partner with Neste, the world leader in the production and advancement of renewable jet fuels, to support these efforts to fly more sustainably. This collaboration is another major step toward supporting the health of our communities and ecosystems."

KIRK MYERS, ALASKA AIRLINES DIRECTOR OF SUSTAINABILITY



Global aviation outlook - the need for sustainable fuels

- 2018-2022 Aviation fuel market forecasted to grow at a CAGR of 3,8 %
- Air traffic is expected to double during the next 20 years
- Air transport as a whole represents 2% of global carbon emissions. The industry is committed to achieving carbon-neutral growth by 2020 and reducing 50% in net emissions by 2050.
- IATA member airlines and the wider aviation industry are collectively committed to ambitious emissions reduction goals. SAF, have been identified as one of the key elements in helping achieve these goals. They are the only low-carbon fuels available for aviation in the short to mid-term

IATA = International Air Traffic Association)

SAF = sustainable aviation fuel

Thank you.

Kati Sandberg
kati.sandberg@neste.com