Cleaner Future by new diesel?

Marku Honkanen
Sebastian Dörr

Workshop Modernisation
Danube Vessels

Chris Castanien
US Version

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Mobility has complex solutions

Aviation

Strong growth continues. Renewable fuels currently the only viable alternative to jet fuel.

Public transport

A variety of solutions are needed. Renewable fuel, biogas, and electrification are viable options.

Passenger cars

Renewable fuels are currently most cost-efficient for decarbonization. Electric vehicles increasingly contribute over time.

Everyday plastics and chemicals

Wherever plastics are used, renewable solutions may replace oil as the raw material. The same goes for paints, solvents, and a variety of chemicals

Marine use

Low-sulfur fuels and LNG help reduce sulfur and nitrogen emissions. Decarbonization in long-haul operations requires renewable fuels.

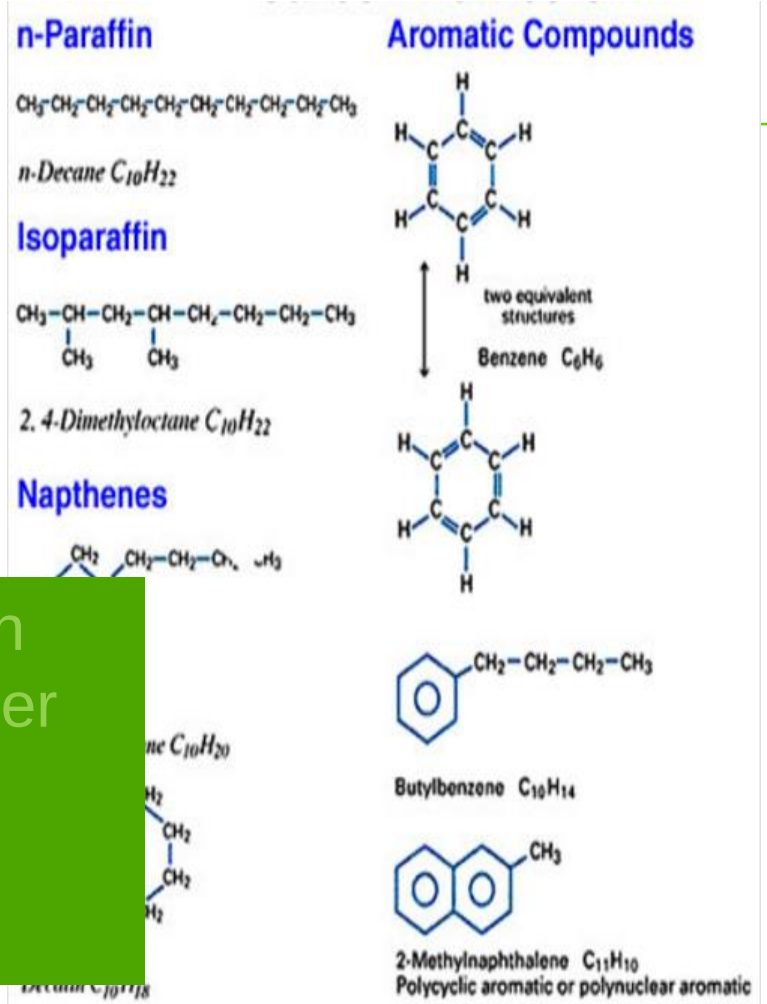
Heavy duty

Renewable diesel with high energy density is the best alternative for conventional diesel in long-haul transport.

Petroleum Diesel
A collection of thousands of molecules

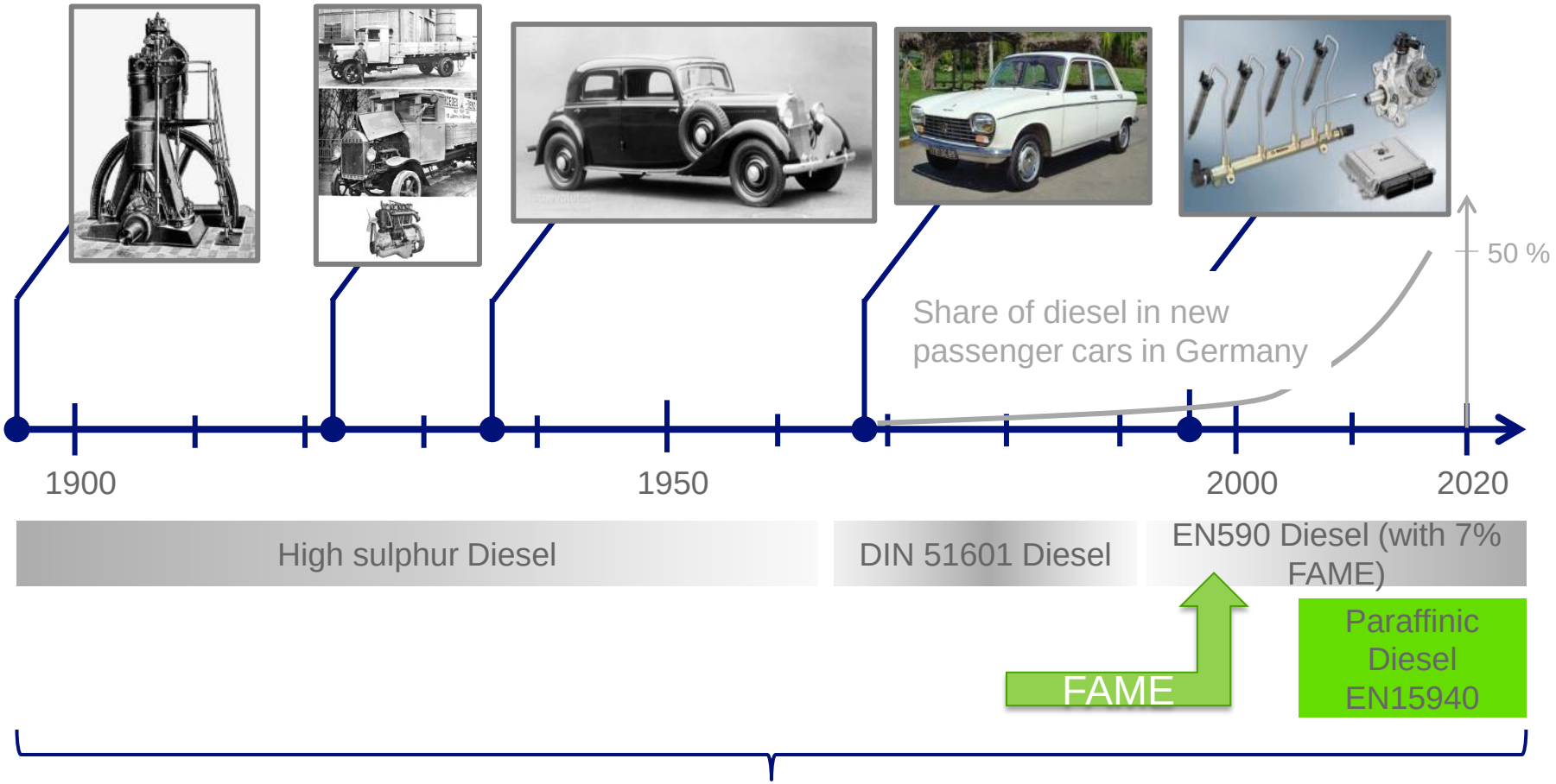
- Paraffins that burn easily and cleanly
- Cyclic Napthenes that are harder to burn but are energy dense
- Cyclic Aromatics that bring a host of complications and

- Each of these structures is found in combination and with N, S and other contaminants.
- Tens of thousands of different molecules



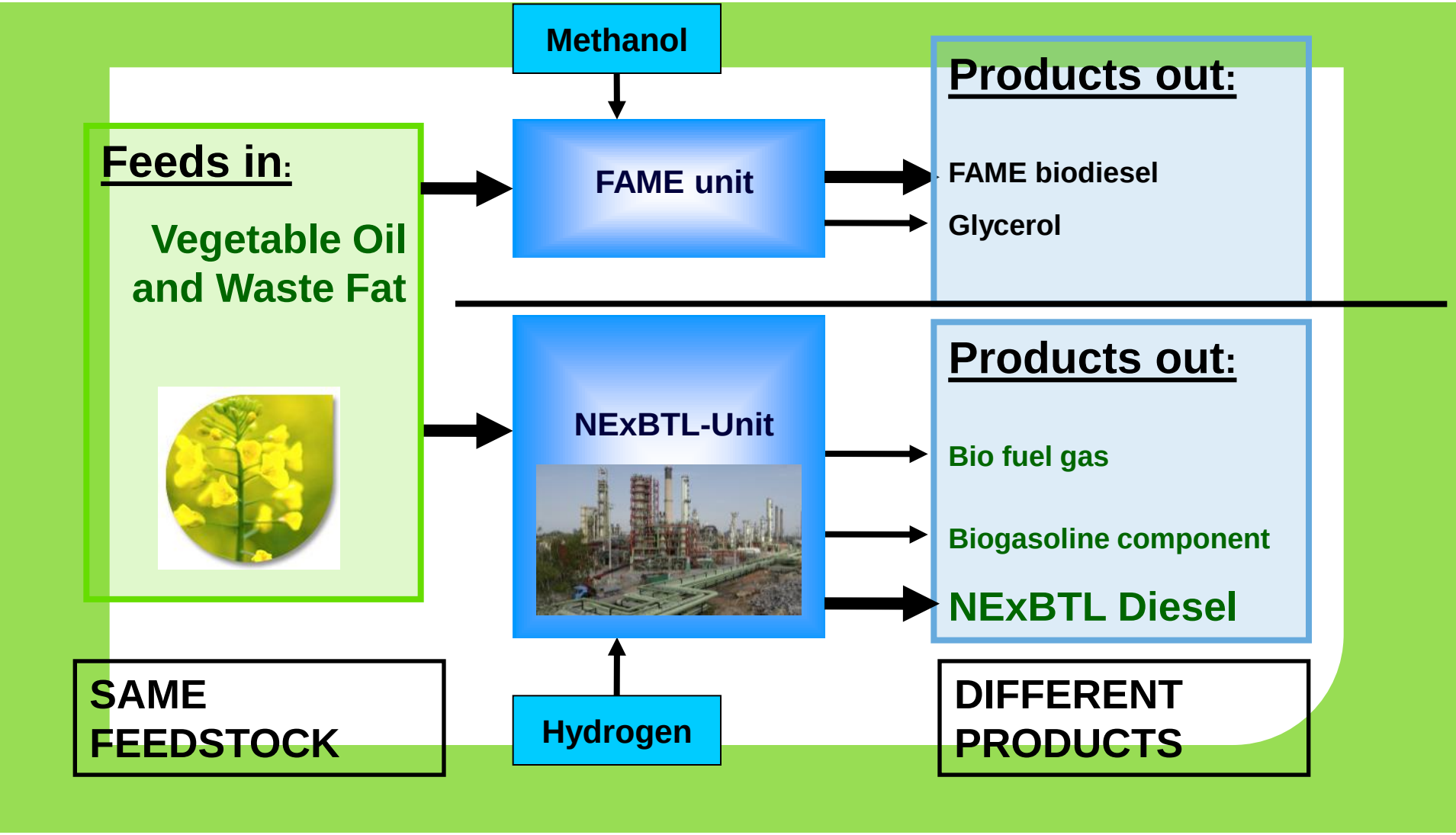
http://criticalfueltech.com/faq.html

Development of Diesel engine and Diesel fuel over the past century



For over 100 years Diesel fuel has not developed much and combustion engine was developed around the fuel

NExBTL & FAME Process

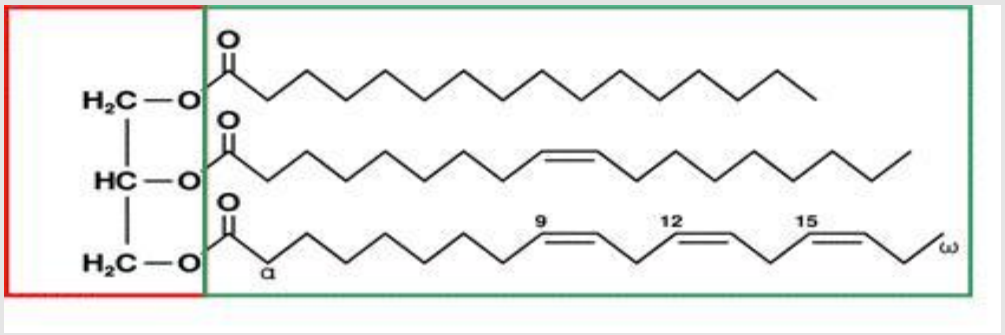


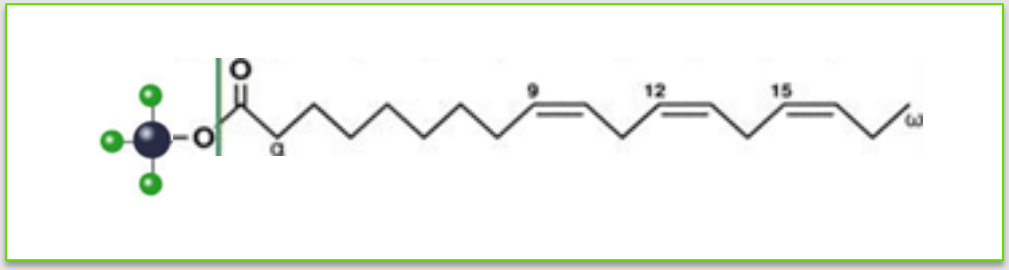
Converting Triglycerides to Diesel Fuel

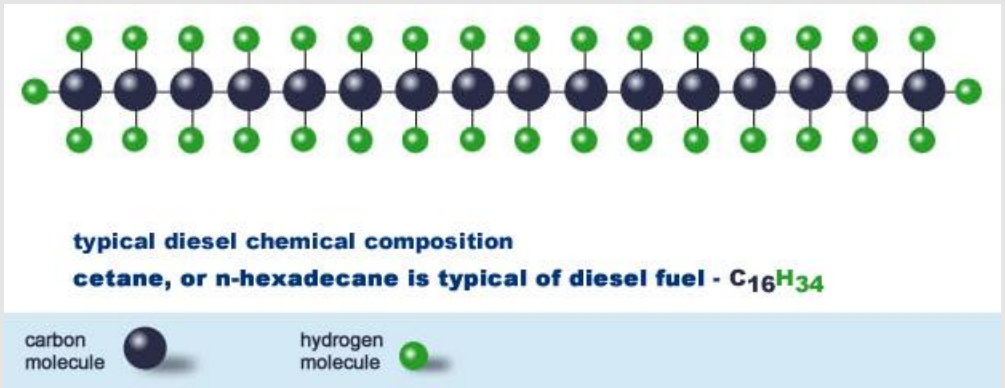
Plants and animals store energy as triglycerides. The majority are C_{16}-C_{18}

Biodiesel (FAME) liberates the Fatty Acids leaving the Oxygen and unsaturated bonds

NEXBTL (HVO) creates fully saturated paraffin diesel and propane



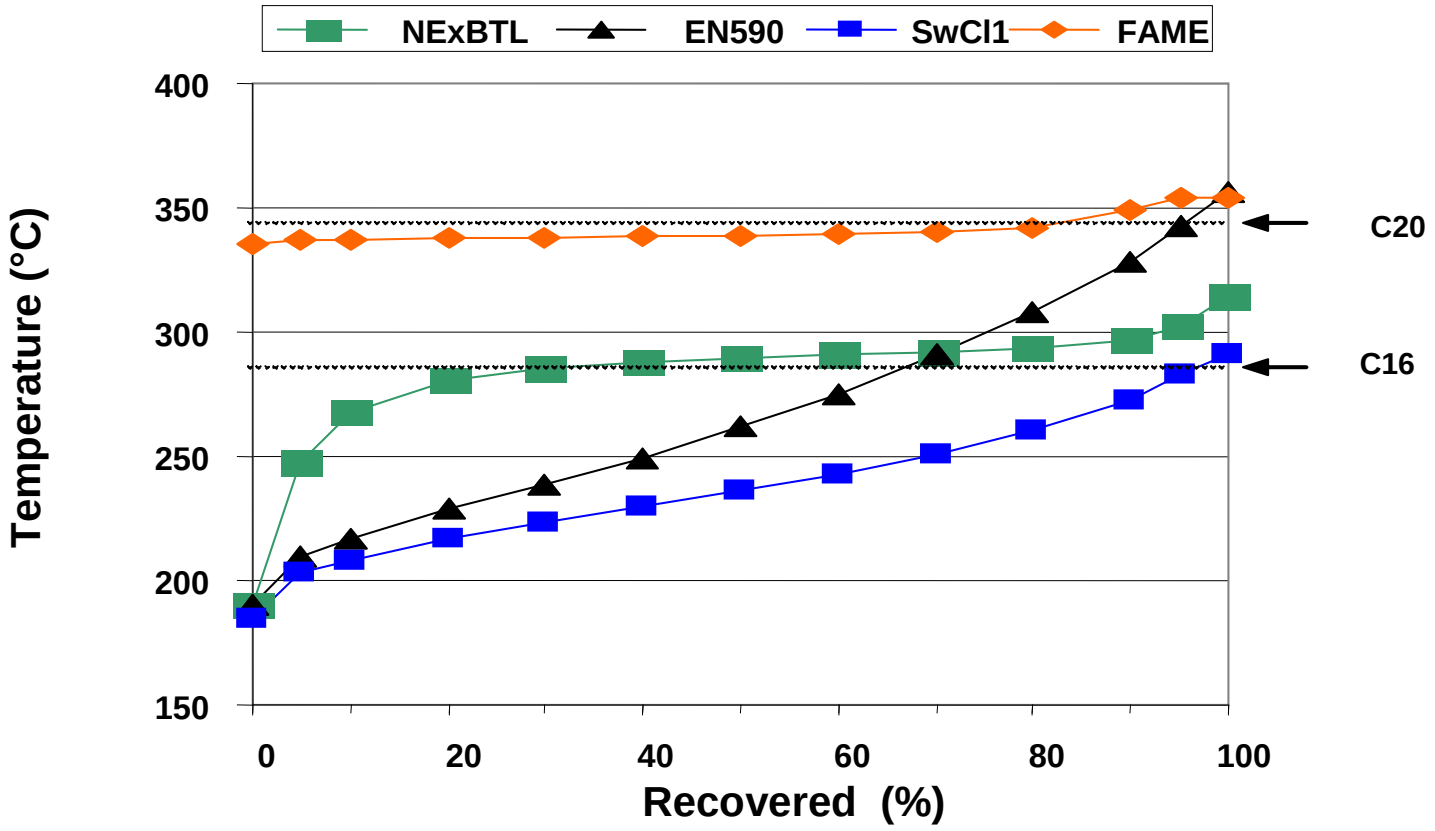




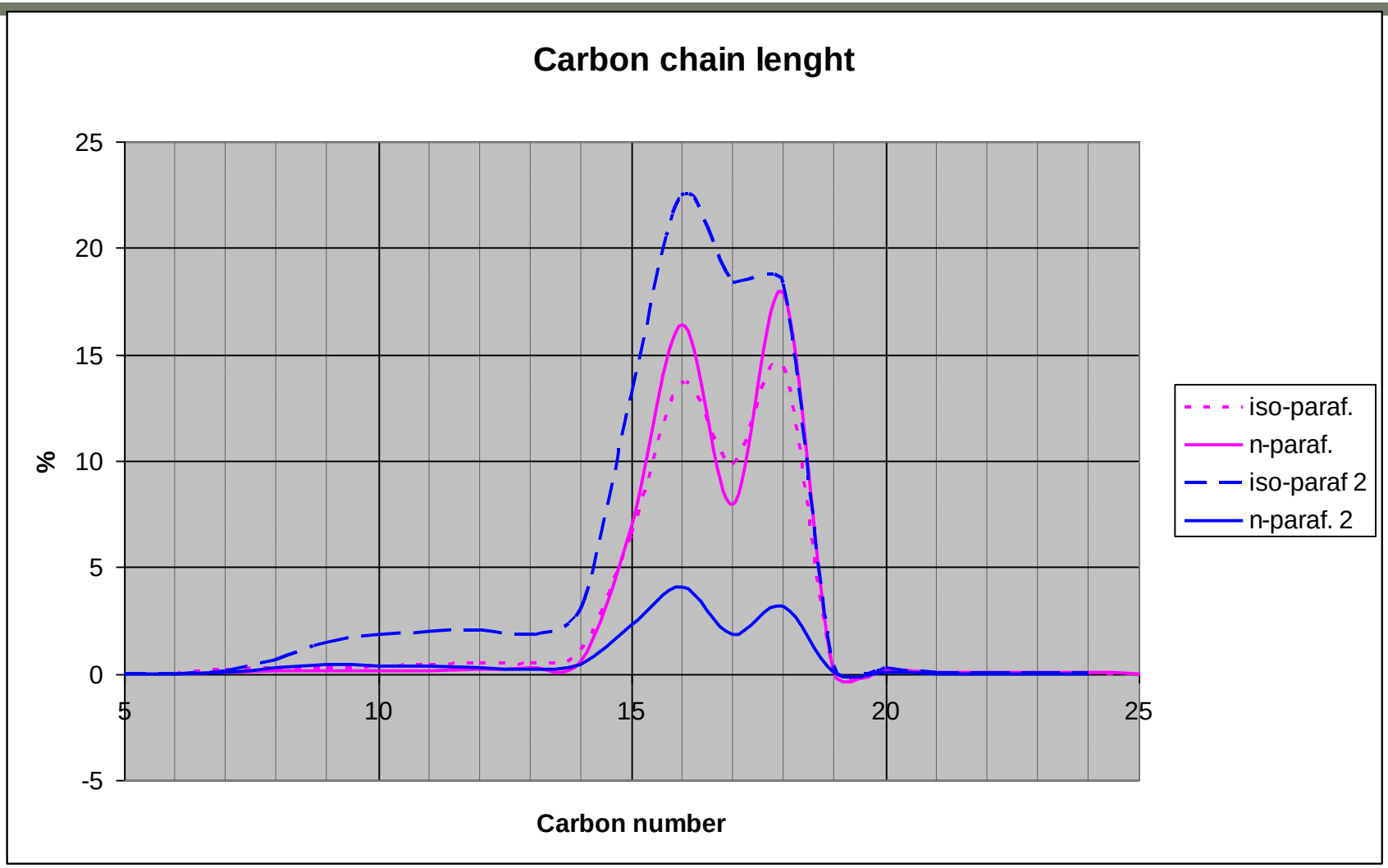
HVO - diesel

- Next step from traditional Biodiesel
- Improved Technology and Product
- Pure Hydrocarbon, fully compatible with Mineral Diesel
- No compromises on Fuel Quality or Vehicle Performance
- In Commercial Production

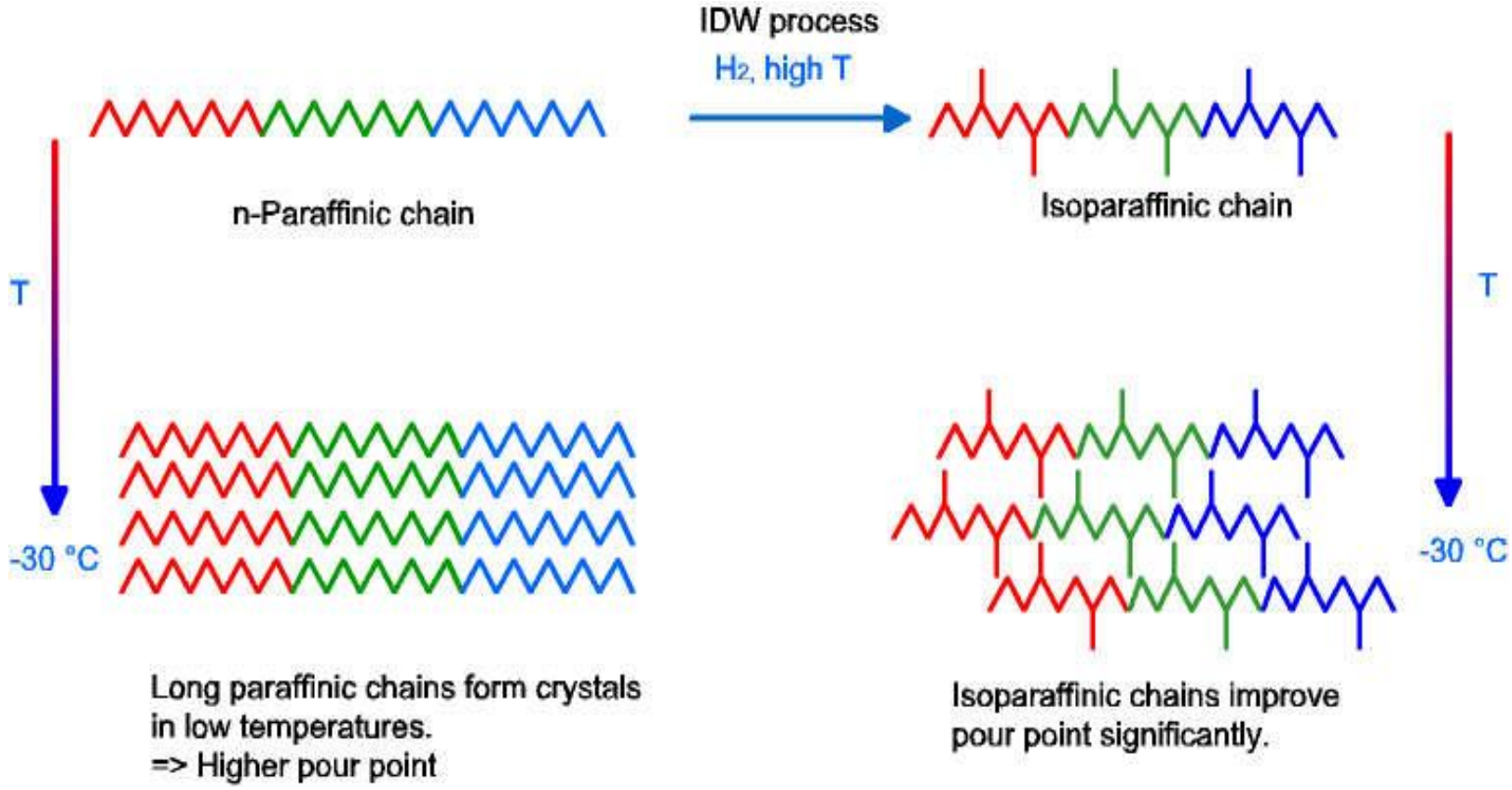
Distillation curves



Carbon distribution



IDW process
Low temperature properties



HVO (xTL) significantly reduces greenhouse gas and tailpipe emissions

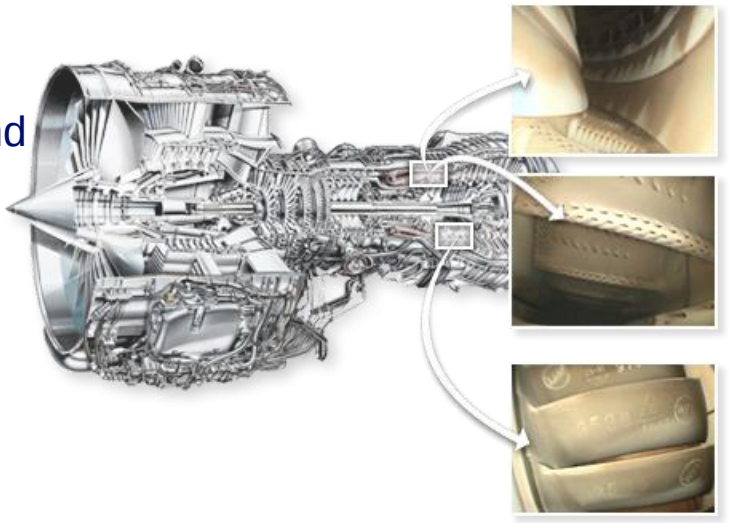
50 million kilometers covered in the world's largest biofuel trial (Helsinki 2007-2010)

HVO contributes to a significant reduction in exhaust emissions:

- Nitrogen oxide (NOx) 10% reduction
- Particulates (PM) 30% reduction
- Greenhouse gases (LCA-GHG) >50% reduction

Perfect fuel for aviation

1. During the operation
Aircraft and engine performed excellently
1% lower fuel consumption due
to the higher energy content
2. Inspection after the program
Fuel system, combustion chamber and
turbines in a perfect condition
Normal function and tightness of
fuel bearing parts
3. Storage stability
Density steady at 783 kg/cbm
No microbial issues



Source of the picture: Lufthansa

Renewable raw materials

Flexible raw material mix

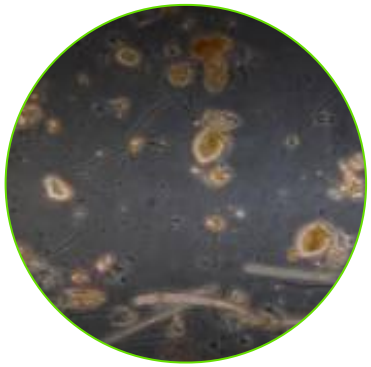
- Neste renewable products can be produced flexibly from a mix of various vegetable oils and waste and residues
- The products have constant high quality independent from raw material used

Expanding our raw material portfolio

Short term

Waste animal fats, waste oils, residue and side streams

Long term



Biological pathways

Thermo-catalytic pathways

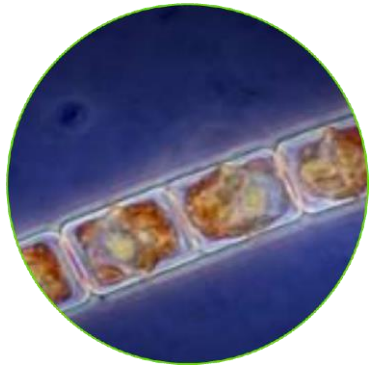
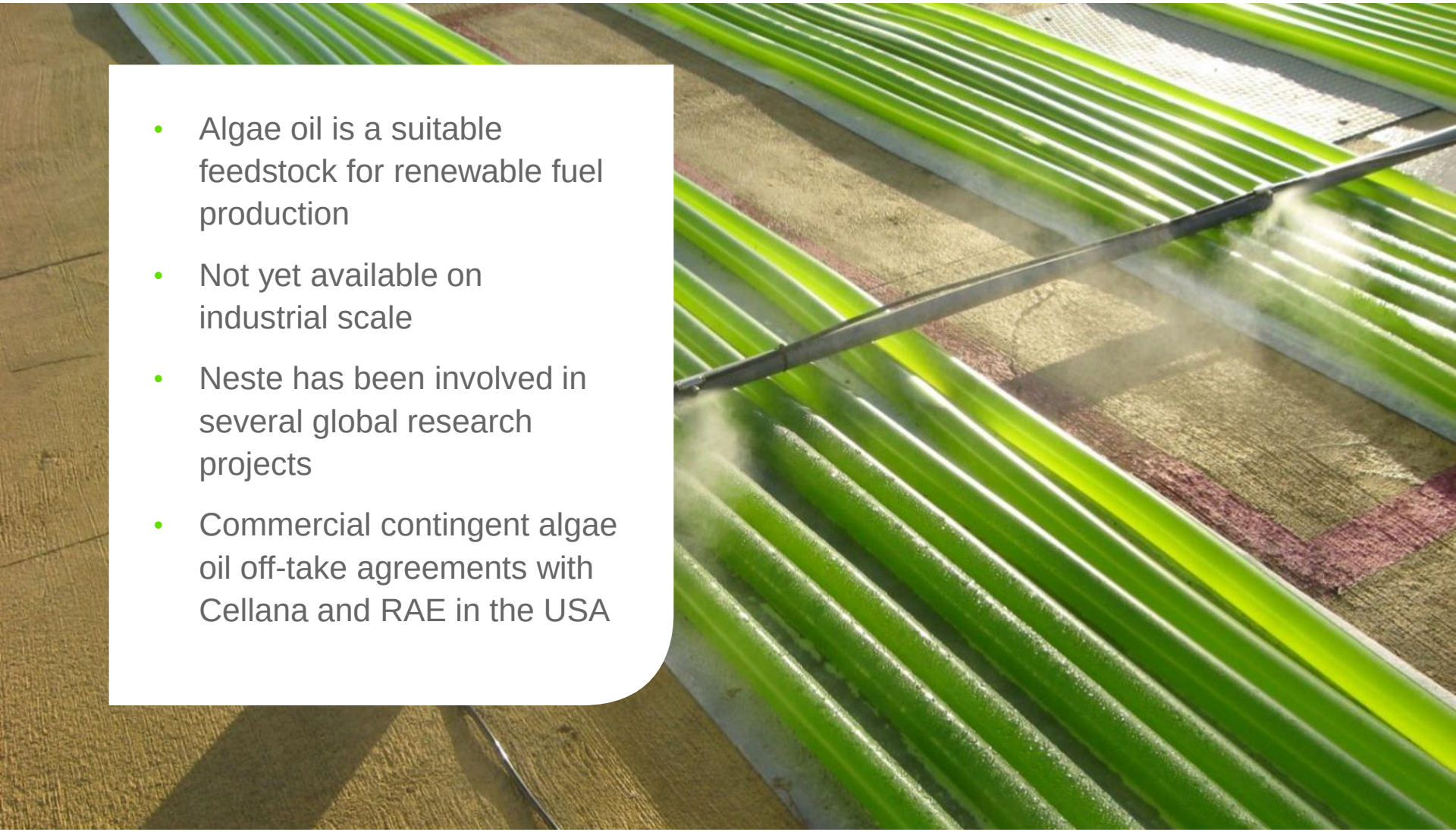


Photo-synthesis

Cutting-edge research

- Continuous research to expand renewable raw material base and further develop NEXBTL technology
- 70% approx. euro 41 million of R&D costs in 2015
- Cooperation with over 20 research institutions around the world
- Approx. 1,000 people working with research and engineering

Microalgae oil – one of the future raw material alternatives



- Algae oil is a suitable feedstock for renewable fuel production
- Not yet available on industrial scale
- Neste has been involved in several global research projects
- Commercial contingent algae oil off-take agreements with Cellana and RAE in the USA

How sustainability can be measured

– example by Corporate Knights

Starting Universe

All publicly-listed companies with latest gross revenue of a minimum of US$1 billion* (~7,300 companies) are assessed based on public domain data.

Screening

4 screening criteria: sustainability disclosure practices (~90% dropped out), financial health, product category, and financial sanctions → shortlist of 100 companies

Selection

21 performance indicators (KPI) - not a reputation or opinion survey:

Financial management	Resource management	Employee management	New KPIs:
(e.g. R&D spend, taxes paid)	(e.g. environmental emissions, energy, climate)	(e.g. pension fund status, employee turnover)	Clean Revenue, Sanctions

The Global100

100 best according to 21 KPI's

Source: Criteria for Global 100 most sustainable companies by Corporate Knights


OUR VISION:
We create responsible choices every day.
Global 100:
Neste is the world's
3rd
most sustainable company.

NESTE

NEXBTL production capacity of 2.4 Mt/a

Unit	Capacity	Year
Finland #1	200 000 t/a	2007
Finland #2	200 000 t/a	2009
Singapore	1 000 000 t/a	2010
Rotterdam	1 000 000 t/a	2011

All Neste's NEXBTL plants are ISCC-EU and EPA-approved.
Neste's aim is to increase production capacity to 2.6 million t/a by 2017.

Emerging local competition offers more support for biofuels

Emerging HVO competitors

ENI

- Conversion of Venice refinery to HVO production plant completed in 2014
- Planned conversion of Gela refinery to HVO production plant

TOTAL

- Conversion of La Mede refinery to HVO production by 2017
- Conversion of Dunkirk refinery by 2017 (not HVO)

PREEM

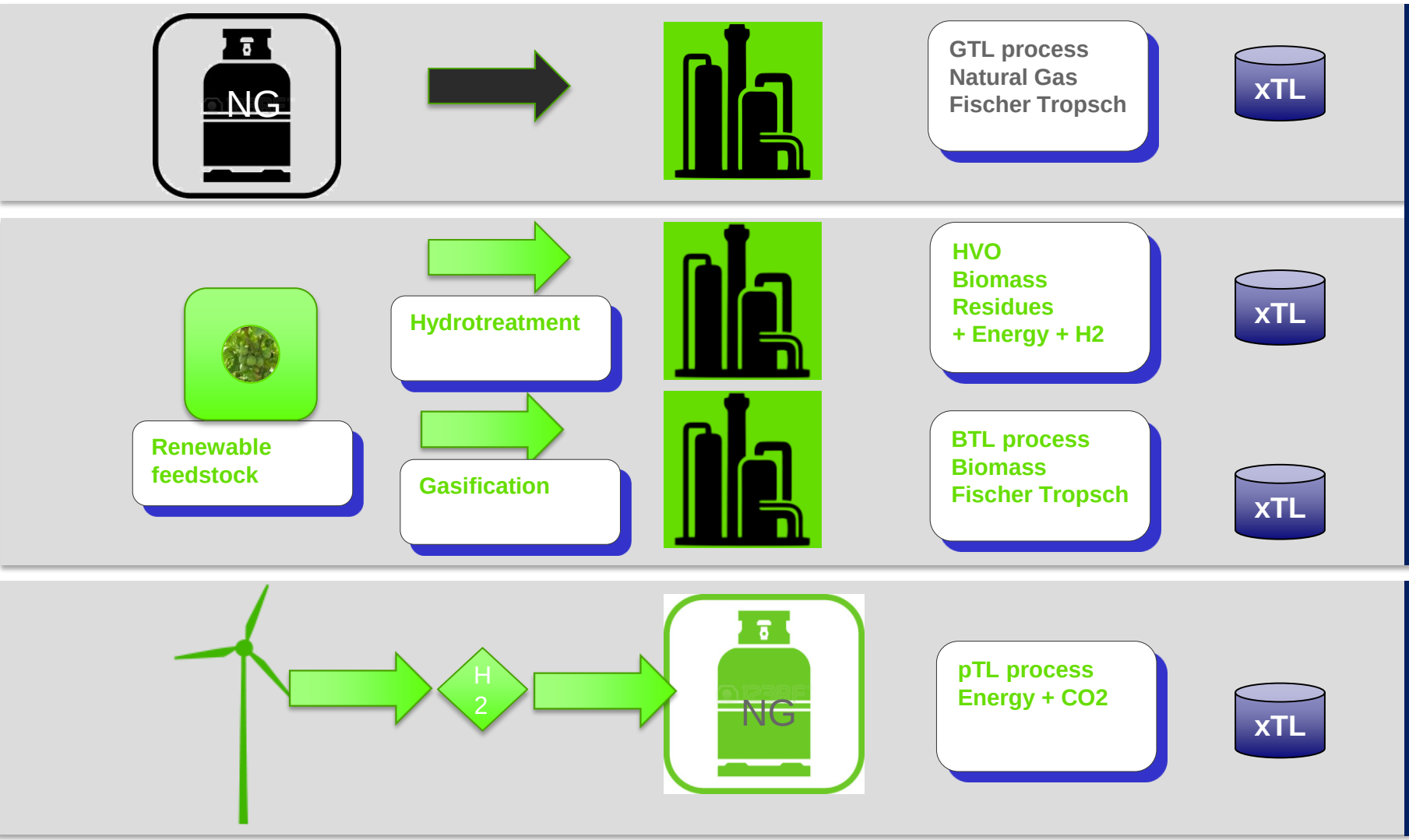
- Plan to double biofuel production in 2015

UPM

- Commercial production of HVO from tall oil in Finland since Q1/2015

Total potential capacity approx. 2 Mton/a

xTL Feedstock and Process



xTL Feedstocks and Processes

	CTL GTL	HVO Renewable diesel	BTL	PTL
Raw material	Black Coal Brown Coal Natural Gas	Vegetable Oil fatty waste residues	Biomass	From Electric Power to H2 Methan
Tec				om ces
End product	Fossil based paraffinic hydrocarbon	hydrocarbon (renewable diesel, jet fuel, bionaphta, biopropane)	(renewable gasoline, jet fuel, diesel)	Renewable paraffinic hydrocarbon
Chemical composition	C_nH_{2n+2}	C_nH_{2n+2}	C_nH_{2n+2}	C_nH_{2n+2}

xTL hydrocarbon diesel is fully compatible with petroleum diesel and can be produced from many different sources and processes

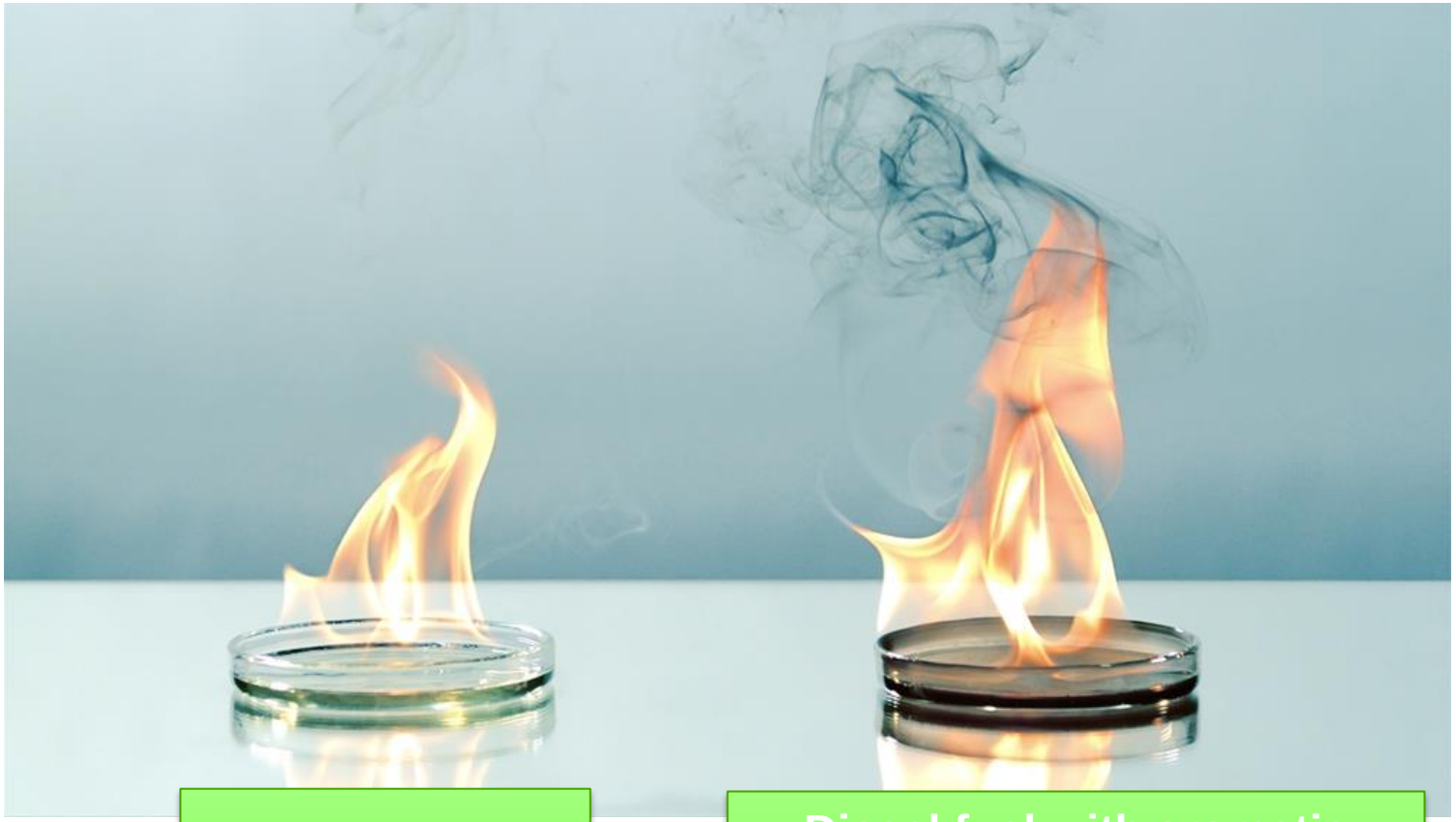
CTL = Coal to liquid
GTL = Gas to liquid
HVO = Hydrotreated Vegetable Oil, advanced biofuel i.e. renewable fuel
BTL = Biomass to Liquid
PTL = Power to Liquid

NESTE

xTL (EN 15940)- Superior Quality

Fuel Properties Typical values	**EN590** **diesel fuel**	**xTL fuels**
Cetane number	**53**	**75-99**
Cloud point (°C)	**0 - -12**	**-5...-30**
Heating value (lower) (MJ/kg)	**43**	**44**
Heating value (lower) (MJ/l)	**36**	**34**
Density at +15 °C (kg/m3)	**835**	**780**
Sulfur content (mg/kg)	**< 10**	**0**
Distillation range °C	**180-360**	**180 - 320**

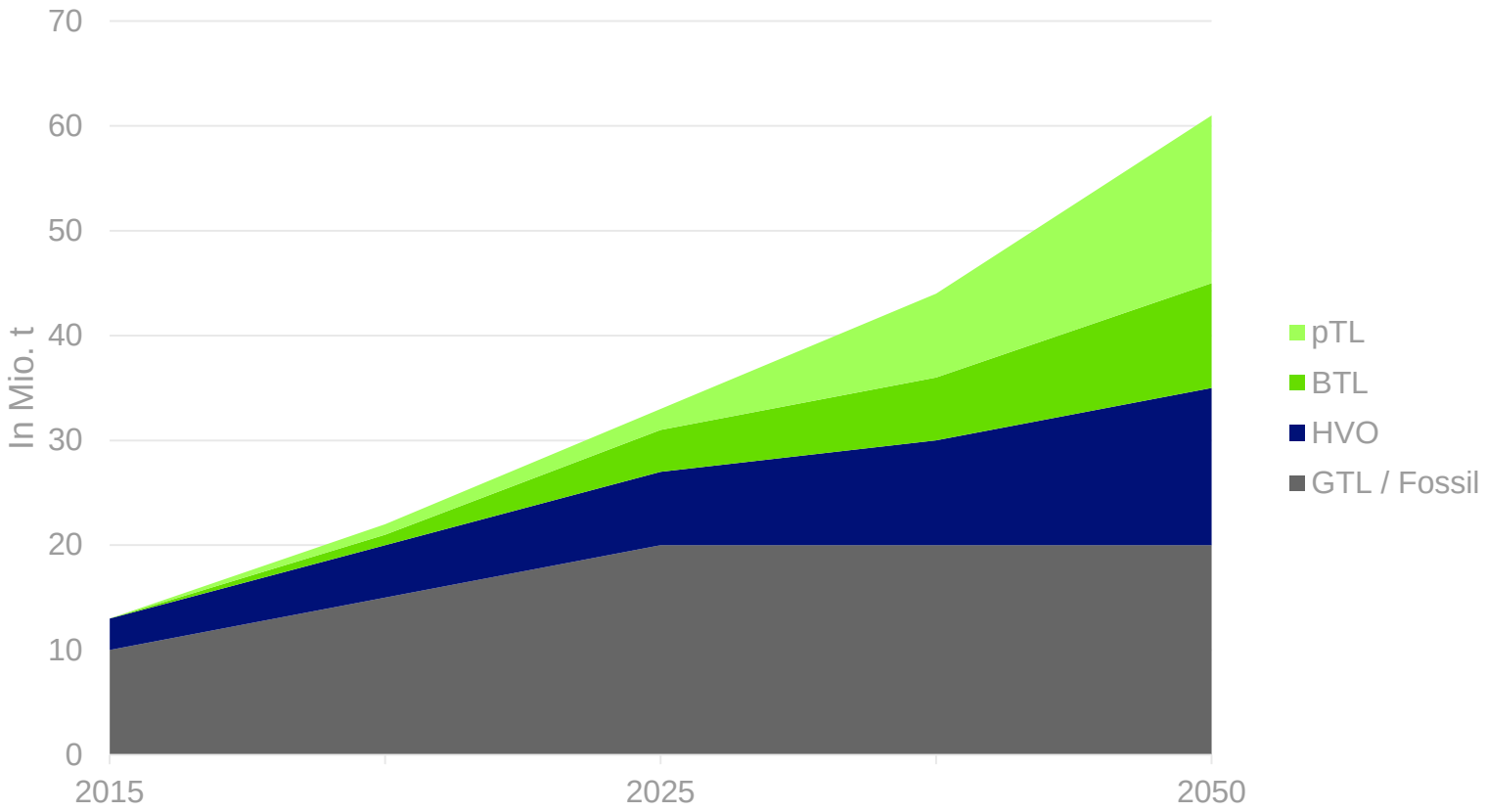
xTL – reduced emissions



xTL diesel

Diesel fuel with aromatic content

xTL Potential Volumes



Field tests and experience

HVO100 - from fleet tests to commercial operations

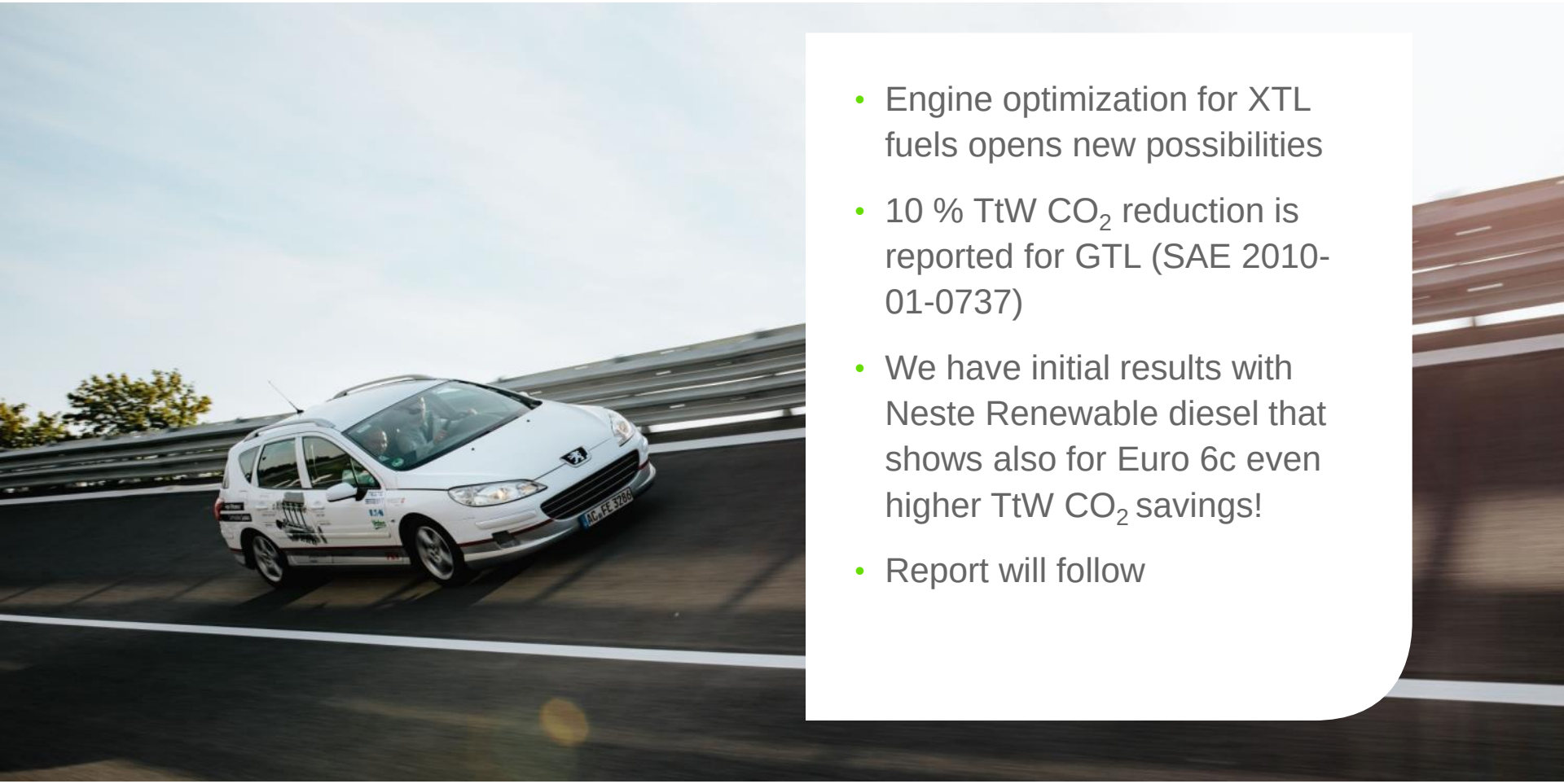
- **Helsinki bus fleet test**, 2007-2010, 300 vehicles of different makes and emission classes
- **DHL-Daimler-Stuttgart Public Transport**, 2008-2011, semitrailers, vans, buses, 3 million km
- **Scania 60 ton fuel tankers**, 300,000 km
- **Volvo- DHL-Renowa**, Euro V and Euro VI trucks in Sweden
- **Swebol Logistic**, Volvo and Scania trucks in Sweden

- **Commercial use of 100% NEXBTL started about 2 years ago**

- **Austria:** around 5000 vehicles run daily on NEXBTL (semitrailers, trucks, agricultural machinery, snow cats)
- **USA:** more than 5,000 vehicles (trucks, busses, construction machinery, i.e. for mines)
- **Sweden:** over 30 fleets with more than 1000 vehicles
- **Netherlands:** several fleet operations and free sales to end consumers as well as off-road
- **Finland:** Helsinki buses

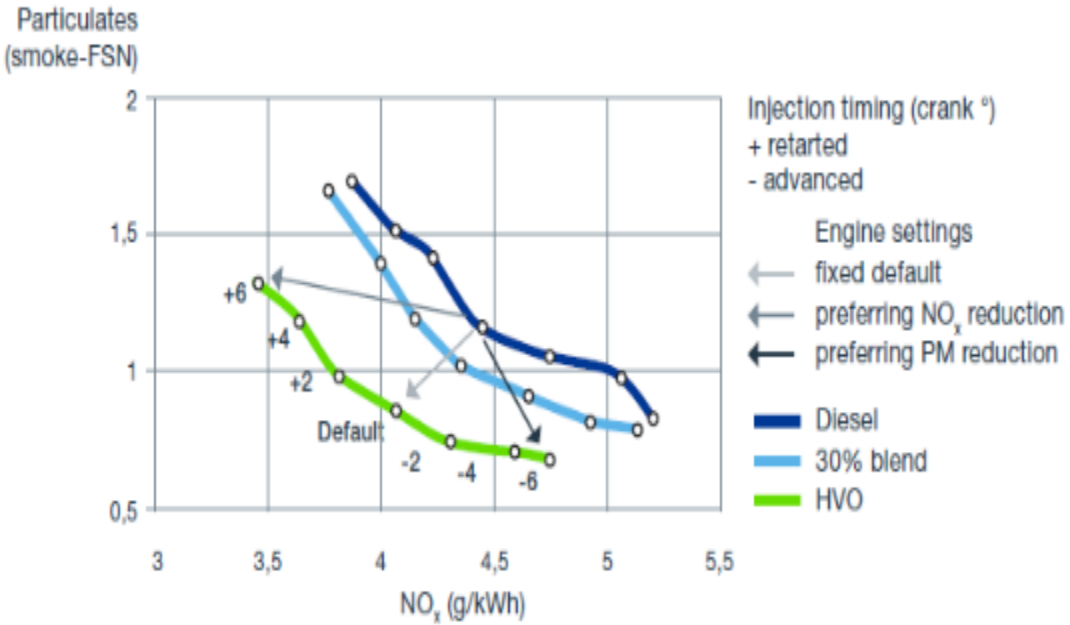
- **Reliable operations**
- **Similar service intervals**
- **Significantly reduced GHG and tailpipe emissions**

CO_2 reduction with XTL



- Engine optimization for XTL fuels opens new possibilities
- 10 % TtW CO_2 reduction is reported for GTL (SAE 2010-01-0737)
- We have initial results with Neste Renewable diesel that shows also for Euro 6c even higher TtW CO_2 savings!
- Report will follow

Fuel Plays a Role in Engine Out Emissions



- In 2008 a non road engine test at one speed and load shows
- That injection timing can be advanced about 4 deg with same NOx level
- Significant PM reduction
- When changing from EN590 to HVO

XTL in future mobility

EN 15940 Parafinic Diesel Plattform

WWFC Category V Field test experience and Euro VI approvals

Engine Optimisation brings significant efficiency gains!

Together with Bio Oxygen Componets Ultra clean Diesel Fuel Concept

ADVANCED FUEL FORMULATION APPROACH USING BLENDS OF PARAFFINIC AND OXYGENATED BIOFUELS: ANALYSIS OF EMISSION REDUCTION POTENTIAL IN A HIGH EFFICIENCY DIESEL COMBUSTION SYSTEM

Presenter:

Christian Castanien — NESTE US Inc.

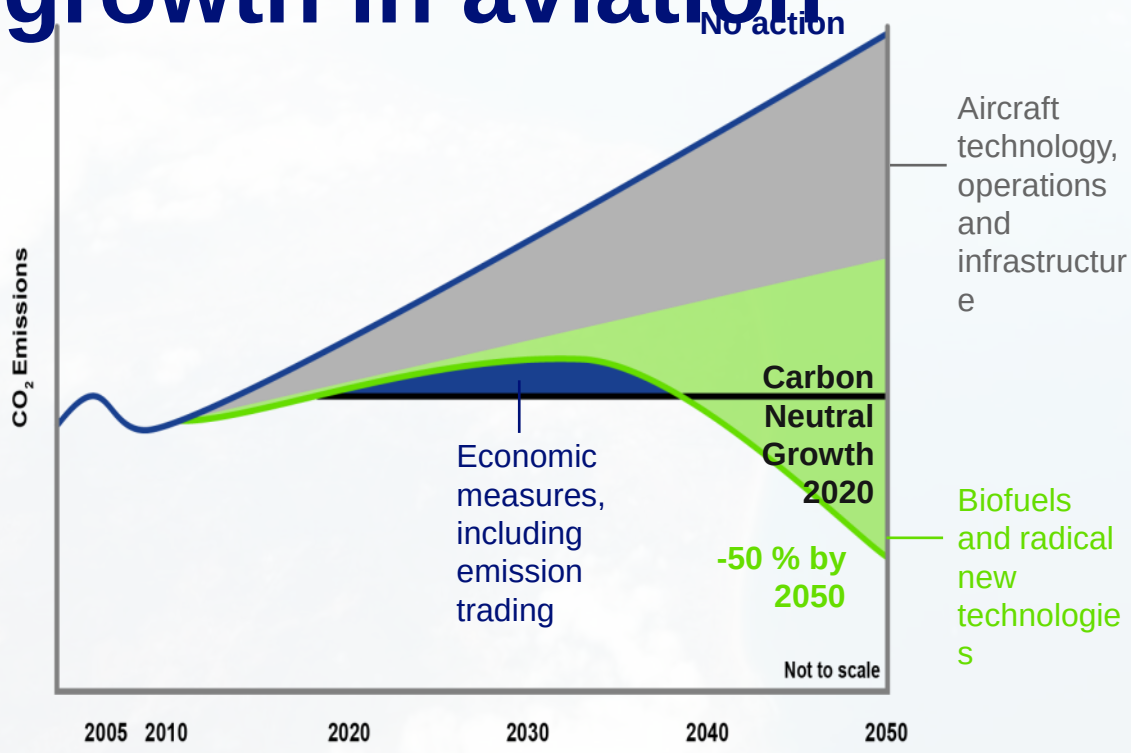
Author & Co-authors:

M. Zubel, B. Heuser — Institute for Combustion Engines, RWTH Aachen University, Germany

O.P. Bhardwaj, B. Holderbaum — FEV GmbH, Aachen, Germany

S. Doerr and J.Nuottimäki — NESTE Inc.

Renewable jet fuel is currently the only viable fuel solution for decarbonizing growth in aviation



Source: International Aviation Transport Association, *Technology Roadmap 4th Edition,* 2013

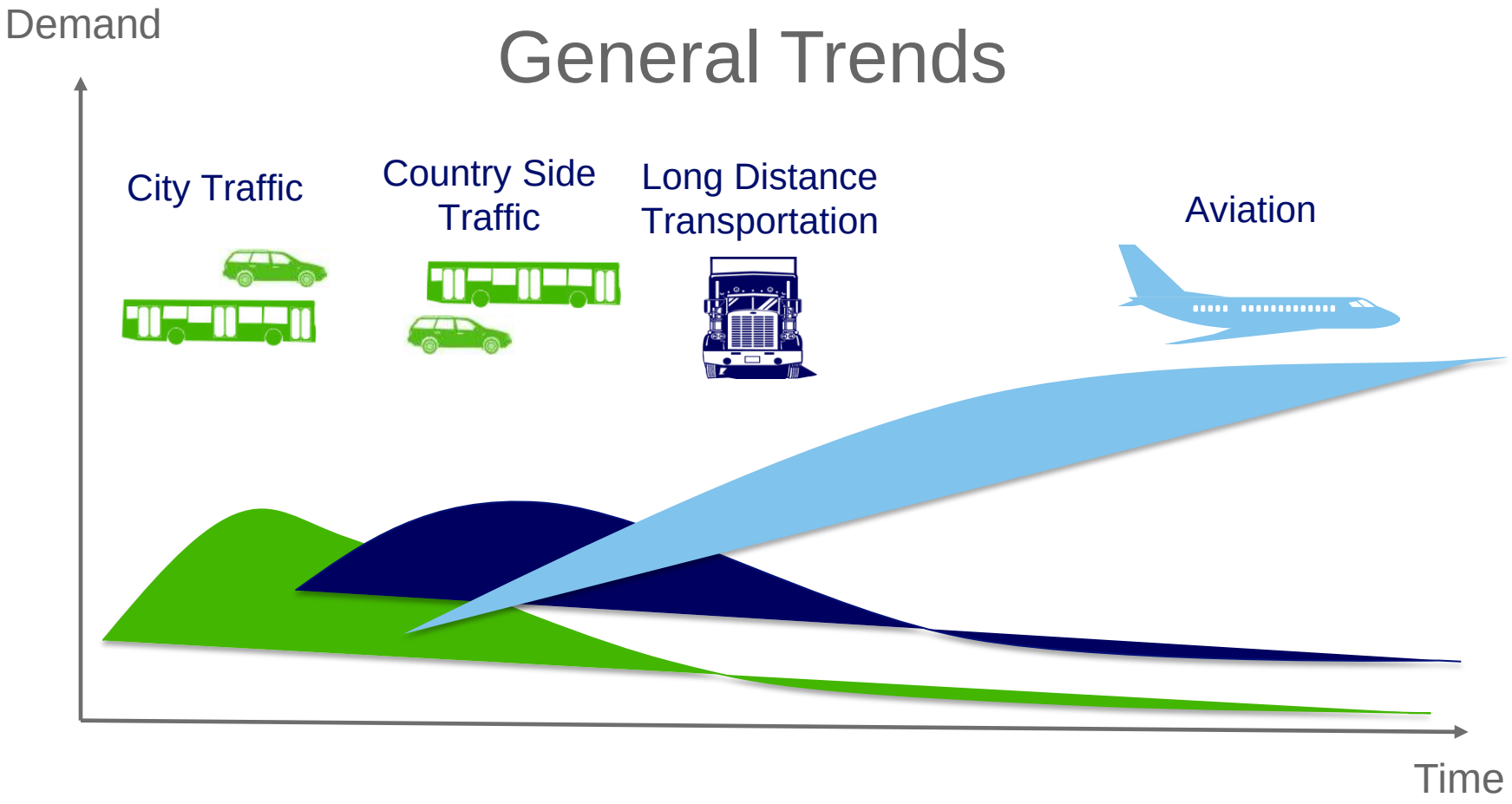
Did you know

> 30

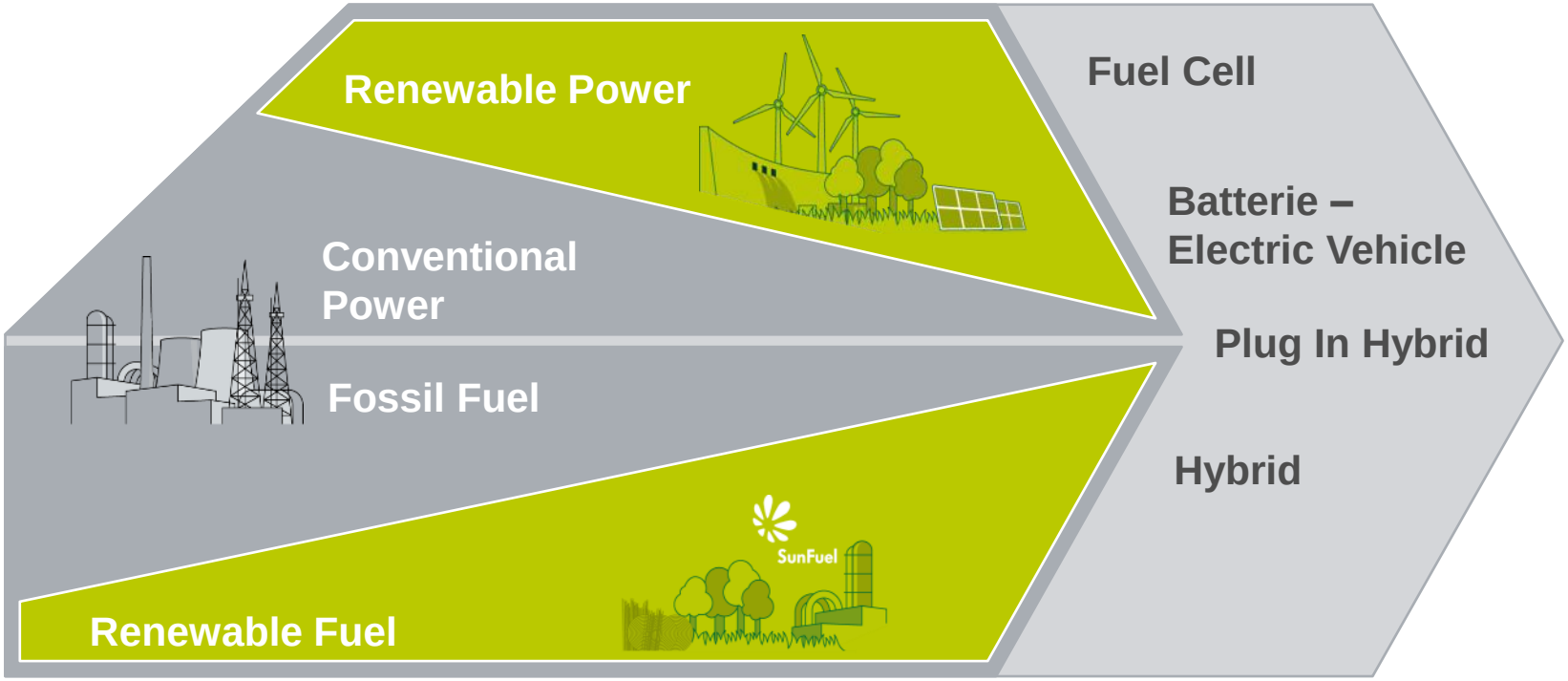
Airlines around the world have operated flights using renewable jet fuel

"We realized about seven years ago that the aviation industry needed to participate in energy source decisions and options, to ensure our industry's long-term growth and a more sustainable future. So Boeing decided to get involved in shaping the development of sustainable aviation biofuel."
- Boeing

xTL Demand over Time and Application



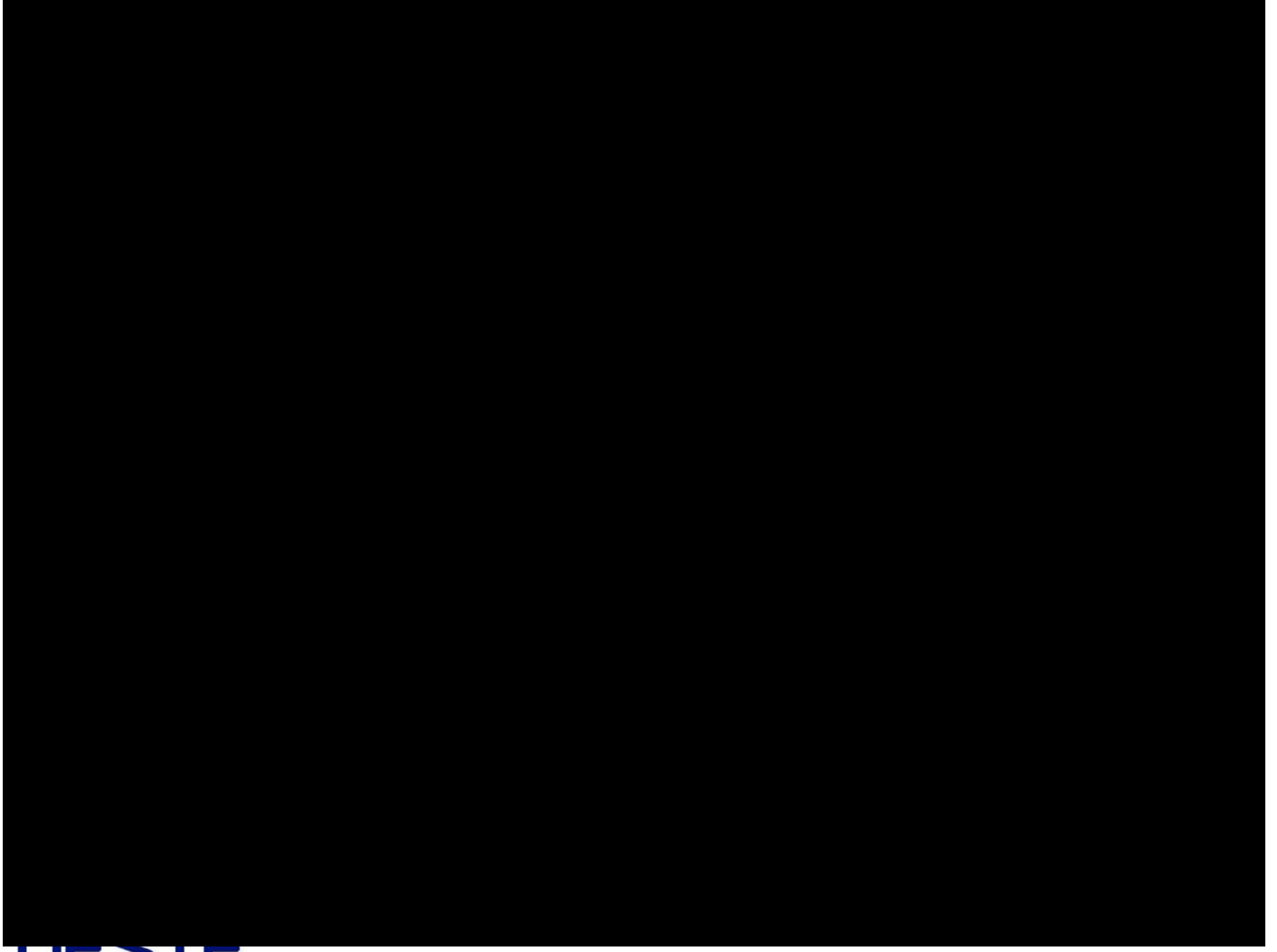
Decarbonisation Strategy



Decarbonisation needs all options:
E mobility as well as decarbonised clean fuels

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

NESTE



https://www.youtube.com/watch?v=ppNBtcOdH-I