Alternative feedstocks and technologies for advanced biofuels

RENEWABLE ENERGY IN TRANSPORT – Challenges and opportunities
Innopoli 2

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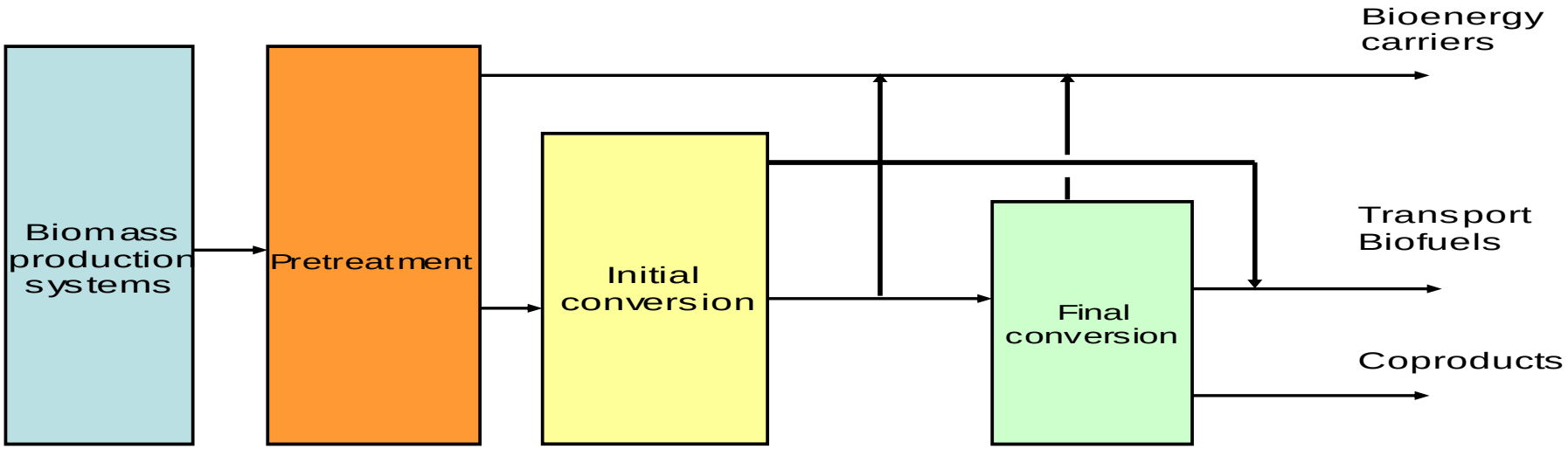
Criteria for advanced biofuels

Criteria issues

End users	**Compatibility = fit for purpose** **Affordability** **Socially acceptable**
Vehicle manufacturers	**Solid engineering design basis** **Availability** **Compatibility** **Helps to meet performance targets**
Distributors	**Compatibility** **Cost effective** **Value adding** **Socially acceptable**
Society / public authorities	**Safe** **Evironmentally & socially sustainable** **No health risks**
Suppliers	**Availability** **Evironmentally & socially sustainable** **Value creation** **Continuity**
Shareholders	**Returns = economically sustainable**

Biofuels value chain

Source: European Technology Platform for Biofuels



Bottleneck in supply, limited by availability, logistics, usability, price, sustainability

Technologies mostly **available**, not excessive CapEx

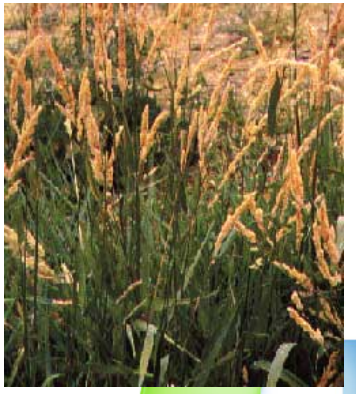
A **great number** of advanced biofuels technologies in making, high CapEx

Technologies mostly **available** and even **existing** capacity

Growing demand of **wide range** of **renewable** products

Feedstock potentials

Biomass Potential



Global biomass potential

	Million hectares globally	Ton/hectare yield	Million tons crude oil equivalent production 2007
1. existing crops (sugar cane, sugar beet, oil crops, wheat, maize, palm)	100-200	5-20	250-500
2. energy crops (Miscanthus, Reed canary grass, eucalyptus etc.)	200-400	15-20	1000-2000
3. agricultural wastes (straw, cornstover, bagasse, rice hulls, palm wastes)	300-600	5-15	700-2000
4. forestry wastes (sawdust, logging residues, black liquor)	100-200	10-20	500-800

Conclusion: **Many studies put potential at 2000-5000 Mtoe/a (some even much higher, BioFrac 2400 Mtoe)**

Compare: **Current global traffic fuel need ~ 2000 Million ton crude oil equivalent / year**

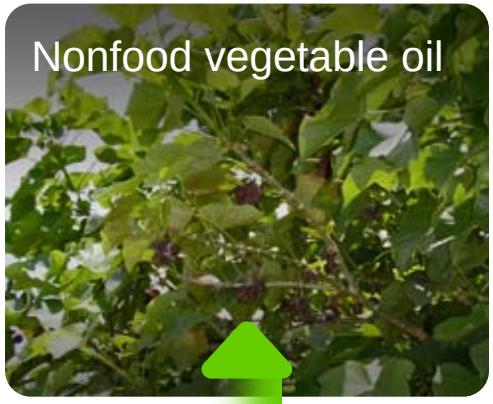
What is the GHG efficiency of each biomass resource?

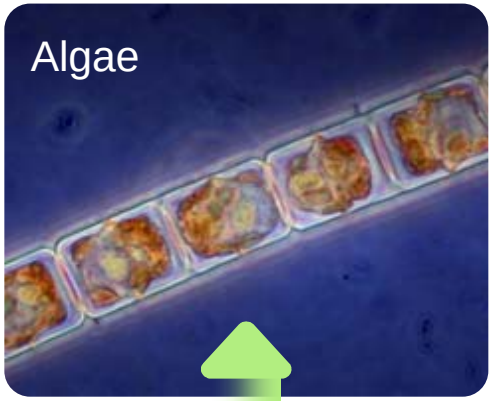
- Large variations in LCAs depending on many specific and geographical factors
- GHG lifecycle saving is expected to have a direct impact to the price level of each biofuel product
- Methodologies are yet unharmonized
- A lot of scientific knowledge and a lot of opinions in debate with undefined system boarders

Alternative feedstocks: get out from the food chain!

- **Food should not be used as fuel, but**
  - that is all we have currently
  - all feedstock should have equal treatment
- **Long-term solutions include**
  - use of non-edible vegetable oils (Jatropha, Castor etc.)
  - new feedstock as algae and bacteria
  - 3rd generation solutions (wood gasification FT etc.)
- **Extensive R&D needed**

Neste Oil's six research initiatives





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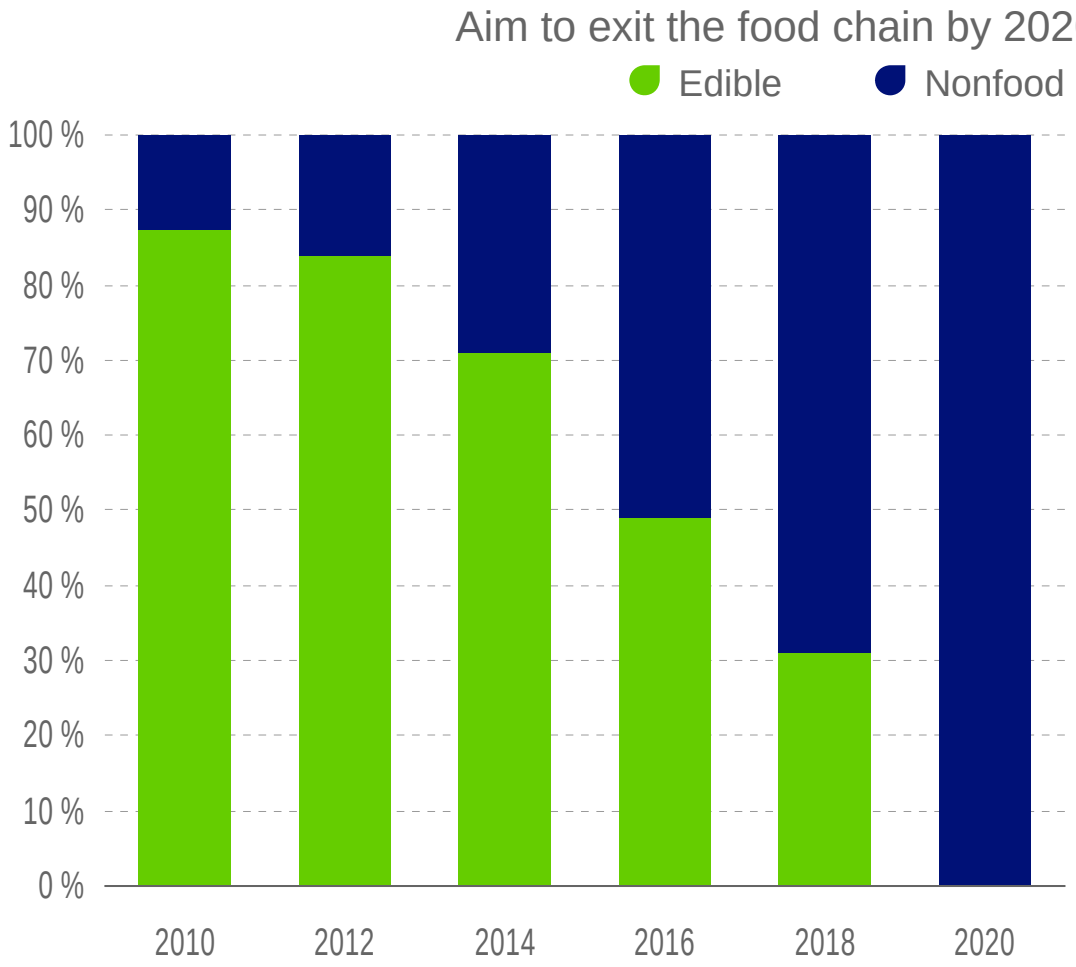
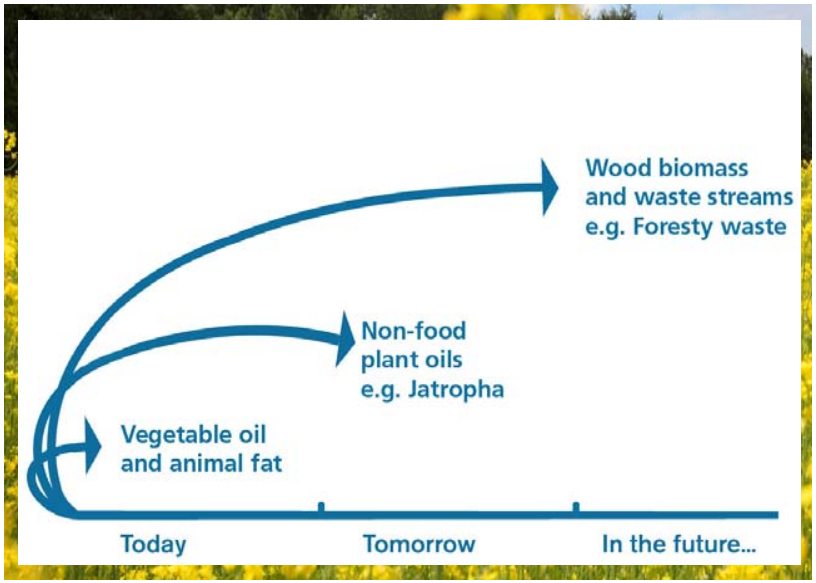
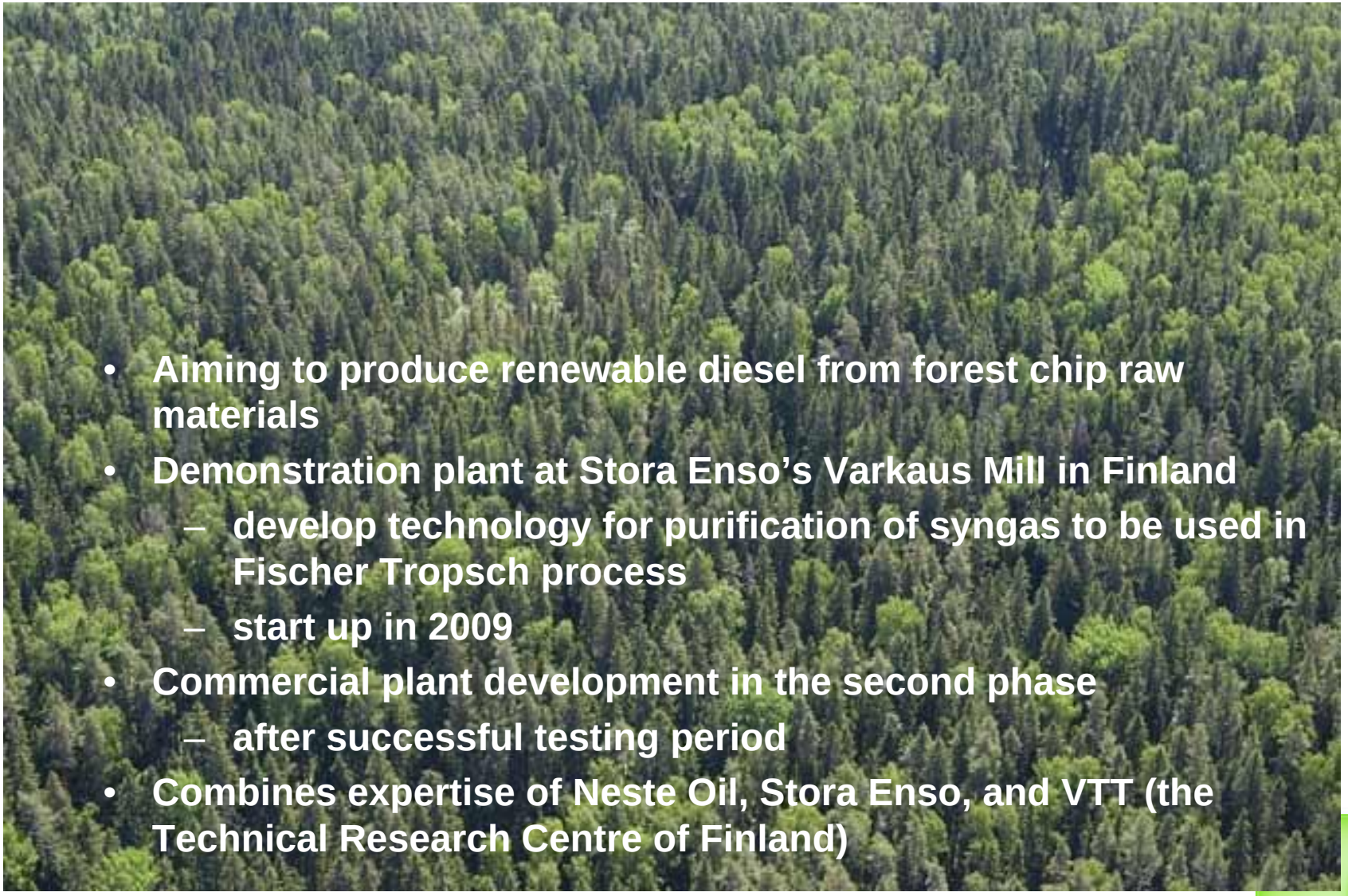
Neste Oil's use of edible and nonfood raw materials





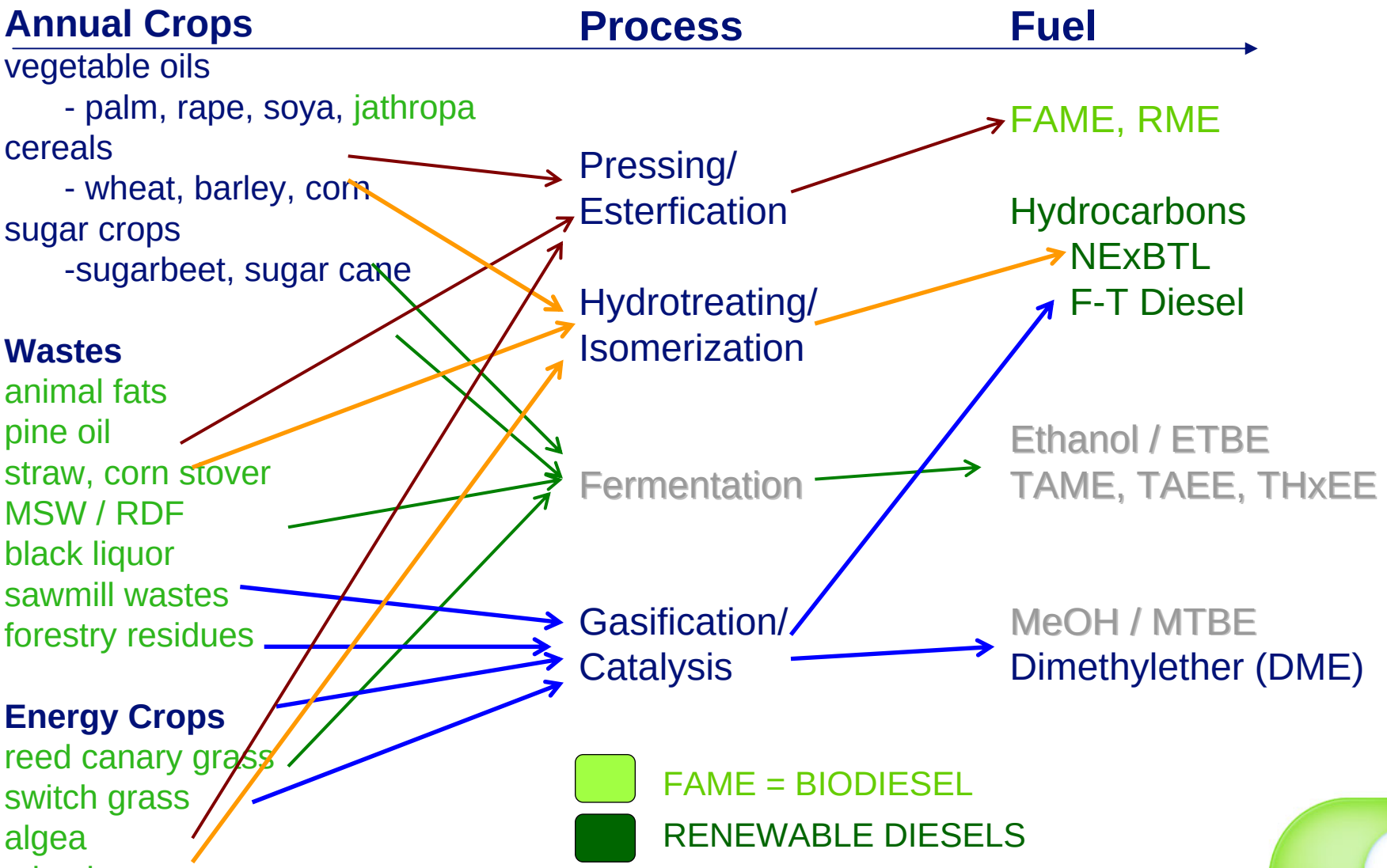
JV with Stora Enso to develop renewable diesel from wood-based raw materials



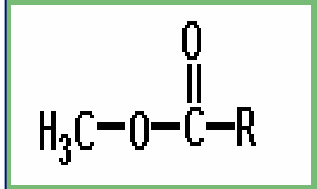
- Aiming to produce renewable diesel from forest chip raw materials
- Demonstration plant at Stora Enso's Varkaus Mill in Finland
  - develop technology for purification of syngas to be used in Fischer Tropsch process
  - start up in 2009
- Commercial plant development in the second phase
  - after successful testing period
- Combines expertise of Neste Oil, Stora Enso, and VTT (the Technical Research Centre of Finland)

Alternatives to make renewable fuel

Technology Options

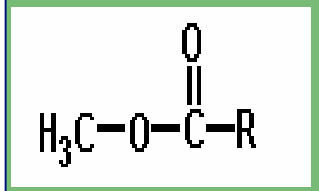


Alternative Fuel Options

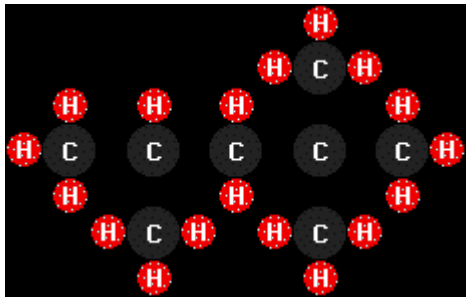
In	Mineral Oil	Natural gas Coal	Vegetable oils Animal fats	Vegetable oils Animal fats	Biomass
	Refining	Gasification Fischer-Tropsch	Esterification	Hydrotreating	Gasification Fischer-Tropsch
Out	Gasoline Jet Diesel	Gasoline Jet Diesel	FAME = Biodiesel	Renewable: Gasoline Jet Diesel	Renewable: Gasoline Jet Diesel
	C_nH_{2n+2} C_nH_{2n}	C_nH_{2n+2}		C_nH_{2n+2}	C_nH_{2n+2}
	Isoparaffins Aromatics Polyaromatics	Isoparaffins	Esters	Isoparaffins	Isoparaffins
	Commercial	Commercial	Commercial	Commercial by Neste Oil	Development phase (Choren, Neste Oil-StoraEnso etc.)

Alternative Fuel Options

Focusing in diesel capacity

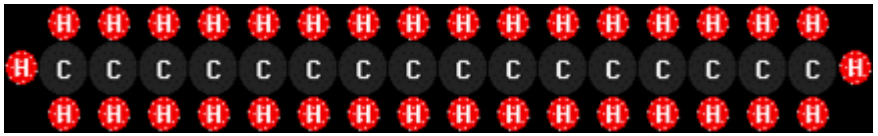
In	Mineral Oil	Natural gas Coal	Vegetable oils Animal fats	Vegetable oils Animal fats	Biomass
	Refining	Gasification Fischer-Tropsch	Esterification	Hydrotreating	Gasification Fischer-Tropsch
Out	Gasoline Jet Diesel	Gasoline Jet Diesel	FAME = Biodiesel	Gasoline Jet Diesel	Gasoline Jet Diesel
	C_nH_{2n+2} C_nH_{2n}	C_nH_{2n+2}		C_nH_{2n+2}	C_nH_{2n+2}
	Isoparaffins Aromatics Polyaromatics	Isoparaffins	Esters	Isoparaffins	Isoparaffins
CAPEX intensity	1	3 - 4	0,6	1	7 - 8

Pure hydrocarbon fuels



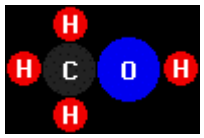
isooctane (C_8H_{18}), gasoline

C_nH_{2n+2}

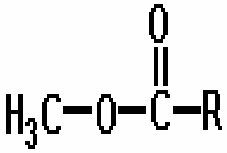


cetane ($C_{16}H_{34}$), diesel

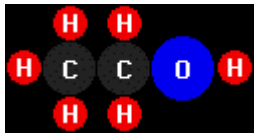
Fuels with oxygen atoms



methanol (CH_3OH)



FAME biodiesel



ethanol (C_2H_5OH)

Butanol (C_4H_7OH)

DME (C_2H_6O)

Alternative Fuel Options

In	Lignocellulosic biomass	Carbohydrates	Black liquour	Algea Microbes	Lignocellulosic biomass
	Pyrolysis Hydrogenation	Biochemical or catalytic conversion	Gasification Catalytic conversion	Hydrotreating	Biochemical conversion
Out	Gasoline Jet Diesel	Gasoline Jet Diesel	DME MeOH	Renewable: Gasoline Jet Diesel	Bioalcohols
	C_nH_{2n+2} C_nH_{2n} Isoparaffins Aromatics Polyaromatics	C_nH_{2n+2} C_nH_{2n} Isoparaffins	C_2H_6O CH_3OH Ether Alcohol	C_nH_{2n+2} Isoparaffins	EtOH BuOH Alcohols
	Development phase	Development phase	Development phase	Development phase	Development phase

Thank You!

The leading provider of cleaner traffic fuels

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