Roadmap sustainable biofuels for shipping

Which strategy to follow?

Loes Knotter

22 January, 2019
Fuels of the Future, Berlin

Key-take away message:

Biofuels are already a cost-competitive low carbon fuel option for shipping containing no (or only limited) sulpur.
However, a '**dedicated**' marine low carbon fuel has not yet been developed.

Design critera:

- Fuel on basis of extensive feedstock base
- Price competitive conversion
- Compatibility with existing engines
- New engines / new vessels have other options
- Biorefinery: multiple markets
- Development to e-Refinery and electrochemical fuels

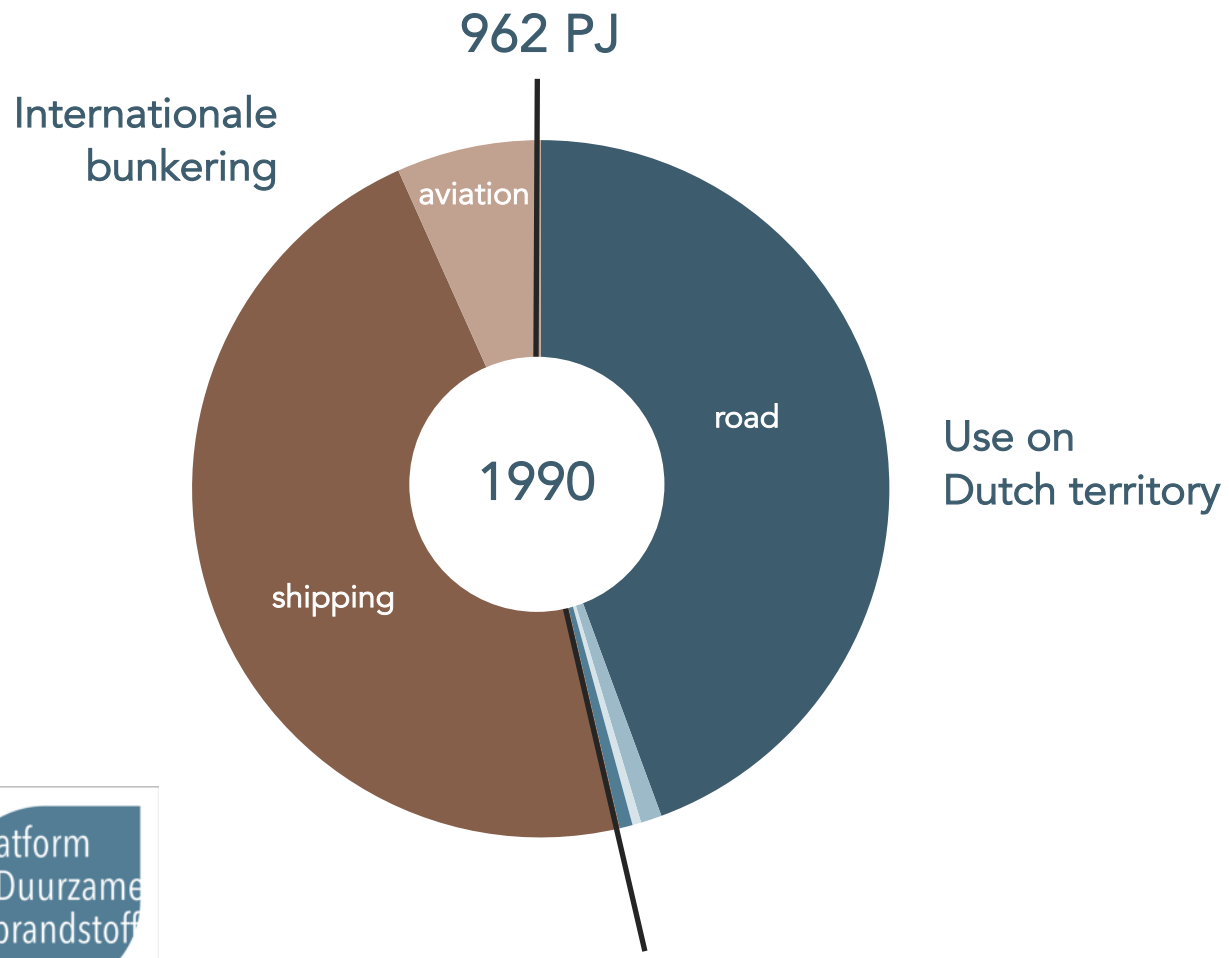
Platform Duurzame Biobrandstoff

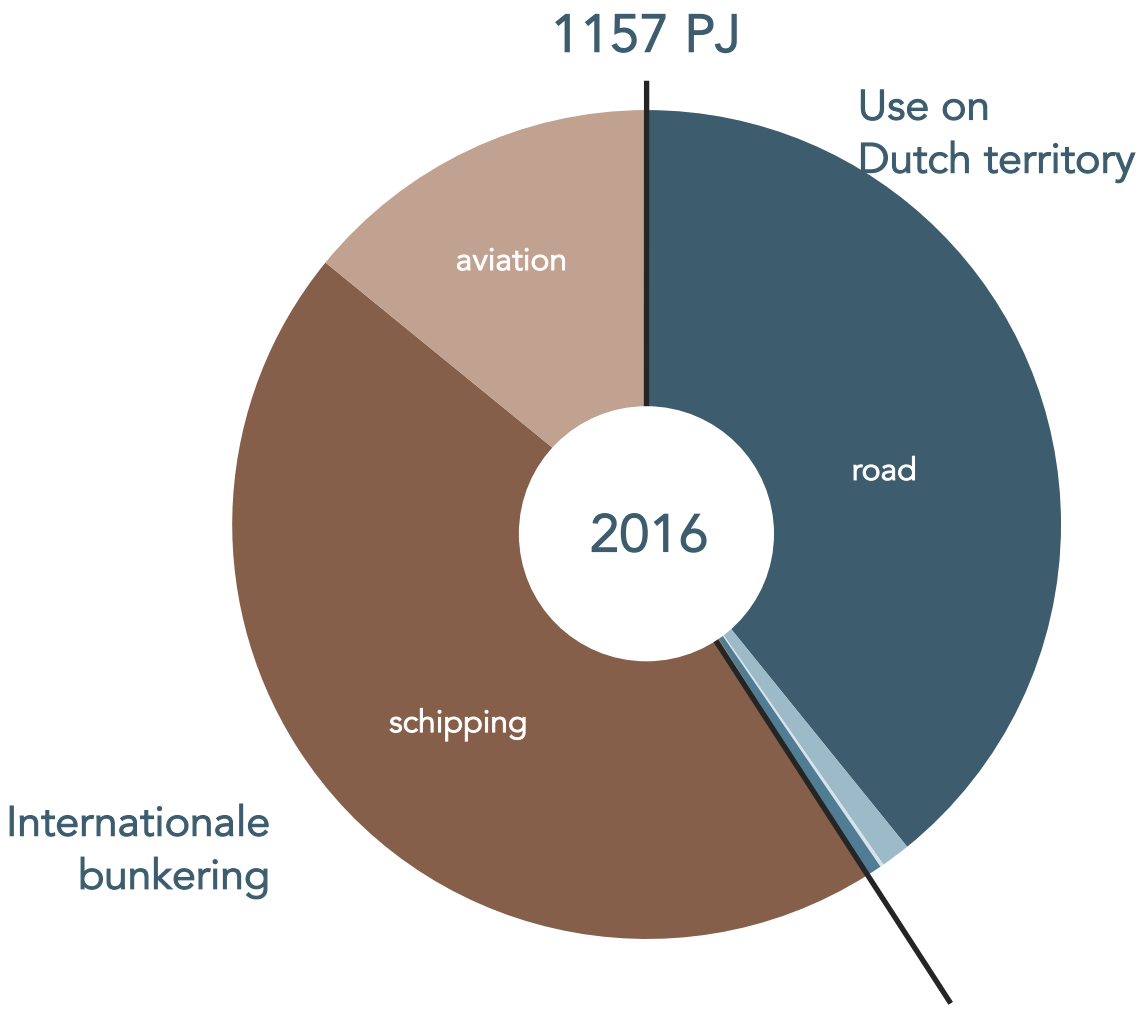
Netherlands Platform Sustainable Biofuels

- Independent knowledge and innovation platform on all biofuels and renewable fuels
- Initiated partly financed by the NL Ministry of Infrastructure and Water Management
- An association of sector players,
- Founded October 2016

- Mission: stimulating demand and deployment of renewable fuels and their production

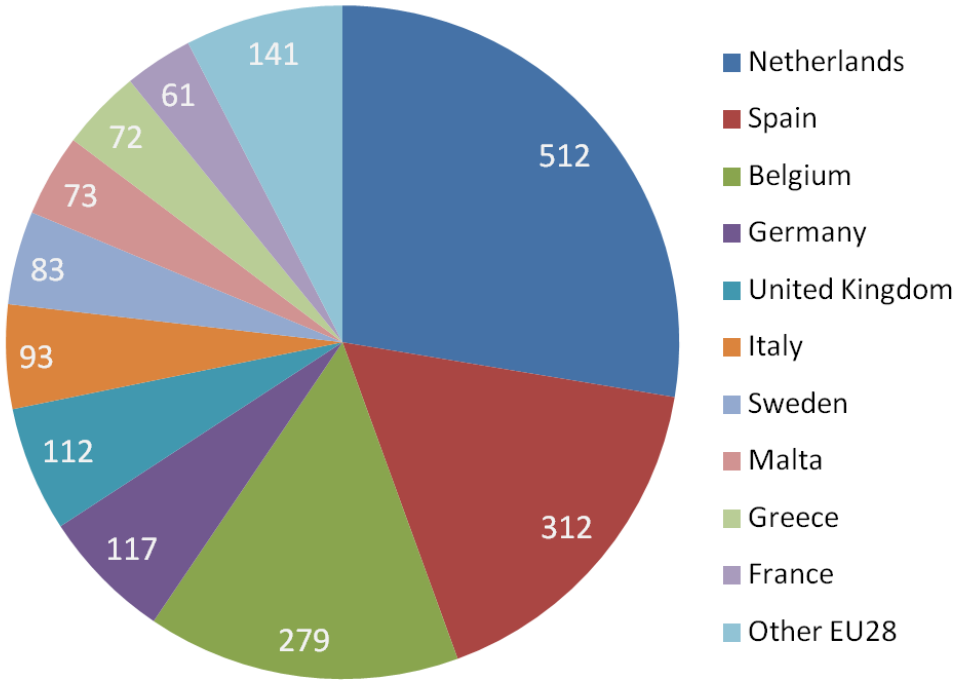
NL International bunkering outnumbers the transport fuels on Dutch territory





Source: CBS Statistic Netherlands

Energy in the EU international shipping sector



	Netherlands		EU	
Sector	Int. shipping	Road & Rail	Int. shipping	Road & Rail
Energy use (PJ)	512 PJ	415 PJ	1849 PJ	8830 PJ
CO2 emissions (mln tCO2-eq)	40,5	29,4	147	890

Source: Eurostat: (data for 2016)

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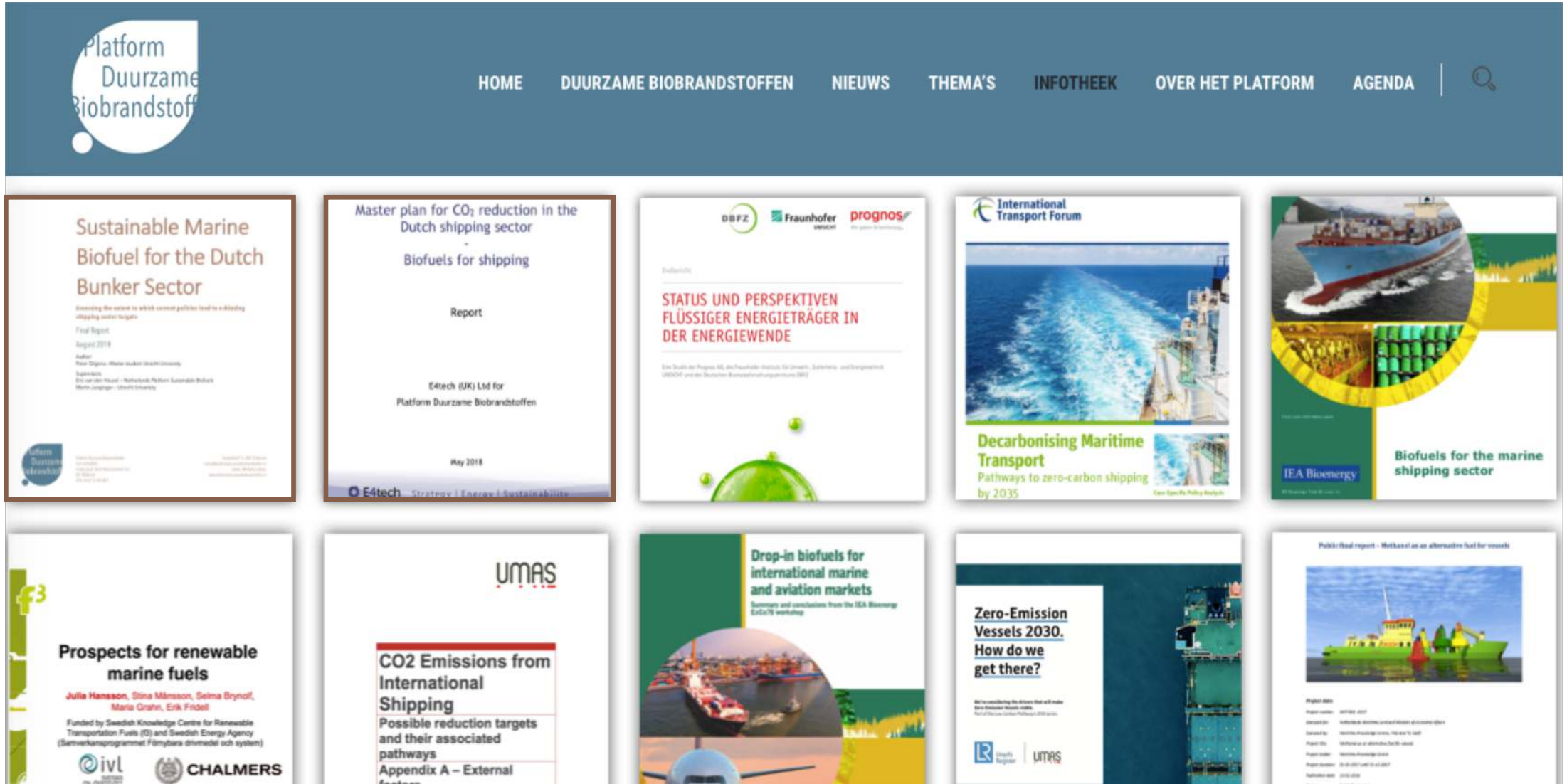
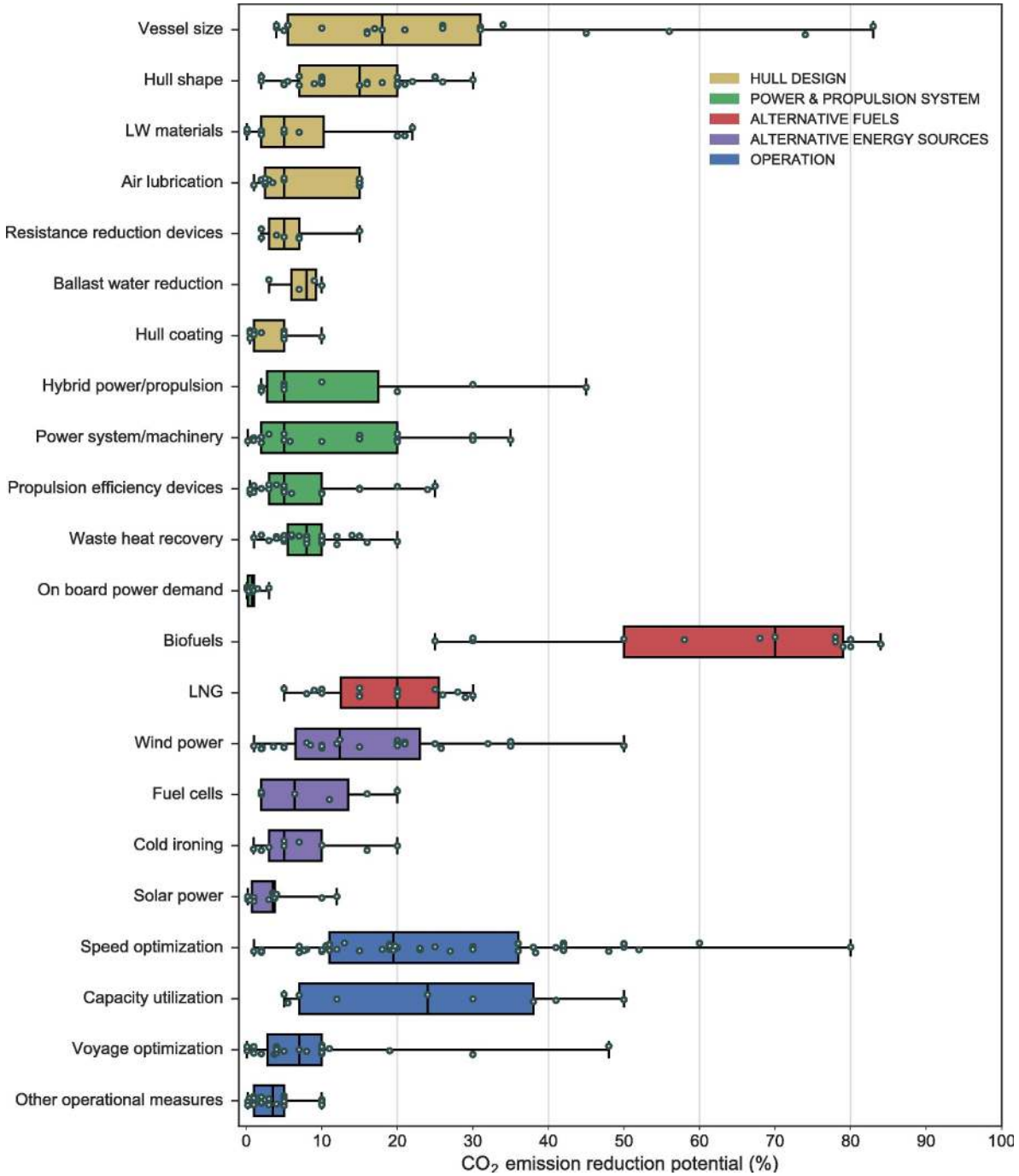
Two recent Platform publications

www.platformduurzamebiobrandstoffen.nl/infotheek



Shipping CO_2 emission reduction potential from individual measures

A recent review of around 150 studies by Bouman et al (2017) pointed to biofuels as having the highest CO_2 emissions reduction potential, compared to other energy efficiency and alternative fuel options.



Source: Bouman et al (2017

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E4tech evaluation of biofuel options for shipping

Table 4-1: Biofuel evaluation criteria for decarbonisation in shipping

Indicator	Readiness of fuel production	Compatibility with current engine and vessel (typical to sector type)	GHG reduction potential
	Established and used widely, readily available and fully developed.	No modification to engine or infrastructure - Drop in fuel or high blends	>90% GHG savings
	Commercially available but not in wide use, could be further developed.	Considerable changes to engine, fueling system and/or storage/infrastructure, or low blends	60-90% GHG savings
	Working demonstration plant	New vessel required	<60% GHG savings

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Biofuels based on waste oils and fats

1

- All the advantages of drop-in
- Main barrier: limitations on feedstocks
- HVO - compatible with engines, commercial production
- SVO – compatibility with deep sea engines, modifactions necessary for use in short-sea and inland shipping vessels
- FAME/ biodiesel – commercially available and widely used and more suitable for use in diesel engines than SVO
  - ISO 8217 – versus statement Wärtsila

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GoodFuels brings bio-MGO / bio-HFO to the market

Alcohols: ethanol/methanol (DME)

2

- Global availability (ethanol / methanol)
- Potential extensive feedstock base, including e-methanol
- Substantial barrier: incompatibility with existing engines/ infrastructure
- For new vessels: methanol/ DME-vessel is a lower cost option than LNG-vessel

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With the Methanol Institute we work on operational aspects of methanol infrastructure in ports

bio-LNG/bio-CNG

3

- For LNG-vessels bio-LNG is an interesting biofuel option
- The same applies for bio-CNG, however more proof of concept is necessary according to E4tech. It sees the CNG-option more suitable in short sea and inland shipping

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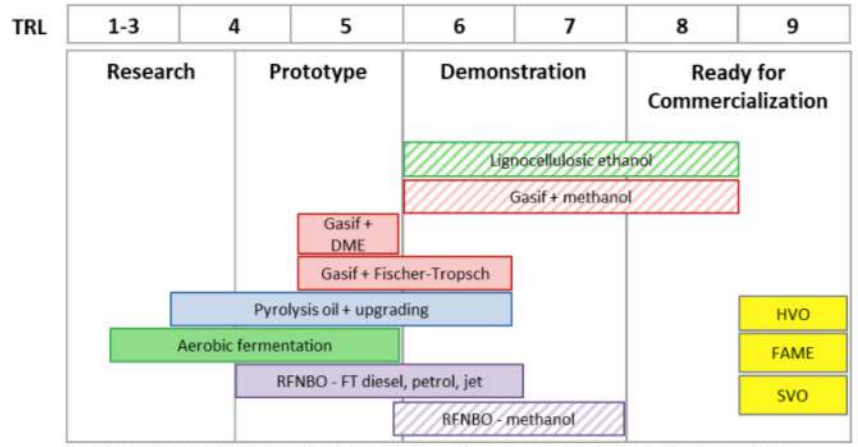
New options FT Diesel / Upgraded Pyrolysis Oil

4

- Drop-in capabilities and extensive feedstock base
- Further technology developments required
- In theory, it is possible to produce any intermediary between crude and fully upgraded pyrolysis oil to produce a suitable (cost-competive) fuel for particular engines, but this would require detailed testing with an engine manufacturer.



Colours represent the principle conversion process, hydrolysis (green), pyrolysis (blue), hydrothermal liquefaction (grey), gasification (red), oil-based (yellow), and non-biogenic routes (purple). Shaded boxes refer to oxygenated fuels. Boxes with block colours represent non-oxygenated fuels

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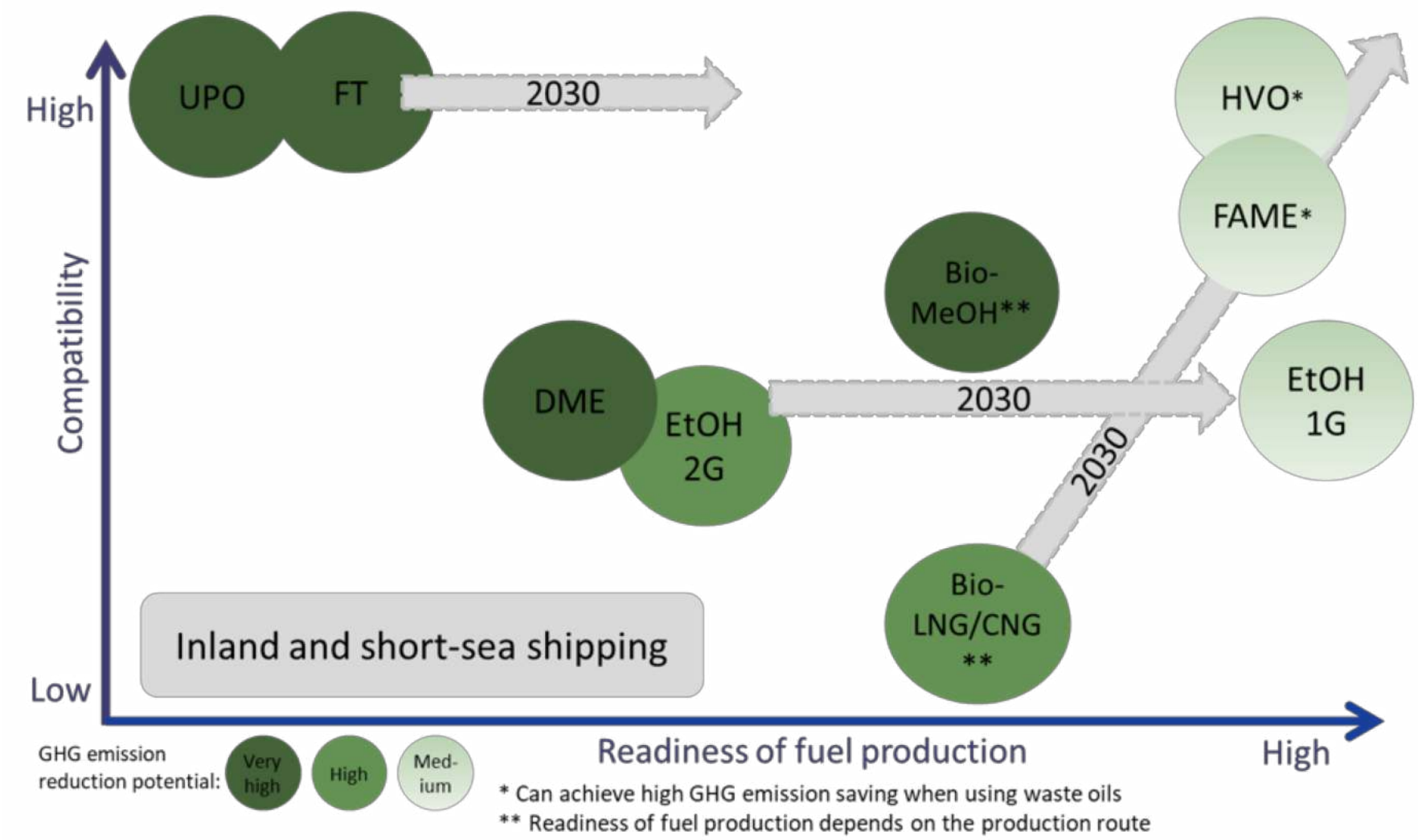
Biofuel options for inland shipping



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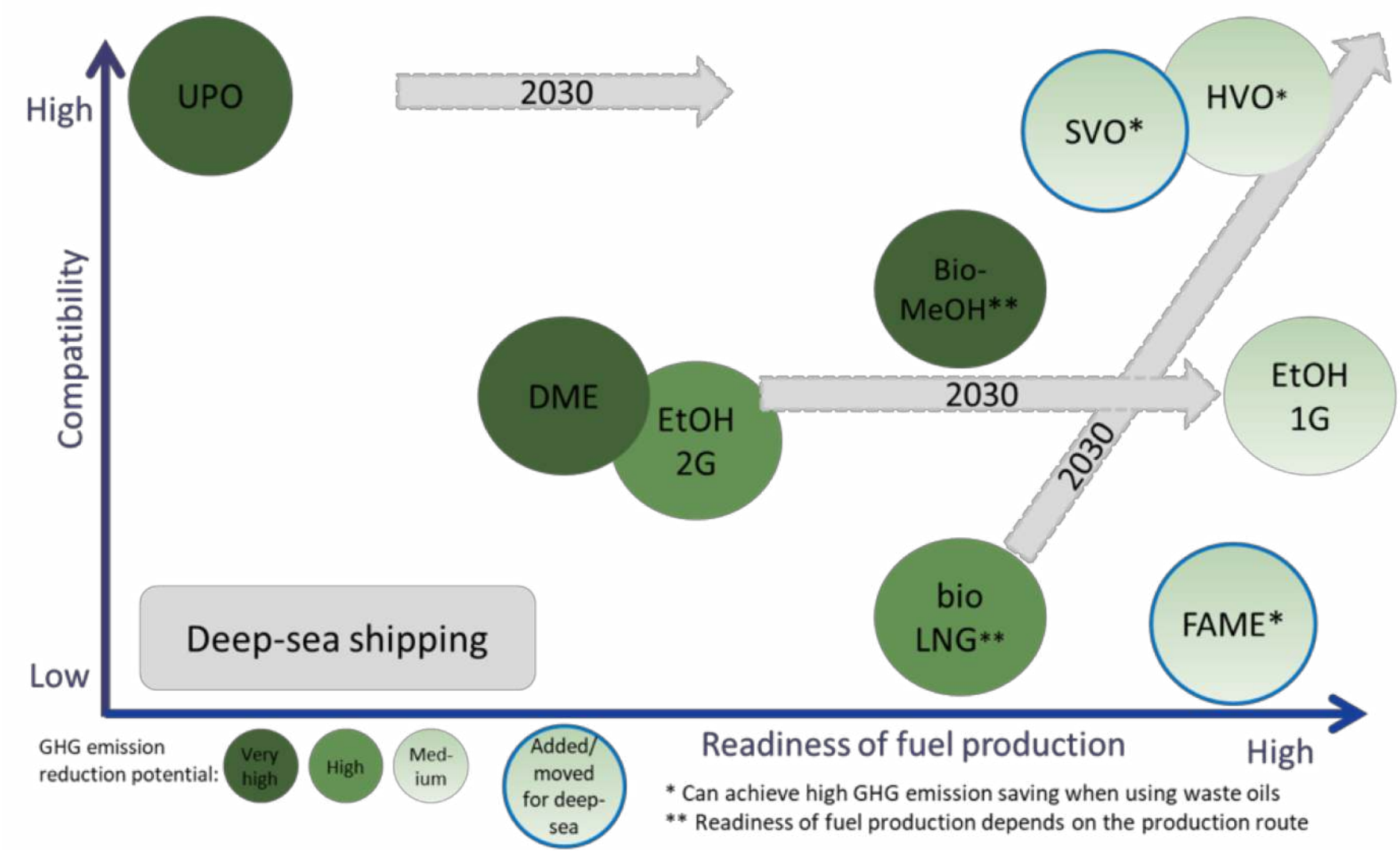
Biofuel options for deep-sea shipping



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Comparing GHG-reduction potential

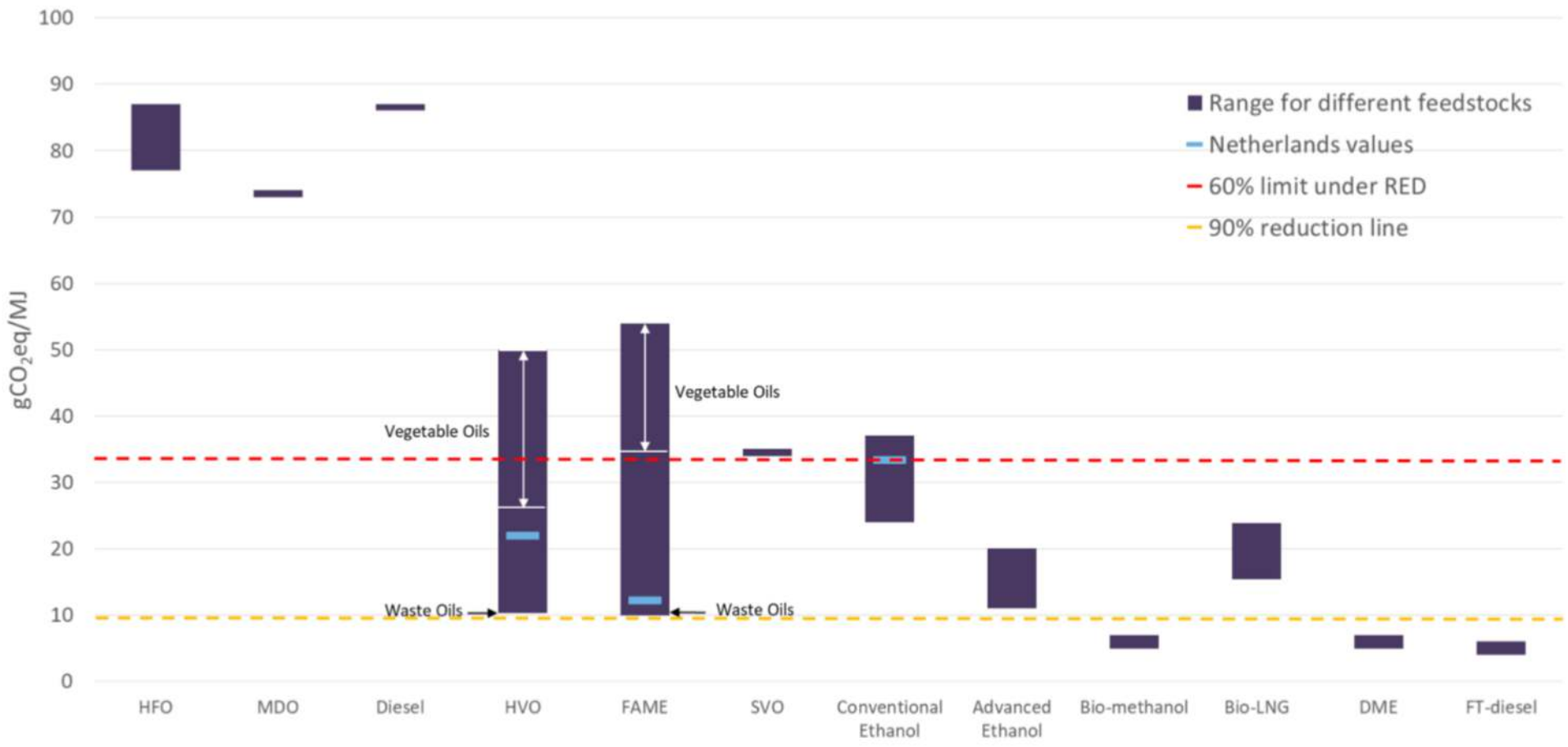

Figure 4-2: GHG emission factors for marine fuels and selected biofuels[220,221,222,223]

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Comparing prices

Figure 4-3: Prices and production costs of marine fuels and selected biofuels. Prices are in light purple and production cost estimates in dark purple[225,226].

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How to get bio and renewable fuels to the international shipping market?

- Nothing so practical as (international) legislation
- IMO GHG Reduction target -50% by 2050. Demand from the shipping sector incentivates availability. (start already uptake of low carbon fuels in the short-term and mid-term measures)
- Missed opportunity for not connecting GHG reduction ambition with Sulphur regulation
- Dutch inland shipping sector is proposing a 30% GHG-reduction target by 2030 in national implementation of Red 2
- RED 2: 1,2 multiplier for shipping

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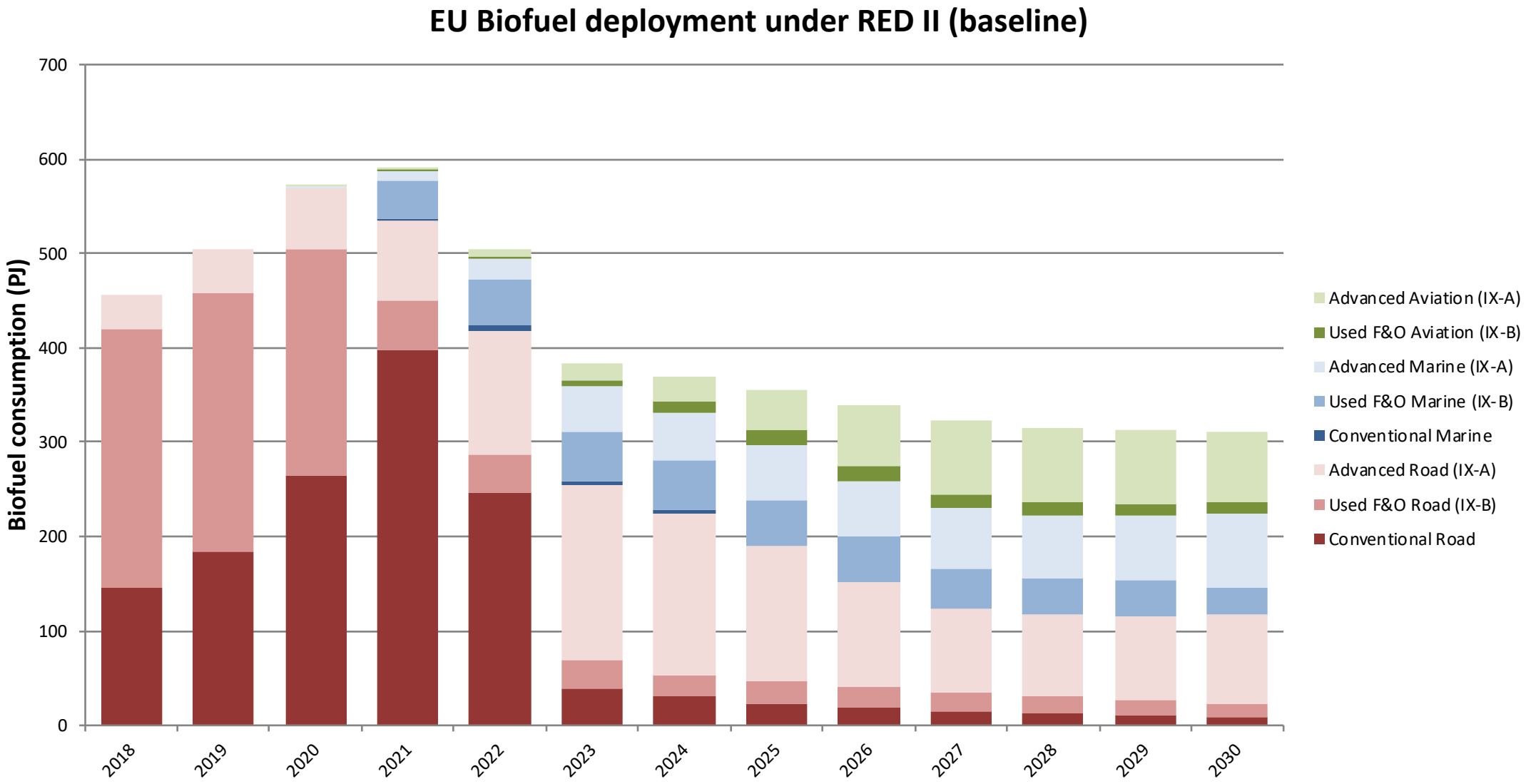
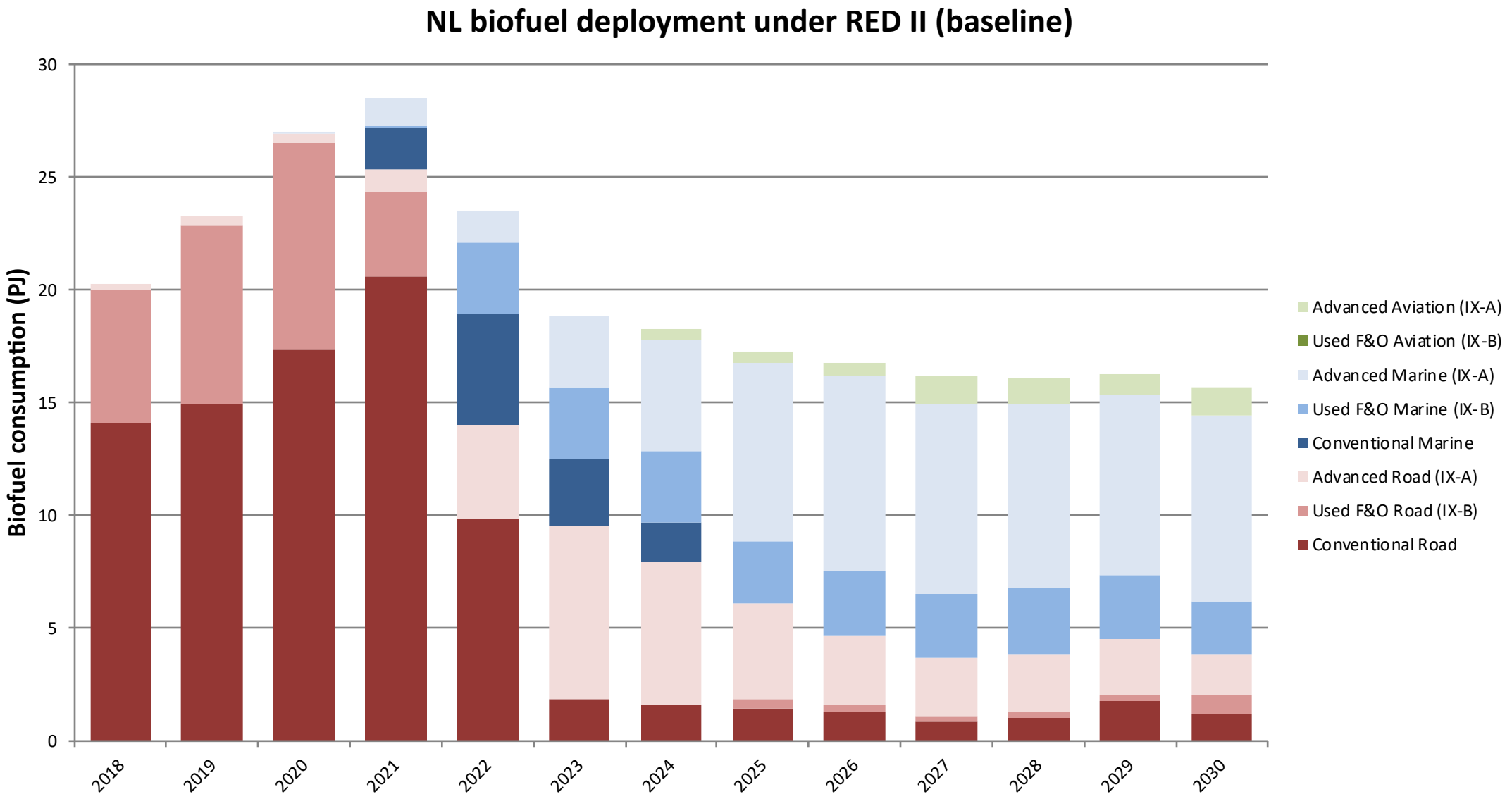
Competition for biofuels between transport sectors, EU



Source: Grijpma, 2018

Competition for biofuels between transport sectors, the Netherlands



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Source: Grijpma, 2018

Market segmentation

GoodFuels Marine

GoodFuels Marine is pioneer and global market leader for marine biofuels.

Segment	Purchase drivers
Dredging & offshore wind	Green public procurement
Government	National GHG targets and energy security
Port authorities & harbor services	Exemplary role model, air quality, regulation, inherent drivers
Pax transport	Green public procurement (ferries), passenger demands & port access (cruise)
Inland waterways	Air quality regulation, CO_2 ambitions of cargo owners
Ocean freight	CO_2 ambitions of cargo owners
Boating & yachting	Port's green reputation, air quality regulation & intrinsic motivation of boat owners

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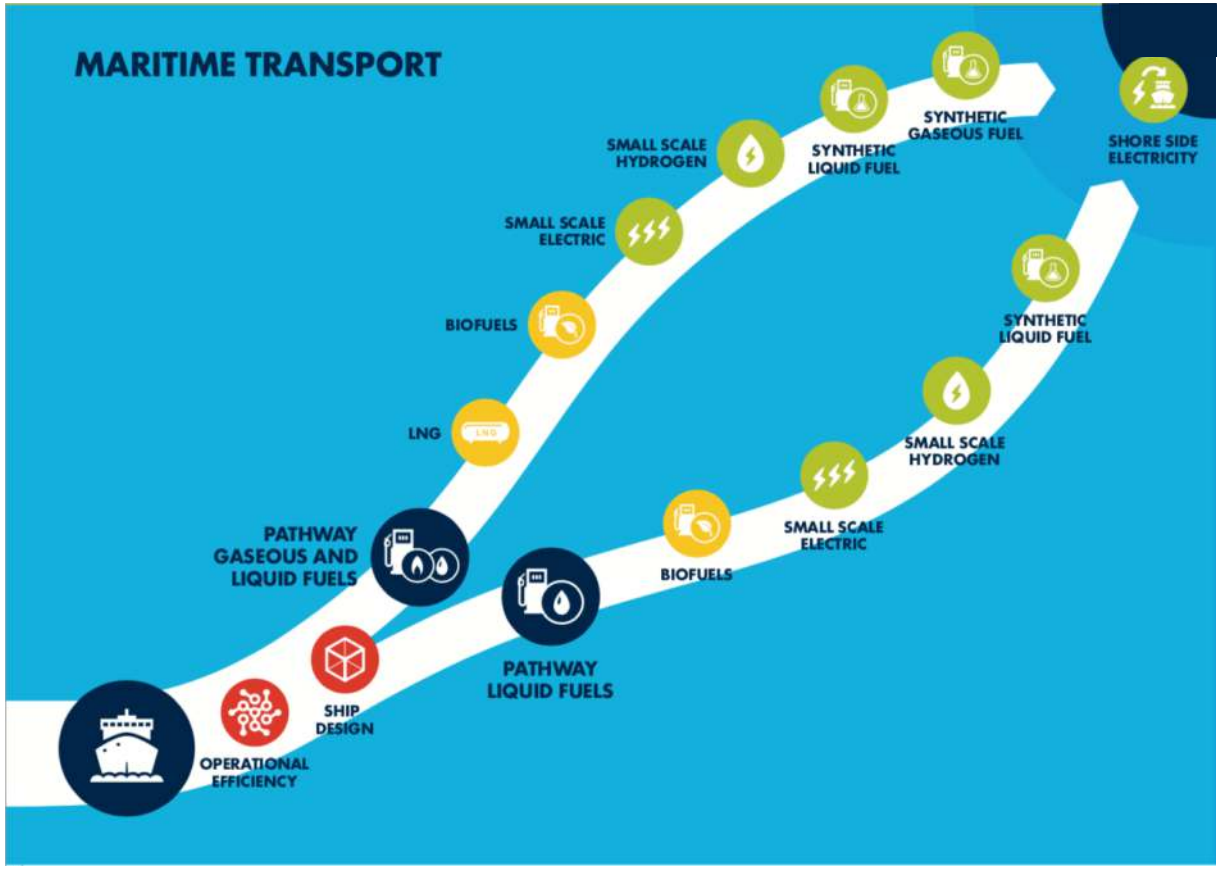
GoodFuels

Port of Rotterdam (PoR) energy transition programme

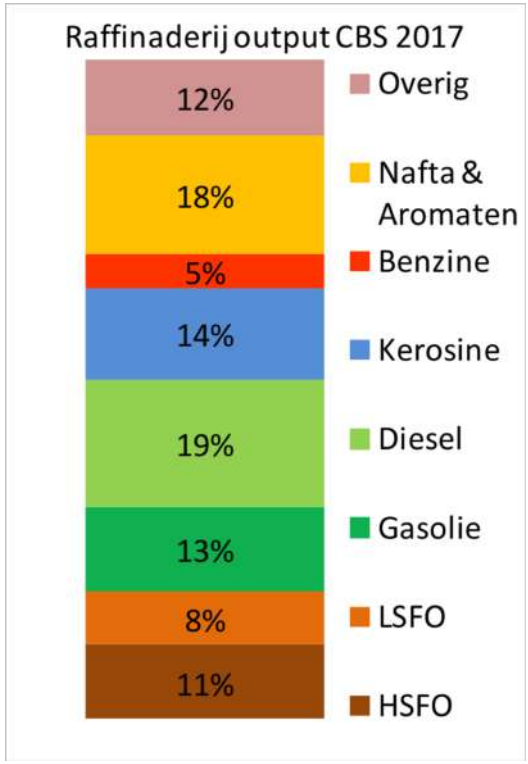


- Advocacy for alternative fuels
  - Dutch National policy: input green deal martime sector / implementation RED2
  - EU (RED2)
  - IMO (MEPC - short term GHG measures)
  - World Ports Carbon Action Programma (international collaboration also on alternative fuels)

- PoR funding for demonstration Low Carbon Fuels in sea-going vessels. (€5 million 2019 – 2022) Launch Jan 2019

- Low Carbon Trade Lanes
  - Developing alternative fuel supply in partnerships on important seagoing trade lanes.

The transition for the NL petrochemical complex



Dutch refinery output in 2017

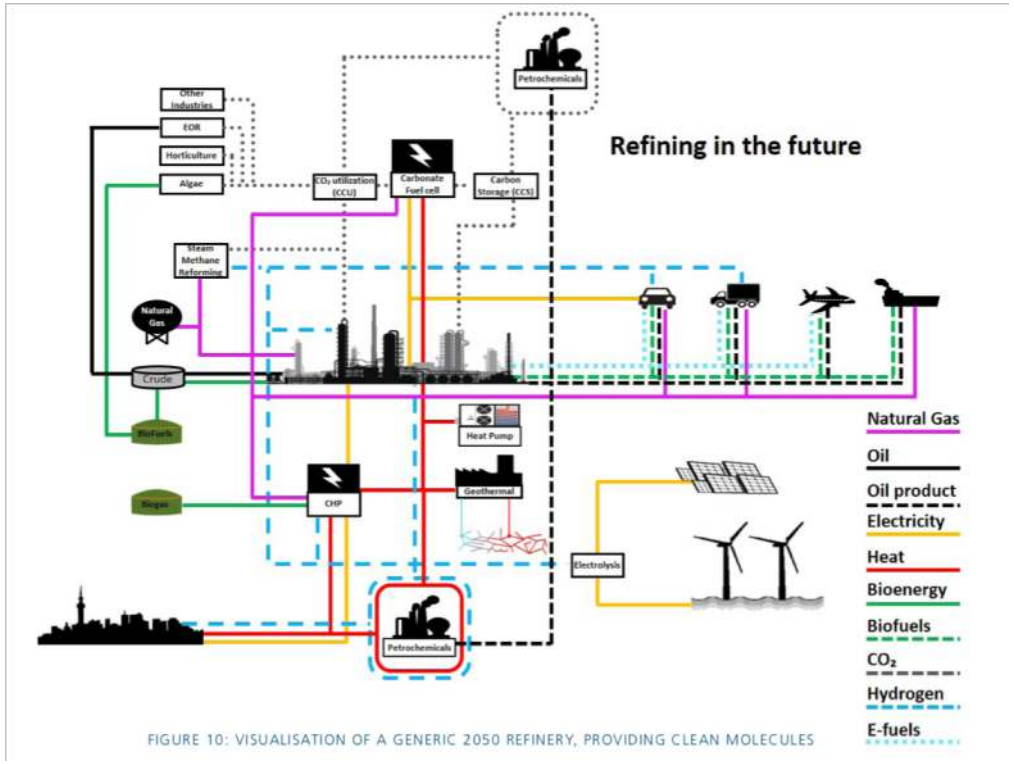


FIGURE 10: VISUALISATION OF A GENERIC 2050 REFINERY, PROVIDING CLEAN MOLECULES

Clingendael International Energy Programme (CIEP) (2018)
Refinery 2050 Refining the clean molecule

Bio-refinery to maximise added value: co-producing bio-chemicals/materials and energy

SUSTAINABLE BIOFUELS TECHNOLOGY LAB

ECN › TNO innovation for life

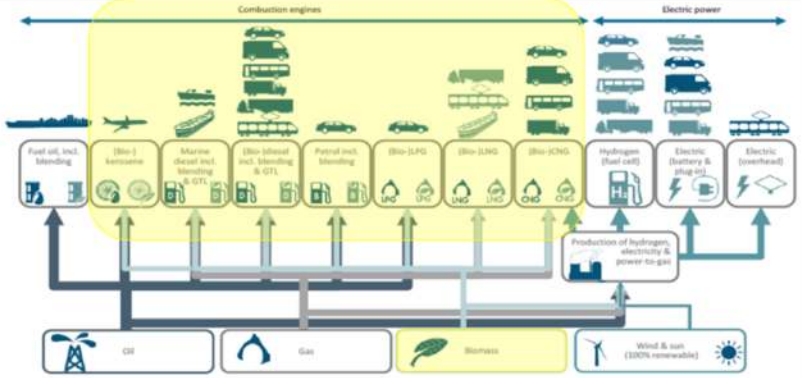
From gasification-based and biorefinery-based biofuel concepts to large-scale implementation of biofuels in all transport segments

- Create two strong biofuels development platforms by expanding existing gasification and bio-refinery infrastructure with the key options to produce biofuels
- Create sustainable alternatives for the Dutch fuel and chemical industry
- Ensure close cooperation with industry, universities, TO2's (e.g. engine labs) and with national initiatives such as the expertise center for biomass gasification InVesta and Biorizon

From: A vision on Sustainable fuels for transport (SER vision program), 2014

Activities

- Gasification and (Organosolv) fractionation-based biorefining
- Bio-LNG production
- Fischer-Tropsch (FT) biofuel production
- Methanol biofuel production
- Bio-ethanol/Bio-butanol fuel production
- Novel furanics based fuel components
- Bio-heavy fuel oil production
- Cost reduction through co-production



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What's on the Roadmap Agenda:

- Address technical, economic and operational barriers to the use of biofuels in shipping

- Develop dedicated marine low-carbon biofuels taking into account:
  - Access to resources
  - Dedicated technology development for cost-competitive marine engine-fuel conversion
  - Development of bio-refinery / e-refinery business cases

- Dutch government intends 200 million EUR support for refineries for renewable fuel production (to be deployed in NL)

More information?

www.platformduurzamebiobrandstoffen.nl

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