FUTURE AMBITIONS FOR LIQUID TRANSPORTATION FUELS

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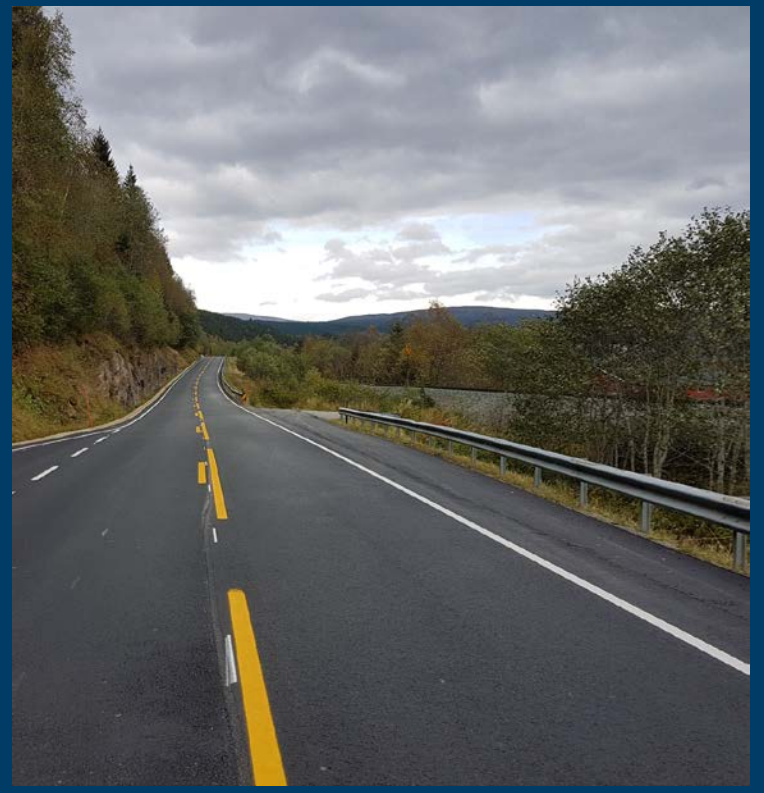
Outline

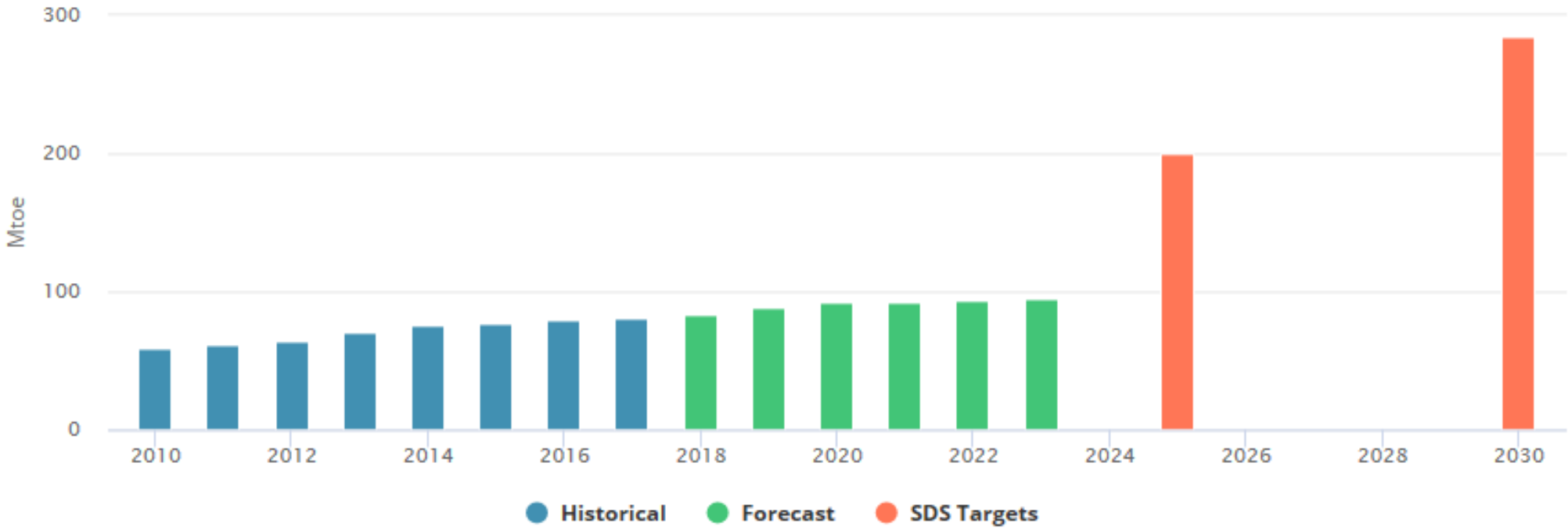


- Global overview of status and ambitions for biofuels
- Status in Europe
- Biofuels' importance in the different transport segments
- Competition for biomass and biofuels
- Conclusions – Is it realistic?

Global status

Global biofuels production and targets - IEA

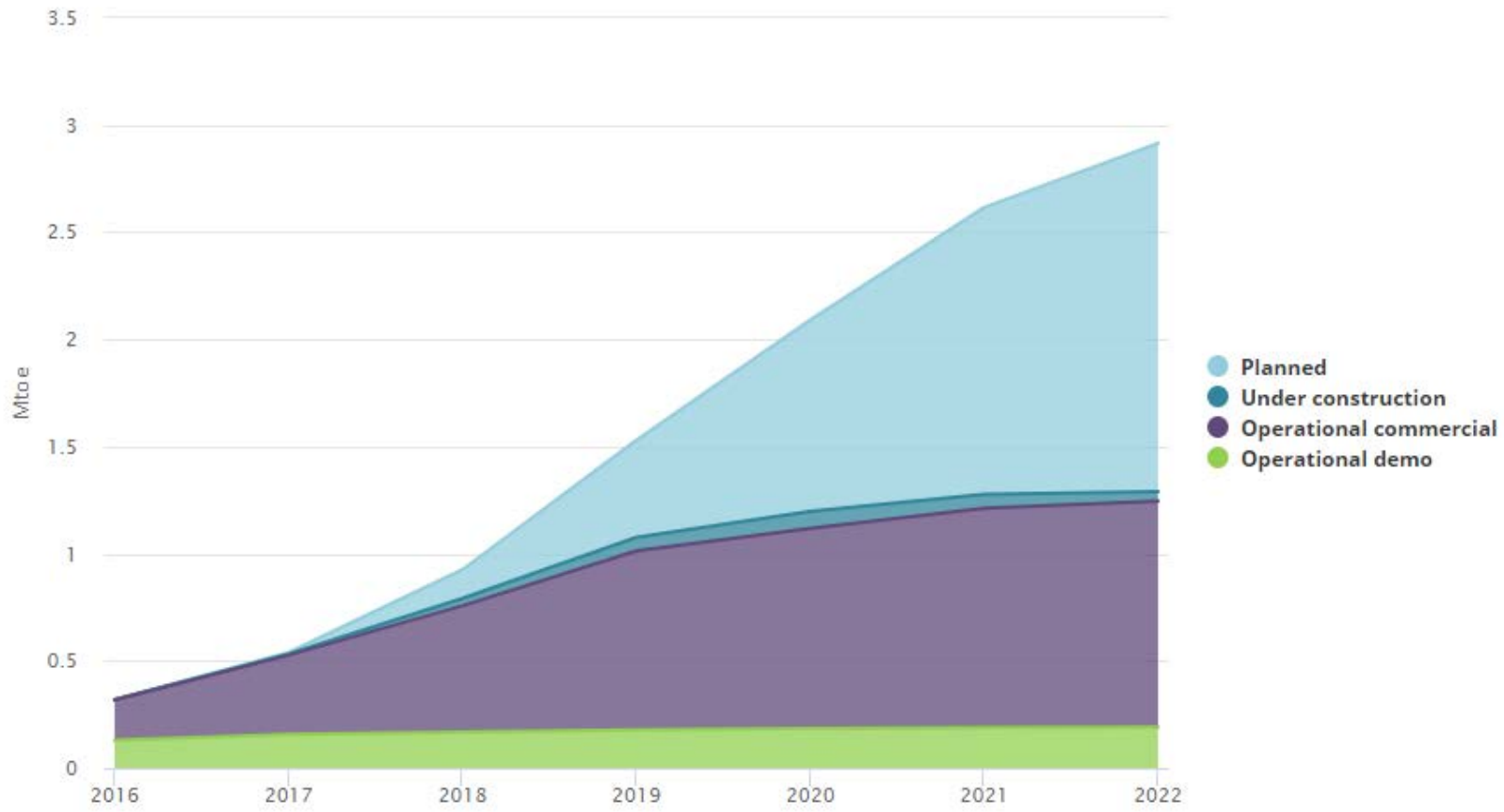
- Current global biofuels consumption: 81 Mtoe (2017) – 3% of the fuel demand
- 2030 Sustainable Development Scenario (SDS) target: 251 Mtoe – 10% of the fuel demand



Source: IEA, http://www.iea.org/tcep/transport/biofuels/

Consumption and production of biofuels – Will the target be reached?

- Average growth in biofuels consumption is predicted to 3%/y
- Limited growth prediction for Europe
- Advanced biofuels production predictions →
- Advanced biofuels production can reach 1.4 Mtoe (2 billion liters) in 2020.



Source: IEA, http://www.iea.org/tcep/transport/biofuels/

IEA's conclusions

- The growth in biofuels consumption is too low, 3% predicted vs the necessary 10%
- Greater use of biofuels in marine and aviation sectors is required
- Greater use of biofuels globally is required
- Scale-up is needed for advanced biofuels production – a significant technology shift is required
- Higher blend levels are favorable – flexi-fuel vehicles or drop in fuels
- Strong policy interest towards advanced biofuels, but it needs to improve. Advanced biofuels quotas as well as financial de-risking mechanisms are needed

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Source: IEA, http://www.iea.org/tcep/transport/biofuels/

Status in Europe

RED II

- Formal approval is expected under the Austrian Council presidency until the end of the year. Once adopted, the Member States will have 18 months to transpose RED II into national legislation.
- Specific transport target of 14 % (including electricity)
- Crop-based biofuels will be capped at a maximum level of 7% (or 2020 level, whichever lowest), high iLUC potential biofuels phase out will be implemented.
- One mandate for the advanced biofuels will be set at 0.2 % in 2022 which will rise up to at least 3.5%by 2030 (including double counting).
- Multipliers will be used: 1.2 for aviation, 1.5 for rail and 4.0 for electricity in EV's.
- Re-evaluation in 2023

Status in Europe

- All transport modes consumed 359 Mtoe in EU-28 in 2015
- Current (2017) biofuels consumption is 10.5 Mtoe in EU-28
- RED II sets a target of up to 50 Mtoe biofuels consumed in Europe (14%)

Where will the biofuels come from?

- Conventional biofuels will be capped at 7% but there is only a slight 0.2 → 3.5% ambition for advanced biofuels.
- No production support, only consumption quotas
- No proposal for other incentives or supporting mechanisms than quotas

Biofuels status in Norway

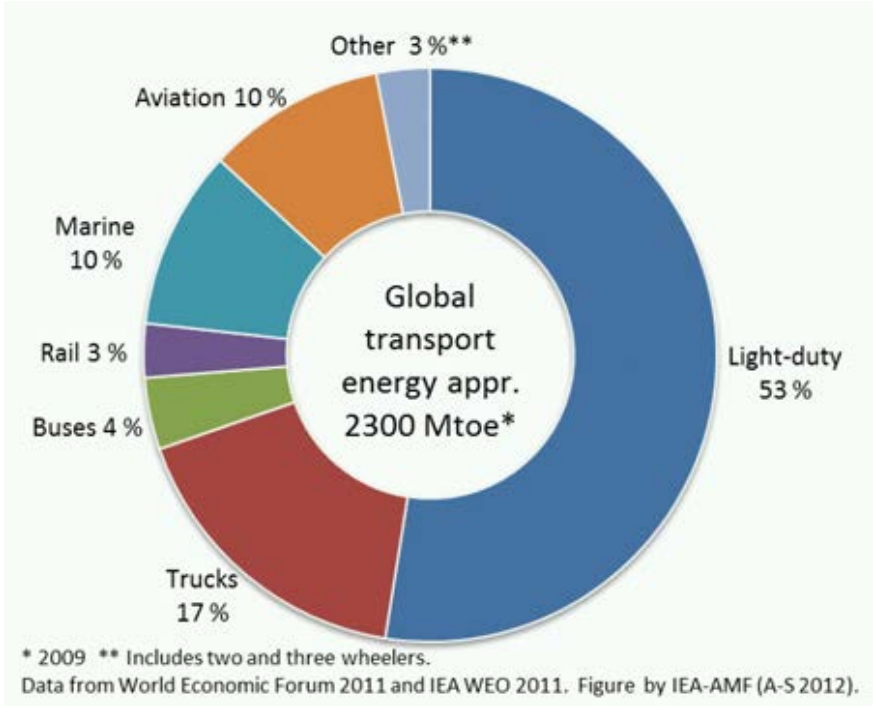
- The Norwegian blending obligation is currently 10 % biofuels, of which 3.5% is advanced biofuels (double counted). Increasing to 20% with 8 % advanced by 2020.
- For aviation, 1% biofuels share is proposed from 2019 increasing to 30% by 2030. Investigations are ongoing for requirements for fuels used in the marine and construction sectors.

- The share of biofuels has increased from 423 mill L liter to 659 mill L in 2017, 19% which is well above the current requirements.
- The use of biofuels had a CO_2 reduction of 1.6 mill tons (16%) from road transportation
- The share of advanced biofuels increased from 60 mill L to 138 mill L (6.6 % advanced biofuels share)
- Norway used huge amounts of (certified) palm oil-based biofuels. Discussions are ongoing regarding the use of palm oil. The government investigates whether Norway can ban palm oil without conflicts with the EEA agreement.

Biofuels' importance in the different transport segments

Transportation segments and their dependencies on biofuels

- Road transportation
  - Relatively well regulated. Largest biofuel consumer.
  - Light weight and passenger cars have alternatives (EV, FCEV, NG, BioNG, etc.)
  - Heavy duty segment is dependent on fuels with high energy density, alternative engine technology is an option
- Aviation
  - Few alternatives. Dependent on high-energy density drop-in and certified fuels
- Marine
  - Some alternatives. Local fleets, ferries and smaller boats can be electrified
  - LNG is increasing
  - International shipping is dependent on high-energy density drop-in and certified fuels
- Construction machinery
  - Temporary installations with few alternatives



Source: ETIP Bioenergy/AMF

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Aviation

- Goal: cut CO_2 emissions in half by 2050 (relative to 2005 levels) carbon-neutral growth from 2020
- The ICAO vision: 128 million tons of biofuels by 2040 (32% replacement), 285 million tons (50%) by 2050.
- European Advanced Biofuels Flightpath target: 2 million tons aviation fuels (0.04%) in 2020
- CORSIA - Carbon Offsetting Scheme for International Aviation
  - 2019 – start emission monitoring, 2021 start offsetting
- Certified aviation biofuels:
  - Hydrogenated Esters and Fatty Acids (HEFA) ← most widespread but limited availability
  - Alcohol to Jet Synthetic Paraffinice Kerosene (ATJ-SPK) – sugar feedstock currently
  - Renewable Synthesized Iso-Paraffinic (SIP) fuel (renewable farnesane hydrocarbon) – sugar feedstock
  - Fischer-Tropsch (FT) based on biomass (FT-SPK, with and without aromatics)

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Source: ICAO, IATA

Marine shipping

- The international maritime sector is currently not covered by any regulatory framework on GHG emissions
- The International Maritime Organization (IMO) aims to reduce GHG emissions by at least 50% by 2050 compared with a 2008 baseline (April '18)
- The first uptakes will be around ports with strict emission controls (Western Europe, the Nordics, and the North American west coast)
- Deep sea shipping needs biofuels in large quantities at a competitive price (or by global mandate)
- Shift to a different marine propulsion (large-scale) in the near-midterm future seems unlikely. → drop-in biofuels importance to run with diesel engines.
- The fuel needs to undergo tests and certifications before it can be used onboard but this looks simpler than that for aviation fuels.

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Source: Biofuels for the marine shipping sector, IEA Bioenergy report, 2017

Construction machines

- No standards, no inventories, the available data is based on patterns
- Most of energy use and CO_2 emissions are attributed to materials
- Machinery runs on diesel – many temporary installations with limited infrastructure
- Transport to/from construction site
- Nordic example: NCC has a goal to reduce its CO_2 emissions by 50% from 2015 to 2020
- Local regulations are suitable for this sector

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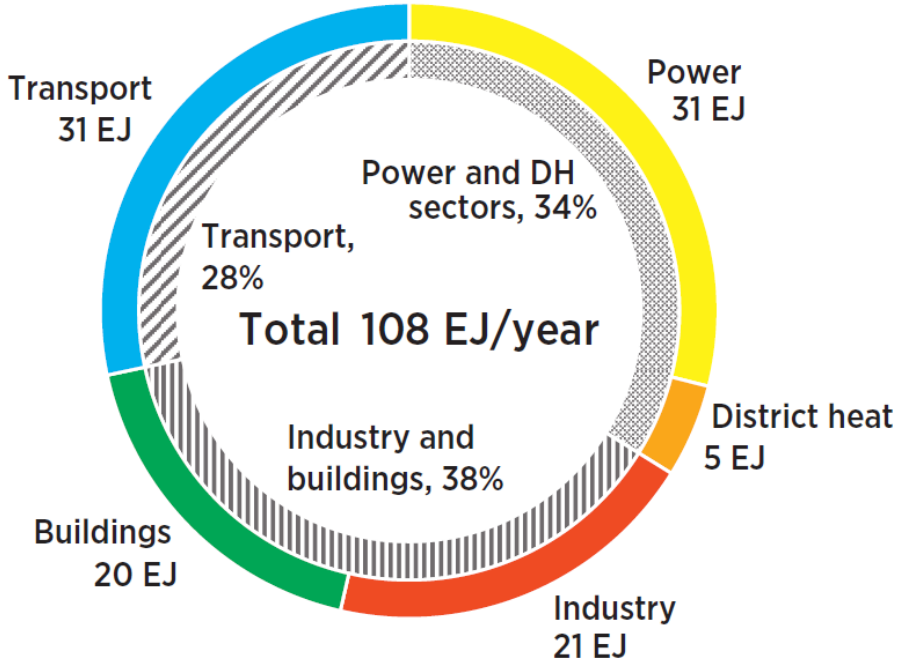
https://www.diva-portal.org/smash/get/diva2:1119056/FULLTEXT01.pdf

Competition for biomass and biofuels

Competition for biomass

- In 2010, half of the global biomass produced was used for cooking and heating.
- Electricity generation is growing
- Biofuels demand
- Renewable plastics and chemicals
- Construction materials
- Reduction materials
- Pulp and paper
- Food and feed
- …



Global biomass demand estimated by IRENA

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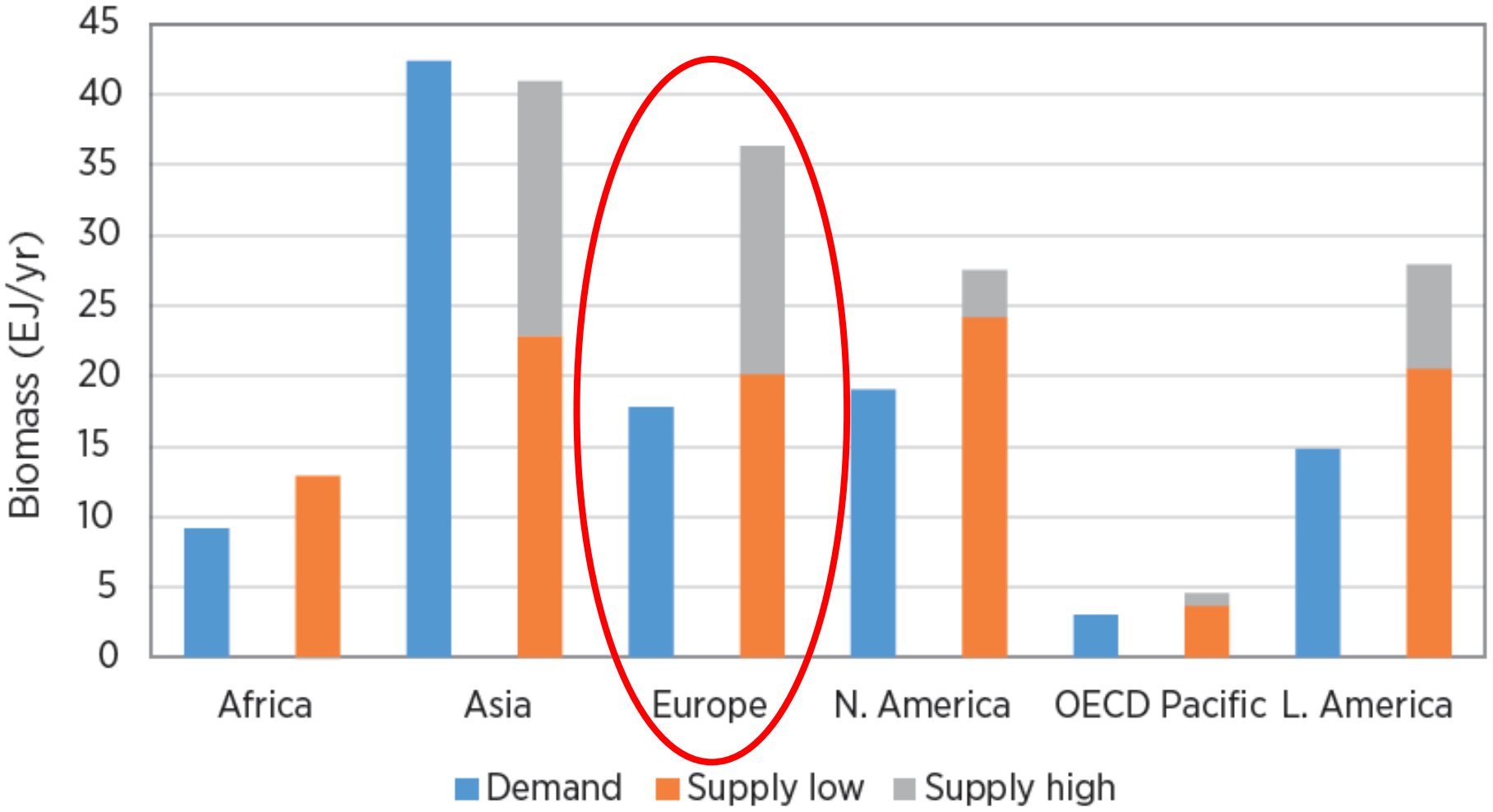
Source: IRENA: Global Bioenergy Supply and Demand Projections: A working paper for REmap 2030

Biomass availability



Source: IRENA: Global Bioenergy Supply and Demand Projections: A working paper for REmap 2030

Competition for biofuels among transportation modes

- Biofuels are mainly used in road transportation. Aviation and marine sectors use minimal biofuels
- 2030 SDS target about 11% of the combined total should be substituted by biofuels (250 Mtoe)
- Aviation and marine sectors are dependent on international or global emission regulations
- Some regional regulations
- Limited advanced biofuel production
- Low efficiency – half of the carbon: CO_2

Fuel consumption or potential	Mtoe
Fuel consumption in the maritime sector	330
Fuel consumption in the aviation sector	220
Bioethanol production in 2016	55
Biodiesel production in 2016	26
Biodiesel potential	50-54
Lignocellulosic biofuel potential	455-805

1 ton diesel = 1.091138 toe
Source: Biofuels for the marine shipping sector, IEA Bioenergy report, 2017

Conclusions

- The general ambitions are big, the reality is different – ambitions for advanced biofuels are modest
- Some of the transportation modes are dependent on drop-in liquid fuels with high energy density – those are currently coming from oil seeds or UCO with limited availability/sustainability
- There seems to be enough biomass, lignocellulosic biofuels can be produced in high quantities and qualities
- The potentials are theoretical, several factors affect the potential, economic viability is a major one
- The conversion efficiencies must be higher – avoid loosing the carbon to CO_2
- More ambitious regulations/support mechanisms are needed for advanced biofuels

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