



9th AIEE Energy Symposium  
Current and Future Challenges to Energy Security  
- sustainable energy security, ready for the future -

**Plenary session - Sustainable mobility challenges for the transition target**

# The strategic role of Carbon Neutral Fuels in Transport Decarbonization

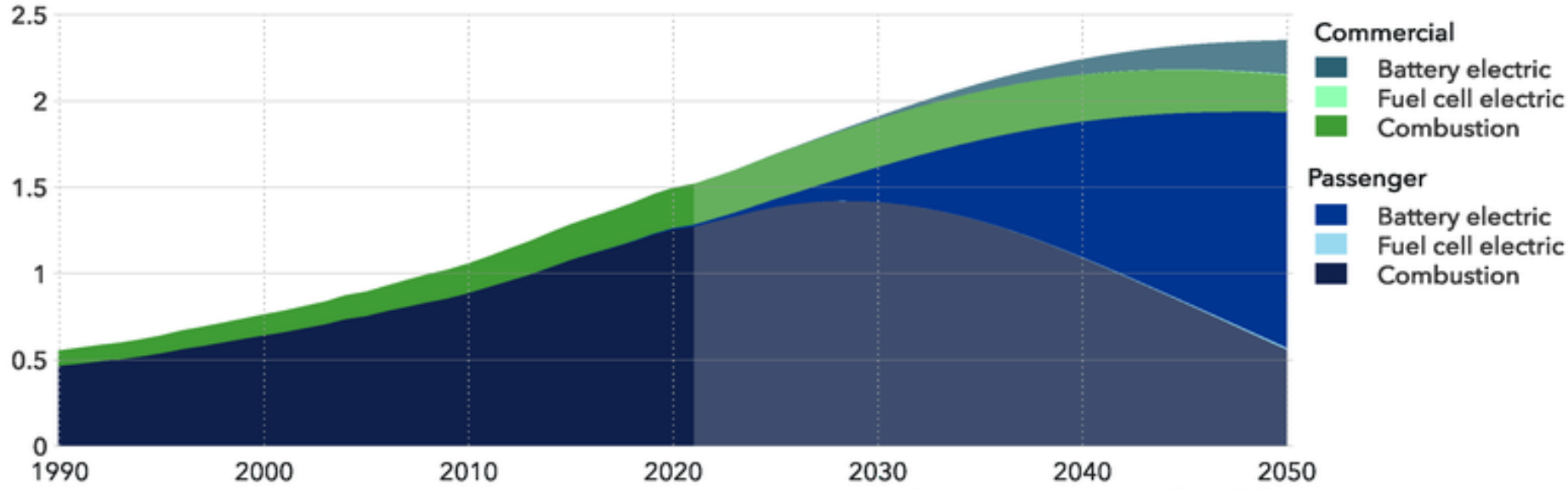
Franco Del Manso - Unem

Rome, 21 November, 2025

# World car fleet Light duty and Heavy duty in 2050

## World number of road vehicles by type and drivetrain

Units: Billion vehicles



Combustion vehicles include ICEs and PHEVs  
Historical data source: Marklines (2022), IEA EV Outlook (2022), EV Volumes (2022)

The passenger vehicle fleet climbs from 1.2 billion cars today to slightly below 2 billion in 2050, with the ICEV share falling precipitously from 97% to less than 30% by mid-century.

©DNV 2023

## More than 1 billion of ICE cars on the road in 2050



- **In Europe, the current car fleet is more than 300 million vehicles, all ICE, and in view of 2035, even if the phase-out remains, many millions more will be registered. In 2050, millions of ICE vehicles will continue to circulate in Europe**
- **The same situation in Italy. We have a car fleet of just under 40 million vehicles with a penetration of electric cars limited to 300,000 vehicles and with a very limited growth trend of this market. A car fleet in 2050 without cars equipped with internal combustion engines is unthinkable**



## The only way to decarbonize the transport by 2050 is to make the internal combustion engine vehicles, zero emission vehicles

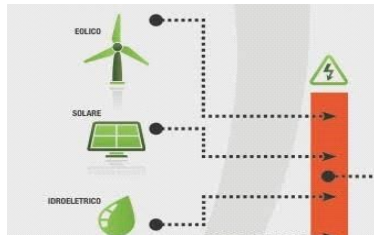
- This can only be achieved with carbon neutral fuels. But what are carbon neutral fuels?: Liquid fuels of non-petroleum origin, renewable and sustainable
- Produced from new raw materials such as sustainable biomass, renewable energy, waste, green H<sub>2</sub> and recycled CO<sub>2</sub>.
- They only emit biogenic or recycled CO<sub>2</sub> that does not increase the concentration of CO<sub>2</sub> in the atmosphere:
  - **Biofuels:** Biodiesel, HVO – Hydrogenated vegetable oil, Biomethane, Bioethanol (conventional and advanced)
  - **E-fuels:** synthetic fuels deriving from the recombination of CO<sub>2</sub> and H<sub>2</sub> (green hydrogen, gasoline, diesel and synthetic kerosene) commonly known as RFNBO
  - **Recycled carbon fuels:** synthetic fuels deriving from the recovery of fossil waste (in particular plastic)

**These are the products that will enable the Fuel Shifting from fossil fuels to renewable fuels for Transport Decarbonization**

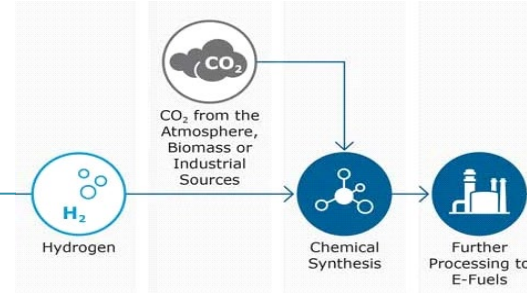


# Technological processes for the production of carbon neutral fuels

**E -fuels  
(Power -to-X)  
SYNTHETIC  
FUELS**



**GREEN  
HYDROGEN**



- SYNTHETIC PETROL**
- SYNTHETIC DIESEL**
- SYNTHETIC METHANE  
CNG o LNG**
- SYNTHETIC LPG**
- SYNTHETIC DME**

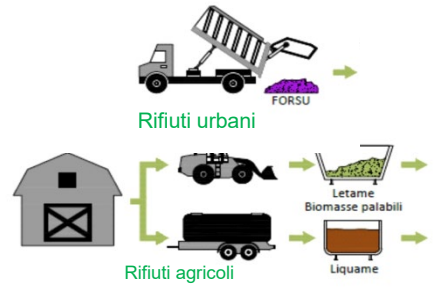
**RECYCLED  
CARBON  
FUELS**



Pyrolysis /  
Gassification

- RENEWABLE LPG**
- RENEWABLE DME**
- OTHER RENEWABLES**

**BIOFUELS**



*Esterificazione*

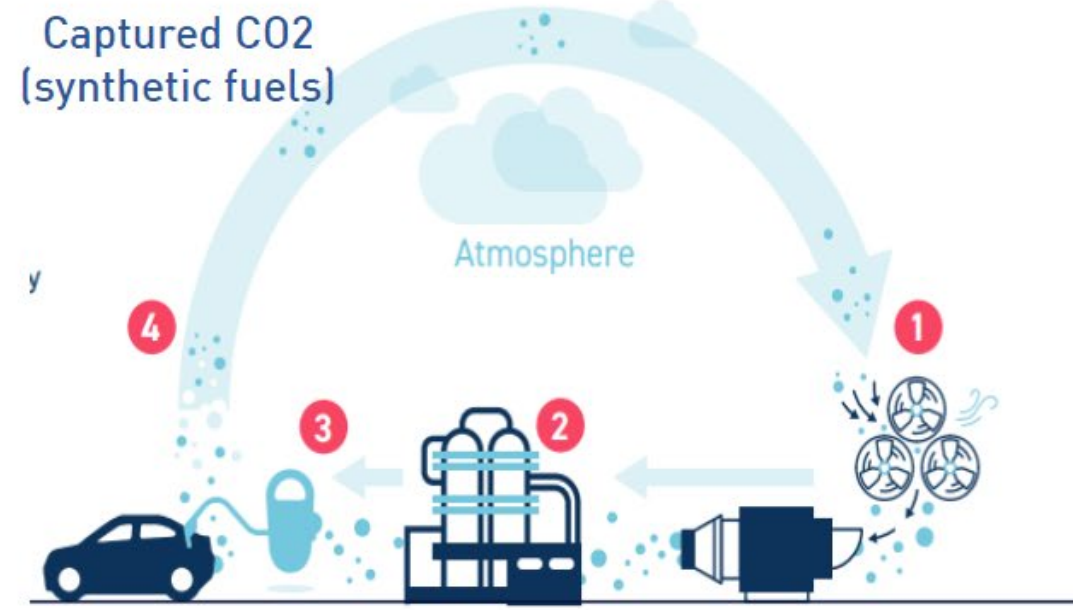
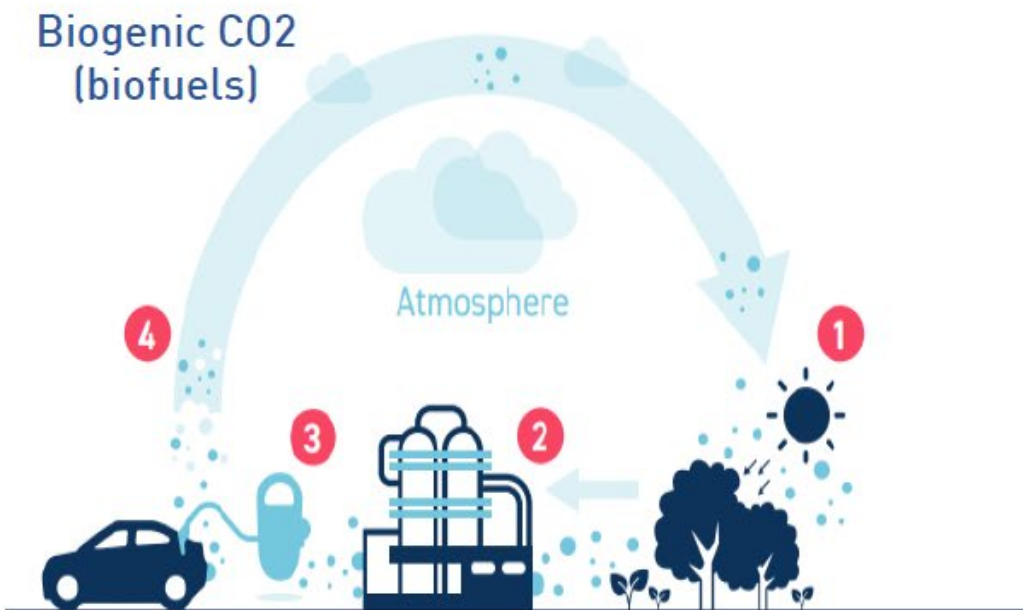
*Idrogenazione*

*Digestione  
anaerobica*



- BODIESEL**
- HVO**
- HVO LPG**
- BIO -METHANE  
CNG o LNG**
- BIO LPG**
- BIO DME**





This is confirmed in other EU regulations, where recycled CO2 is considered **ZERO EMISSIONS**:

- In ETS, emission from biomass → zero emissions
- In ETS road and building (ETS 2), emissions from biofuels & synthetic fuels → zero emissions
- In RED (renewable energy directive), emissions from biofuels & synthetic fuels are compensated (credits arising respectively from photosynthesis and CO2 capture) → zero emissions

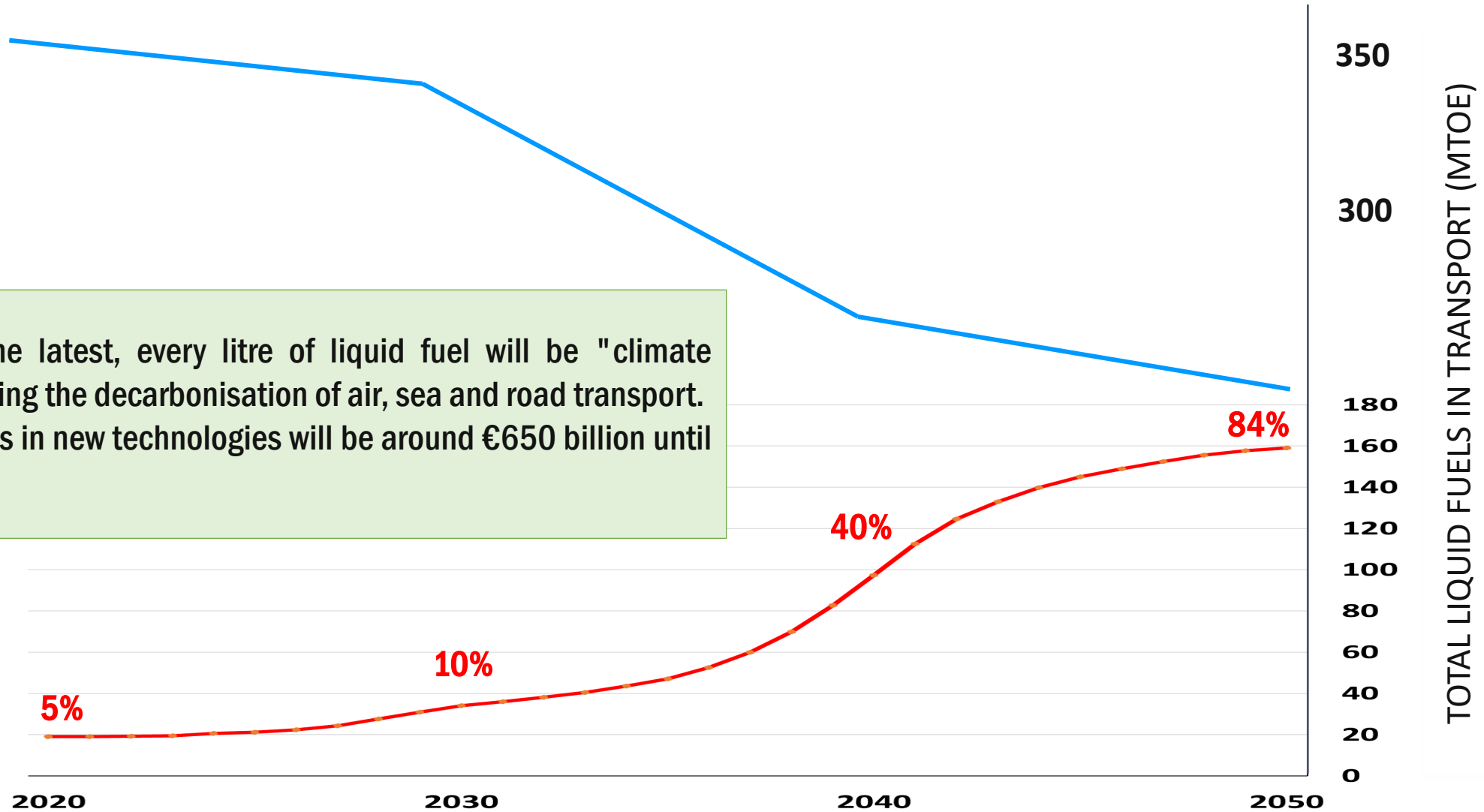


# Our vision - Carbon Neutral Liquid Fuels progressively replacing fossil fuels in transport

Total liquid fuels (fossil + LCLF)

By 2050 at the latest, every litre of liquid fuel will be "climate neutral", allowing the decarbonisation of air, sea and road transport. The investments in new technologies will be around €650 billion until 2050

Total LCLF



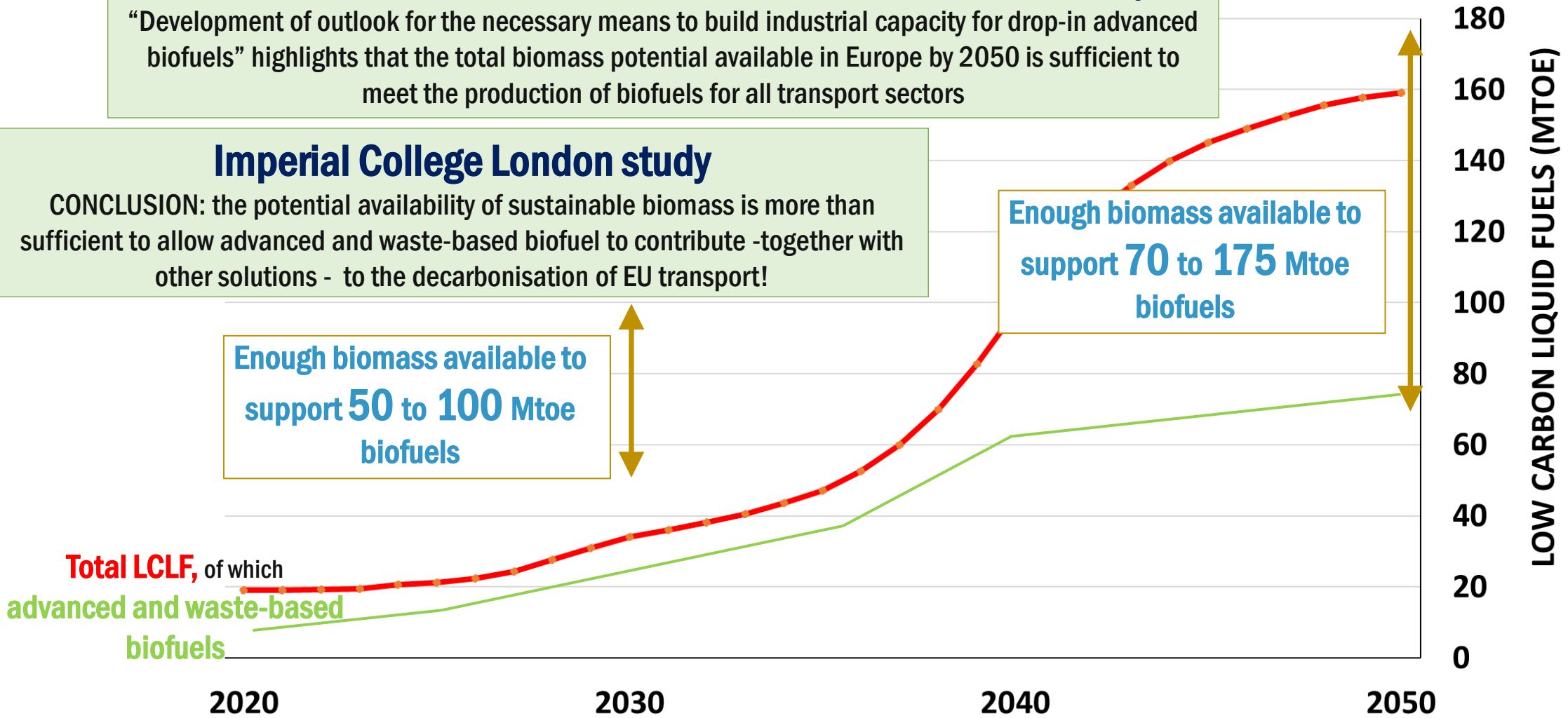
# Enough sustainable biomass available for road, aviation and marine fuels biofuels

## UE Commission Directorate-General for Research and Innovation Study

“Development of outlook for the necessary means to build industrial capacity for drop-in advanced biofuels” highlights that the total biomass potential available in Europe by 2050 is sufficient to meet the production of biofuels for all transport sectors

## Imperial College London study

CONCLUSION: the potential availability of sustainable biomass is more than sufficient to allow advanced and waste-based biofuel to contribute -together with other solutions - to the decarbonisation of EU transport!

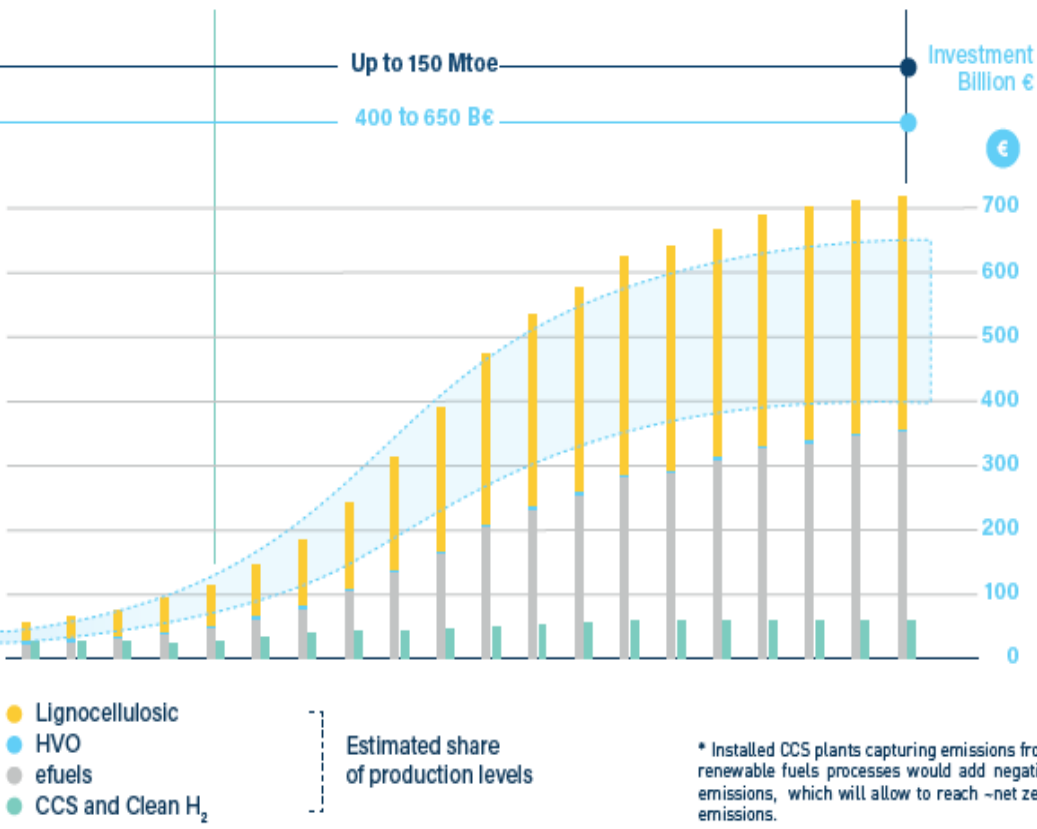
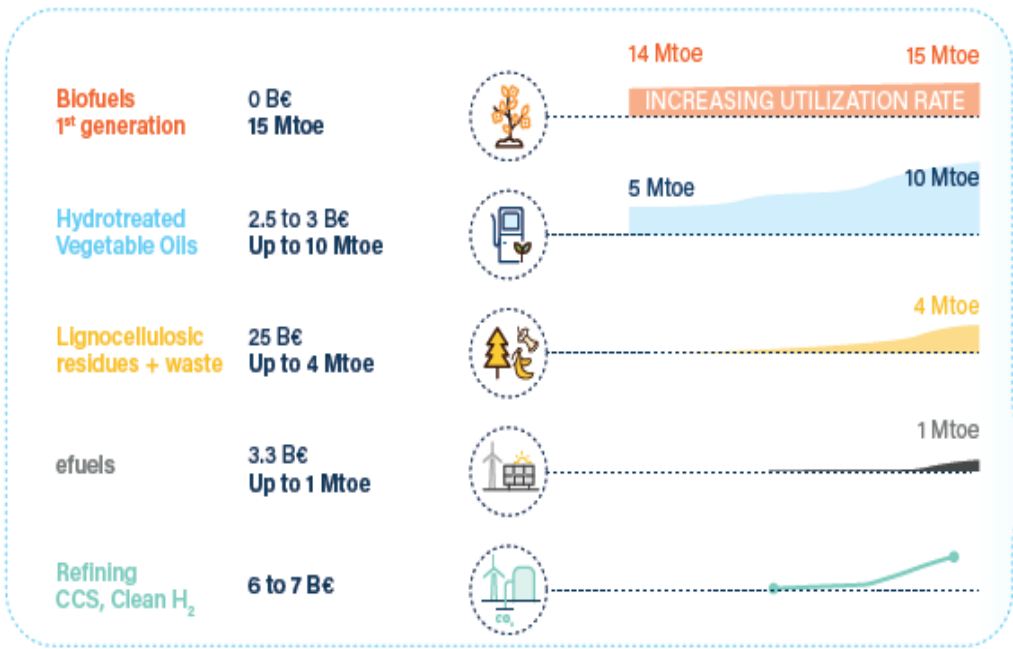
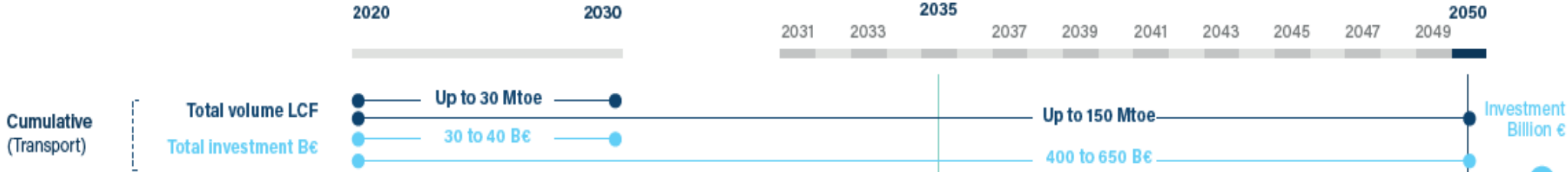
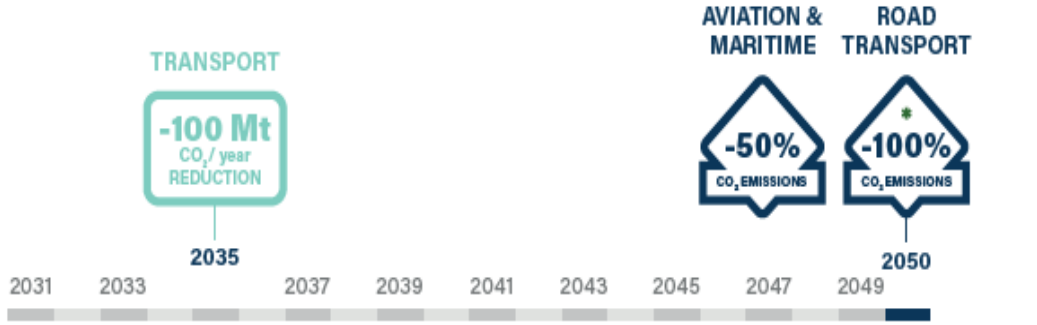


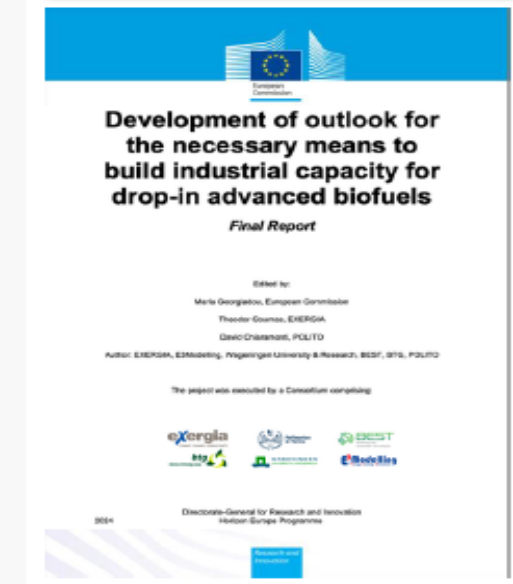
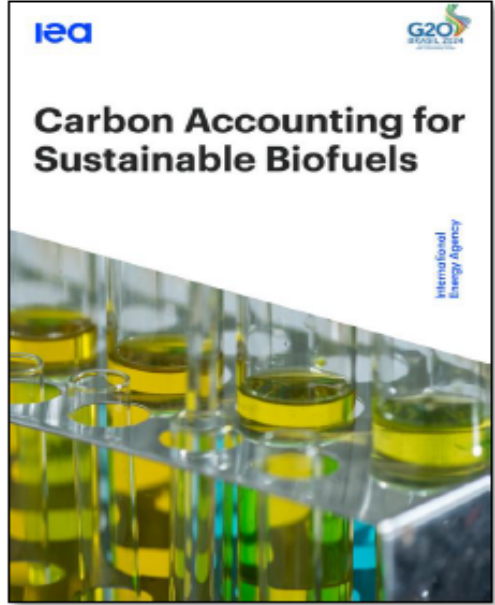
FuelsEurope’s elaboration, based on the Imperial College London Cons. study and Concawe’s scenario assuming LCLF in all transport modes  
<https://www.concawe.eu/publication/sustainable-biomass-availability-in-the-eu-to-2050/>



# Enough sustainable biomass available for road, aviation and marine fuels biofuels

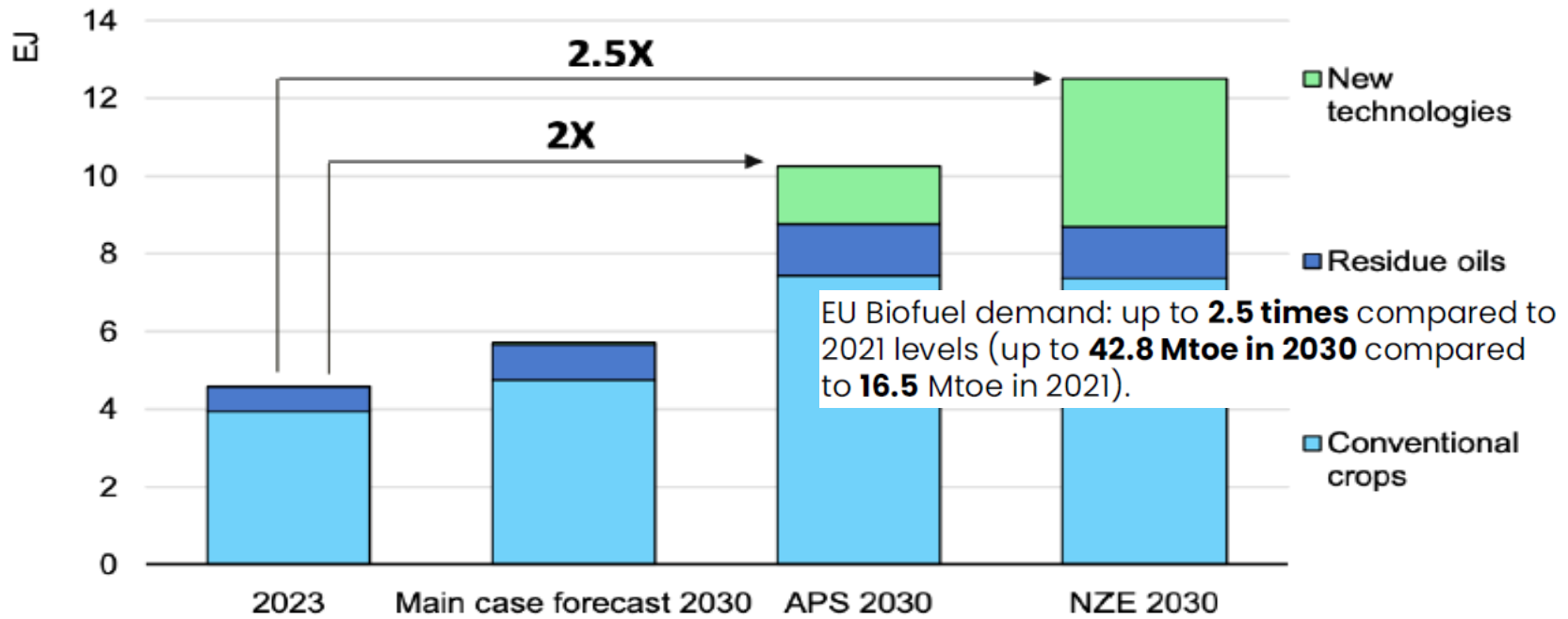
## EU refining industry 2050 potential scenario (% GHG red. vs 100% fossil)





## G20 IEA Study (Oct 2024)

**Figure 1.3 Biofuel production by feedstock: Current, main case, Announced Pledges Scenario and Net Zero Emissions by 2050 Scenario, 2023-2030**



IEA. CC BY 4.0.

Notes: APS = Announced Pledges Scenario. NZE = Net Zero Emissions by 2050 Scenario. "Conventional crops" refers to corn, sugarcane, soybeans, canola/rapeseed, palm oil and other crops. "Residue oils" refers to used cooking oil, animal fats, palm oil mill effluent and other residue oils. "New technologies and practices" refers to biofuel production from (lignocellulosic) agricultural and forestry residues, municipal solid waste and oil seeds grown on marginal land through intercropping, double-cropping and other approaches that do not otherwise compete with food and feed production.

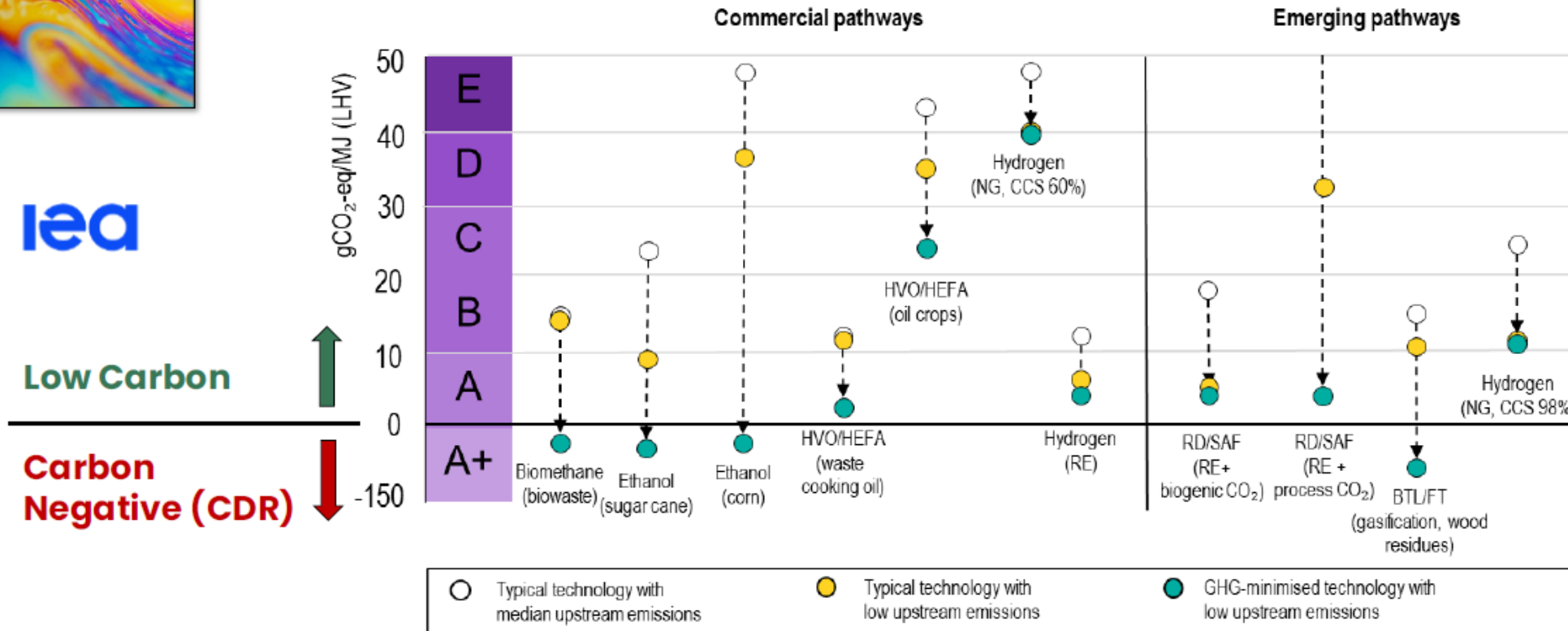
Sources: IEA (2024), [Oil 2024: Analysis and Forecast to 2030](#); IEA (2023), [World Energy Outlook 2023](#).





## IEA – The global dimension: common definitions Developing a common GHG intensity label for sustainable fuels

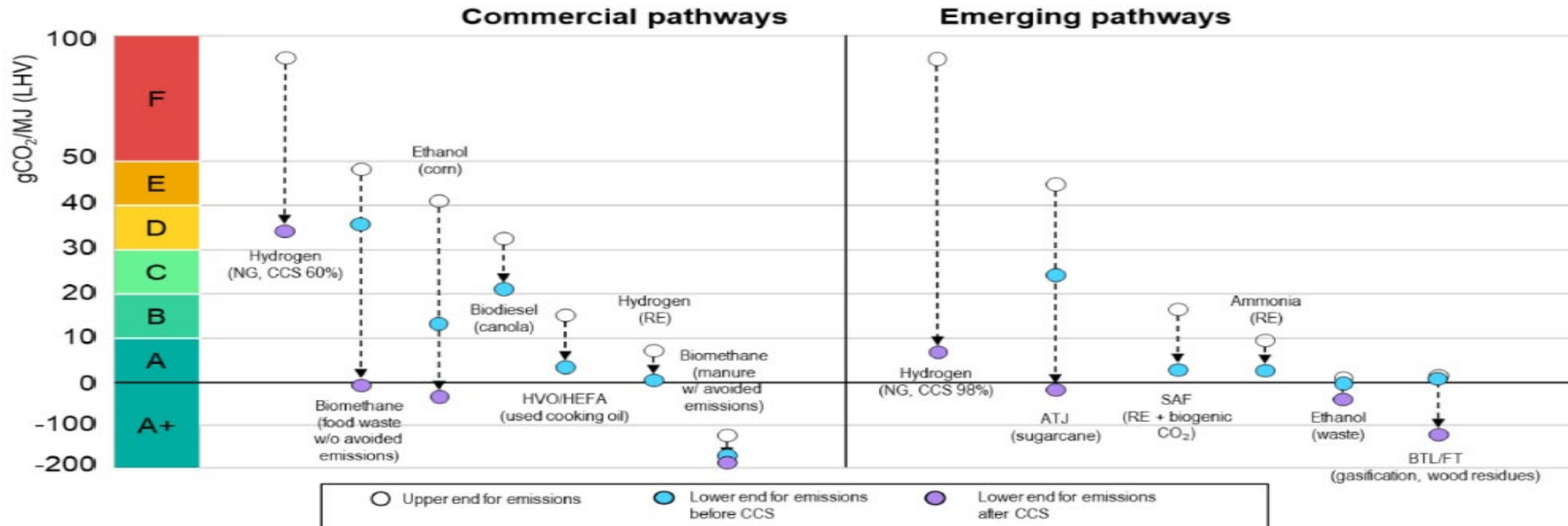
Example of quantitative **GHG intensity labelling system** for selected sustainable fuel pathways at the point of delivery



**More organic Carbon in coproducts (residues) than in main product (e.g. lipids, etc)**



Figure 4.3 Lifecycle GHG emission ranges for selected fuel pathways

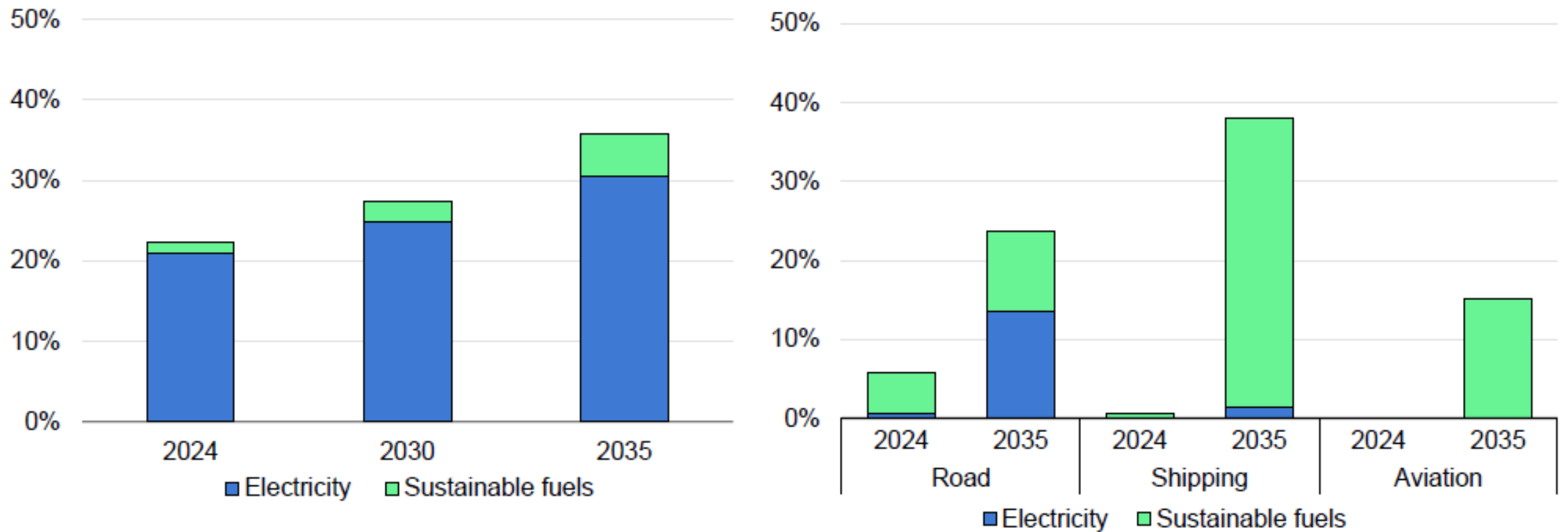


IEA. CC BY 4.0.

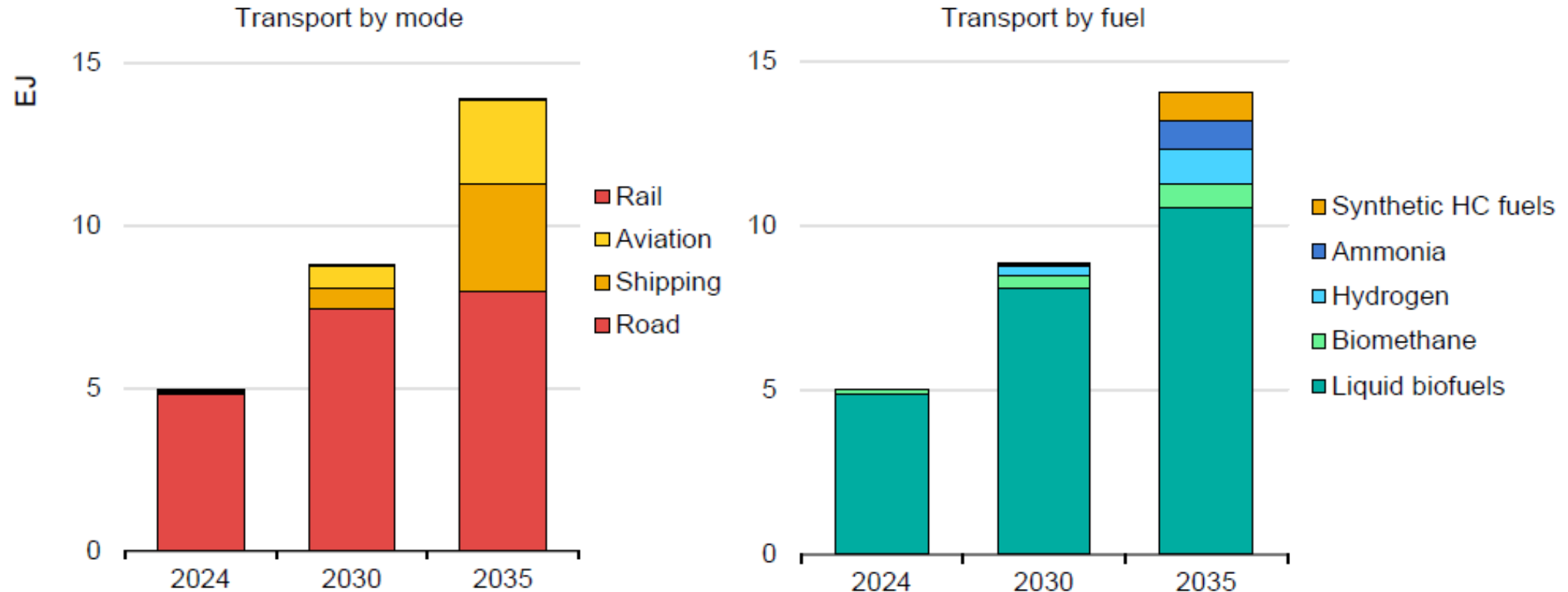
Notes: HVO = hydrotreated vegetable oil; HEFA = hydroprocessed esters and fatty acids; NG = natural gas; CCS = carbon capture and storage; ATJ = alcohol-to-jet fuel; SAF = sustainable aviation fuel; RE = renewable electricity; BTL = biomass-to-liquid; FT = Fischer-Tropsch. GHG intensities for the biofuel pathways from R&D GREET 2024 Rev1. Direct land use change is included, but indirect is excluded. CCS assumptions and other pathways based on IEA analysis. Removals through soil carbon accumulation are possible for some of the pathways but are not considered in this figure. Electrolysers are assumed to be powered by renewable electricity. Embodied emissions of renewable power are included (assuming 50/50 hybrid PV/wind power plant for upper end and hydropower plant for lower end). All values are for lower heating value. Emissions from transport and distribution of final fuel to end user are 2 gCO<sub>2</sub>/MJ for liquid fuels and pipeline transport of methane, and 4 gCO<sub>2</sub>/MJ for pipeline transport of hydrogen.



**Figure 5.2 Shares of sustainable liquid and gaseous fuels and electricity in global final energy demand (left) and in selected sectors (right) in the accelerated case, 2024-2035**



**Figure 5.3 Use of sustainable liquid and gaseous fuels in the transport sector by mode and by fuel in the accelerated case, 2024-2035**

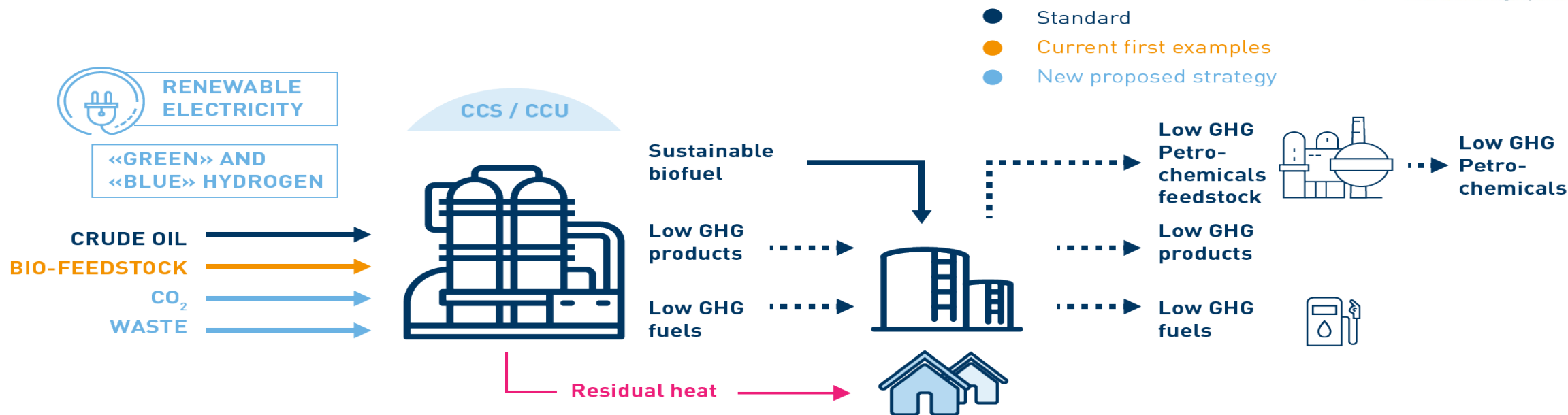


Note: HC = hydrocarbon.

IEA. CC BY 4.0.



# The fuels producer's industry is central to transport and strategic for energy supply.



- The demand for fuels and low-carbon fuels will continue to be met by the refining sector in the coming decades.
- Already today, some refineries have been converted into biorefineries, while others are increasingly using new feedstocks (bio-based, waste-derived, CO<sub>2</sub>) in co-processing plants that will operate alongside petroleum until they fully replace it, with the goal of complete decarbonization of the supply chain.
- In the short term, rapidly increasing shares of conventional and advanced biofuels will be used, which in the long term will be complemented by e-fuels which technology is confirmed to be relatively mature





## Low Carbon Fuels are already a reality

- 1. GREEN HYDROGEN: 18 projects beyond Final Investment Decision (FID). 4 further projects (pre-FID) currently announced.
- 2. RENEWABLE LIQUID FUELS: 27 projects beyond Final Investment Decision (FID) – including some already operational. 10 further projects (pre-FID) currently announced.



## General Overview of the Tour Data

### 16 vehicles

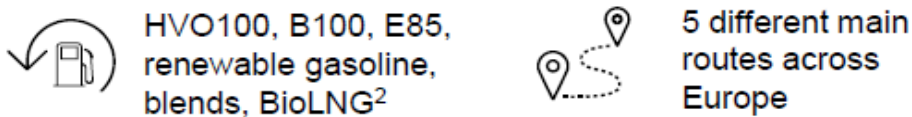


### 17 countries<sup>3</sup>

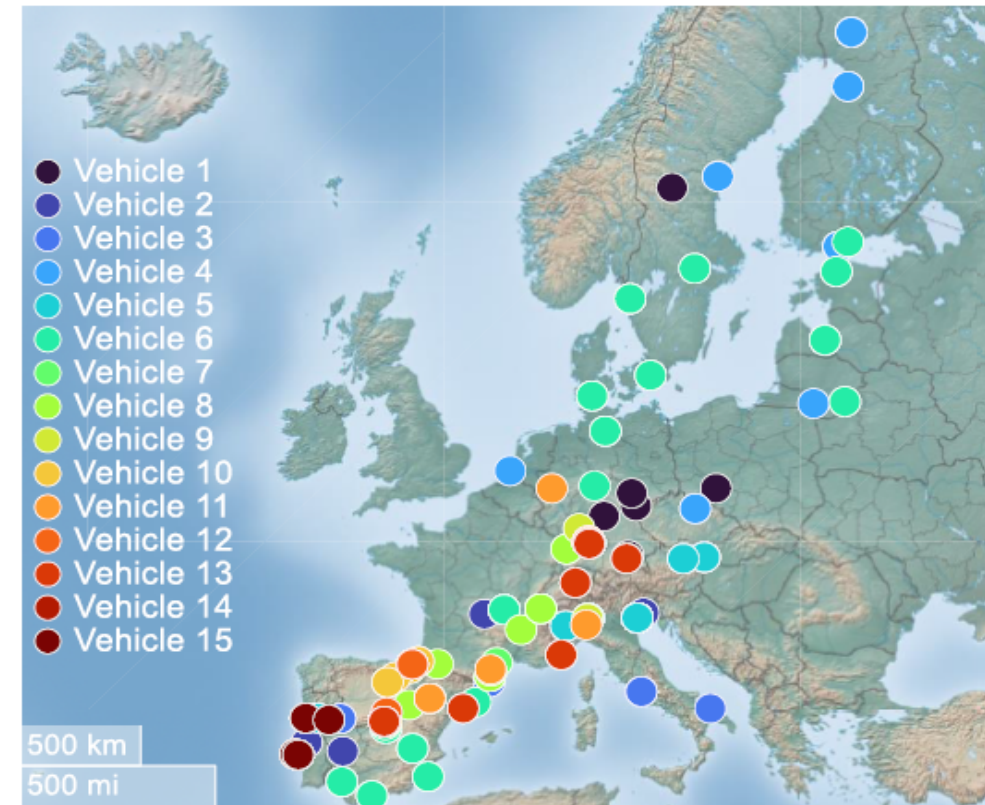


AT | CH | CZ | DE | DK | EE | ES | F | FR  
 IT | LT | LV | MC | NL | PL | PT | SE  
 Representation of the availability of  
 renewable fuels in Europe

### 289 refueling events during > 77500 km



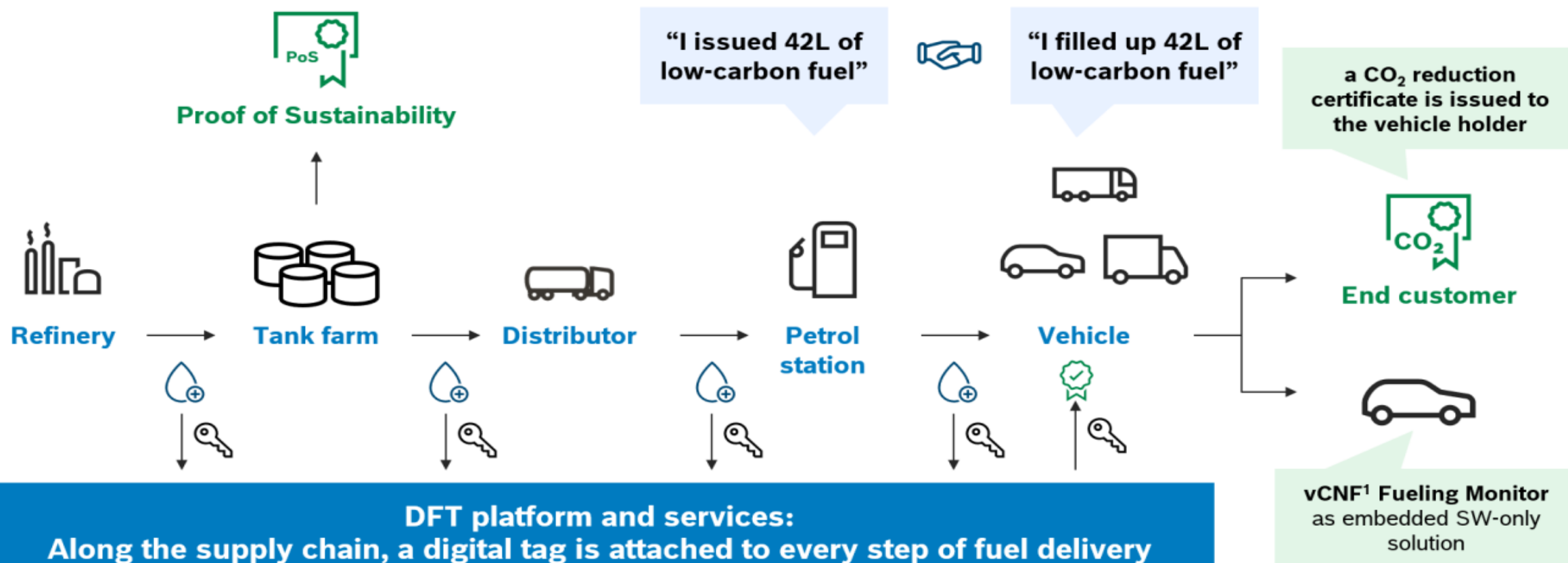
### Refueling events



1 Including one FlexFuel car    2 BioLNG data collection ongoing    3 Number of countries with data collection



## Bosch Digital Fuel Twin Platform (DFT) Working Principle



1 – Carbon Neutral Fuel Vehicles



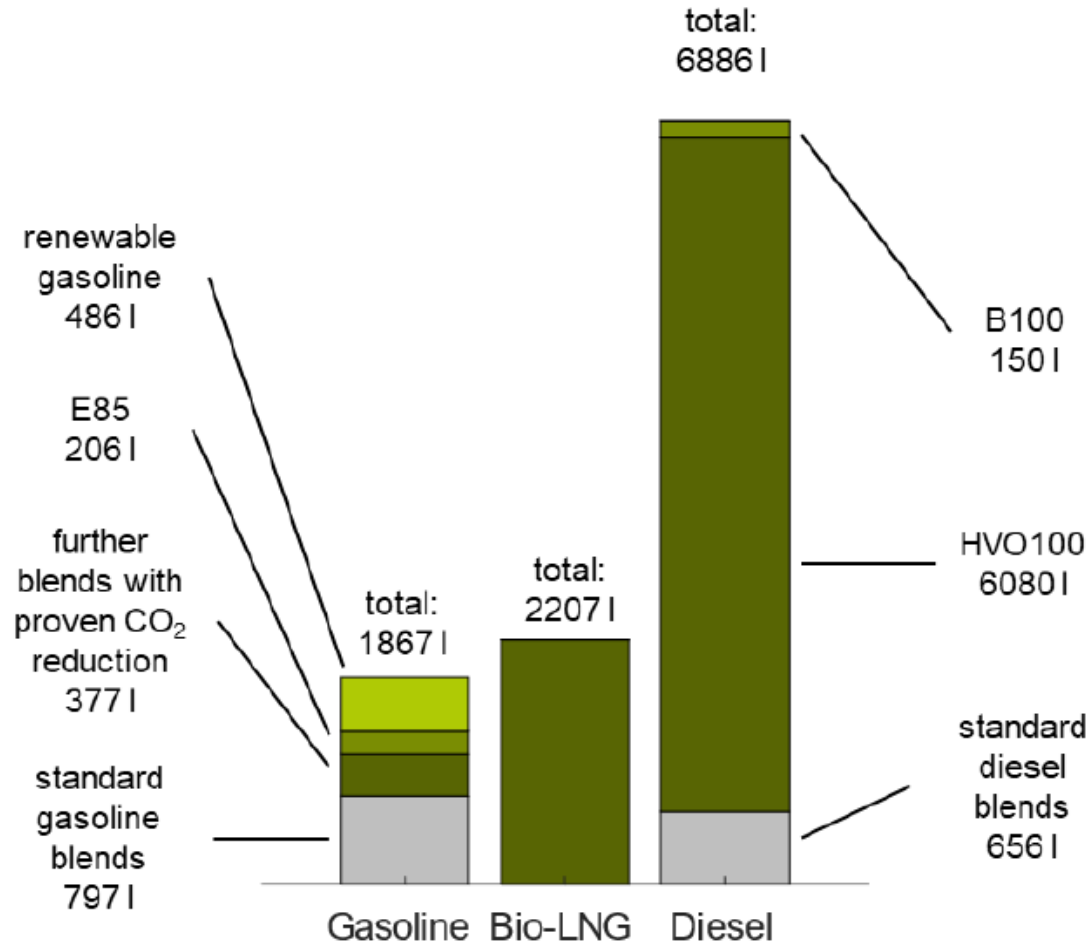


Figure 12: Total fuel amounts used during TdE

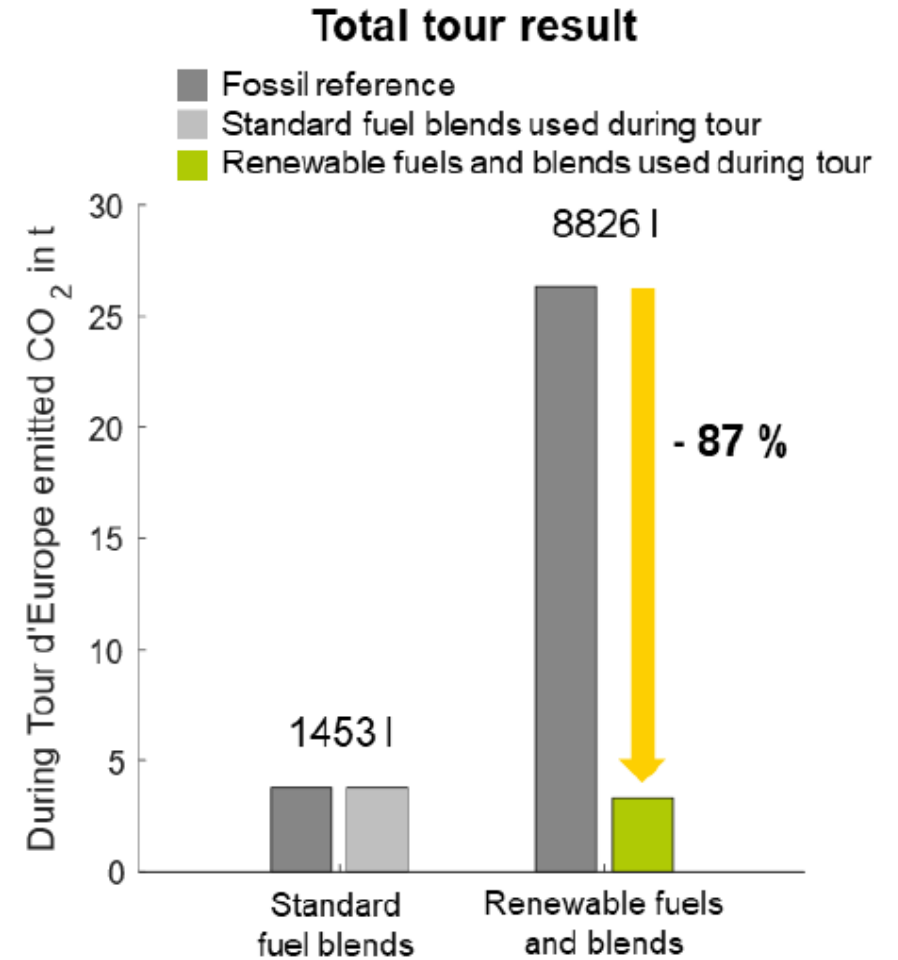


Figure 14: Total tour result



- **To enable us to make a significant contribution to deliver climate neutrality by powered by carbon neutral fuels2050, to ensure a secure supply of energy, and to foster innovative, EU-based, globally competitive fuels and automotive industry we need to:**
  - **Revise the CO2 fleet regulations with the aim of introducing additional flexibility to avoid disproportionate penalties, allowing the recognition of low- and zero-emission vehicles other than battery-electric vehicles to contribute to the OEM's compliance with CO2 vehicle standards**
  - **To continue to be eligible for registration beyond 2035, new vehicles exclusively fueled with Carbon neutral fuels**
  - **To enhance energy security by the gradual low-carbon transformation of existing, strategic EU refineries to make clean products for transport & the industrial value chain from domestic raw materials**



- In preparing the review of the CO<sub>2</sub> emissions regulation for passenger cars and light commercial vehicles we are carefully assessing complementary pathways to achieve climate neutrality in the road transport sector
- The assessment focuses on the potential contribution of zero and low-emission fuels to the transition towards zero-emission mobility beyond 2030
- This includes consideration of:
  - **E-fuels**, for which commitments have already been outlined in the Commission's guidelines
  - **Advanced biofuels**, which may play a role in reducing lifecycle emissions in specific transport segments
- The objective is to ensure that the regulatory framework supports technological openness, innovation, and a cost-effective transition, while maintaining the integrity of the EU's long-term climate objectives and the European automotive industry.





**Vi invitiamo a seguirci sui  
nostri canali social**

**w** [www.unem.it](http://www.unem.it)   **t** [@unem\\_it](https://twitter.com/unem_it)   **in** [/company/ unem](https://www.linkedin.com/company/unem)