Hydrogen in heavy-duty transport

Aleksandra Saarikoski

Renewable powertrains of trucks

- Zero and low-emission vehicles are gaining interest in the transport industry to get rid of fossil fuel dependency and decrease emissions

- Gas and BEV the most developed options – hydrogen trucks still catching up
  - Globally there are around 8000 medium- and heavy-duty trucks compared to 300 000 electric trucks[1]
  - Transport represents less than 1% of the total global hydrogen usage[2]
  - Both ICE and FCEV options with different benefits

1: IEA – Global Hydrogen Review 2023
2: IEA – Global Hydrogen Review 2022

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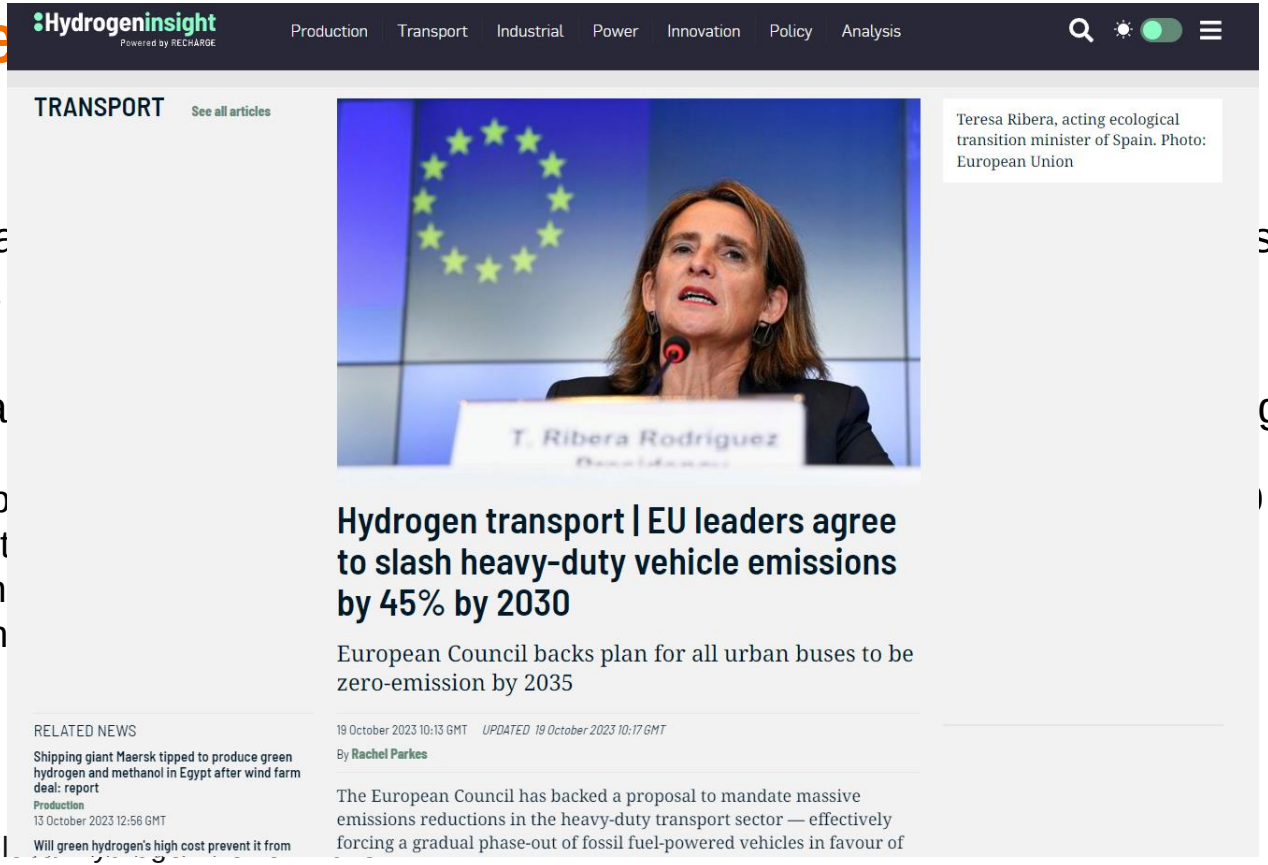

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Teresa Ribera, acting ecological transition minister of Spain. Photo: European Union

Hydrogen transport | EU leaders agree to slash heavy-duty vehicle emissions by 45% by 2030

European Council backs plan for all urban buses to be zero-emission by 2035

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By **Rachel Parkes**

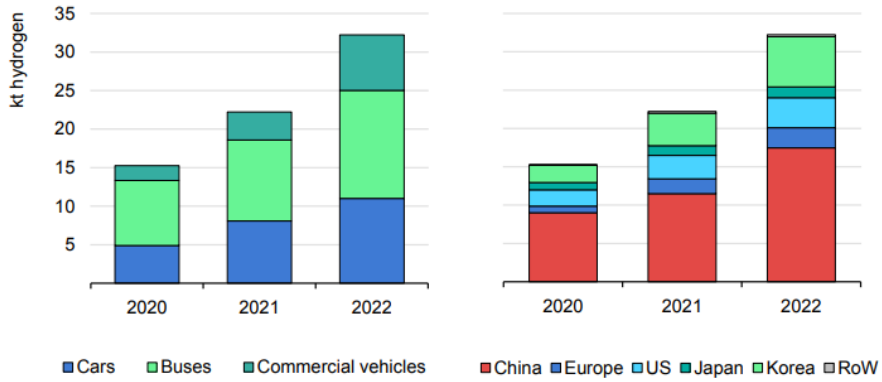
The European Council has backed a proposal to mandate massive emissions reductions in the heavy-duty transport sector — effectively forcing a gradual phase-out of fossil fuel-powered vehicles in favour of

1: IEA – Gl …
2: IEA – Global Hydrogen Review 2022

Global hydrogen vehicle market

- Most FCEV located in Asia (mostly China)
- 20% of FCEV located in China
  - consume more than a half of the hydrogen used in road transport
- Hydrogen use in the transport sector (especially heavy-duty) increasing significantly but represents only a small part of the whole hydrogen demand

Figure 2.6 Hydrogen consumption in road transport by vehicle segment and region, 2020-2022

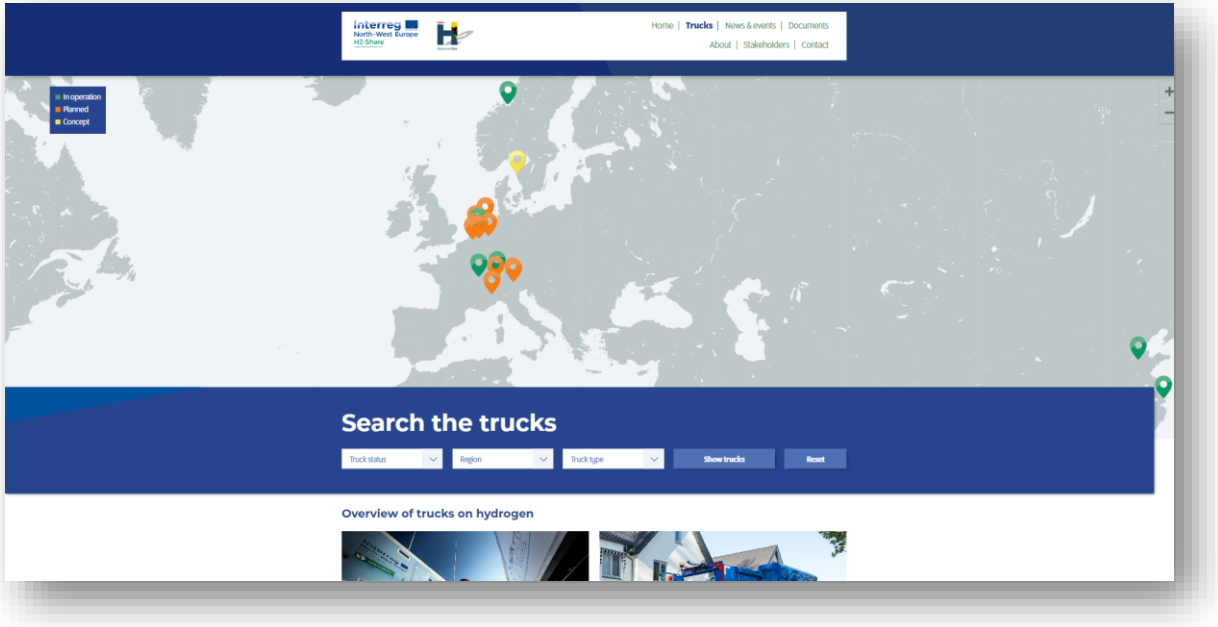


Notes: RoW = Rest of World; US = United States. Commercial vehicles include light commercial vehicles and medium- and heavy-duty trucks. Assumptions on annual mileage and fuel economy have been updated to match the IEA Global Energy and Climate Model.

Global Hydrogen Review 2023 - IEA

Hydrogen trucks in use

- https://fuelcelltrucks.eu/project/ - heavy-duty trucks using hydrogen mapped



Why hydrogen trucks?

- Classified as zero-emission (both H2ICE and FCEV)[1]
- More suitable to long haul and heavy loads than BEV
- AFIR – available hydrogen infrastructure in the future (also for heavy-duty?)

Heavy-duty fuel cell electric truck models, 2022

Make	Model	Range (km)	Year available
Hyundai	XCIENT	400	2019
Hyzon	Hymax	400-680*	2021
Hyzon	FCET 8	800	2021
Dayun	E8	310	2021
Dayun	E9	430	2021
Skywell	TP11	500	2021
FAW	J7	700	2022
Feichi	FSQ4250	500	2022
King Long	KLQ4250FCEV3	510	2022
SAIC	CQ1180FCEVEQ		2022
Shaanxi	X5000		2022
Dongfeng	LZ5180	460	2022
Hyundai	HDC-6	1 280	2023
Kenworth	T680	480	2023
Nikola	Tre	800	2023
Nikola	Two	1 450	2024

* Ranges given for the 24-, 46-, and 70-tonne configurations.

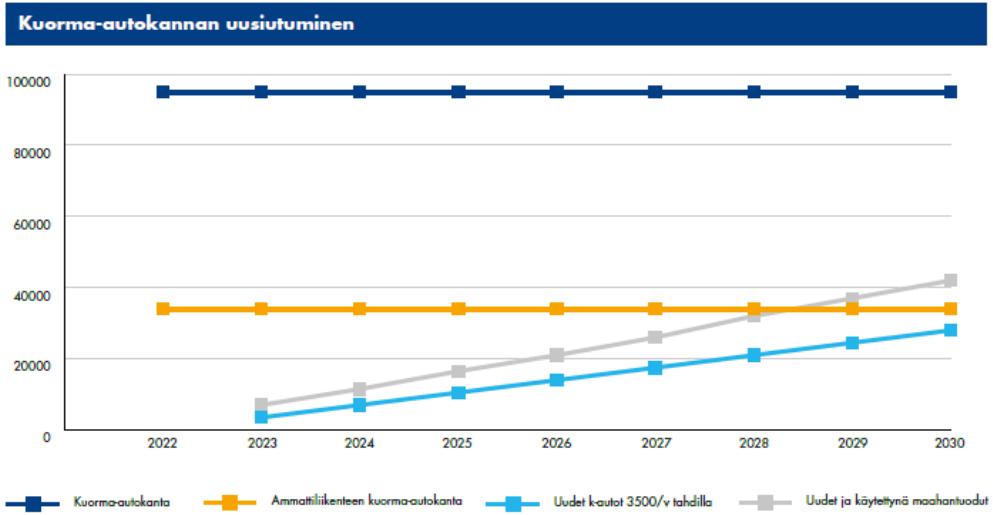
Source: CALSTART (2022), Drive to Zero's Zero-emission Technology Inventory (ZETI) Tool Version 7.0

IEA – Global Hydrogen Review 2022

1: H2ICE results NOx emissions due to combustion

Heavy-duty transport in Finland

- Over 99% of the Finnish heavy-duty truck fleet are diesel-based
- Gas trucks make up the greatest portion of low- or zero-emission trucks (0,05%)
  - Only a handful of BEV trucks in use



Truck fleet in Finland: ~93 000

The fleet renewal is 3500 trucks/year

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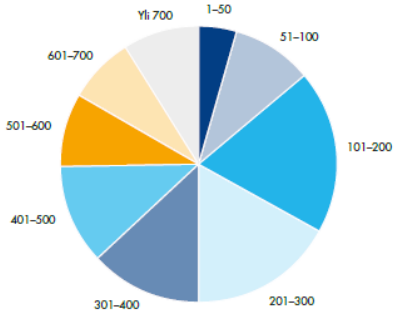
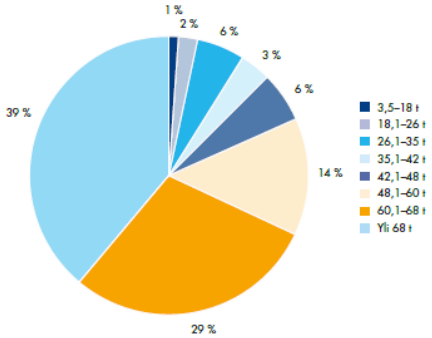
Kuljetussuorite kuljetusetäisyyden mukaan, 2021, km



Kotimaan kuorma-autoliikenteen kuljetussuorite kuljetusetäisyyden mukaan jaoteltuna (ilman maa-aineskuljetuksia). Lähde: Tilastokeskus.

Kuljetussuorite kokonaismassaluokan mukaan, 2021



~70% of deliveries are carried out by trucks over 60t

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Hydrogen as a powertrain in trucks

Efficiencies[1]

- FCEV has the best potential efficiency of around 60% compared to H2ICE and diesel (45-50% peak efficiency)
- H2ICE and diesel have similar efficiencies, small variation exists

Costs[2]

- The cost of a H2ICE truck ~1,5 times and a FCEV tractor ~2 times that of diesel (BEV cost is slightly more than 2 times the cost of diesel)

Fuel consumption[1]

- FCEV has a high possible efficiency - would result in fuel savings of around 20% compared to diesel
- H2ICE would consume around 15-20% more fuel than diesel → cheap hydrogen required

1: https://www.energy.gov/sites/default/files/2023-03/h2iqhour-02222023.pdf & insight from Jari Ihonen
2: Hydrogen Insight 2023 - Why the world needs hydrogen combustion engines — even though they're so inefficient

Summary

- Only small amounts of hydrogen currently used in heavy-duty transport – the amount increasing especially in China
- Hydrogen infrastructure going to increase with AFIR in 2030 – at least for light vehicles
- Hydrogen-powered trucks suitable for long haul applications with long mileages and heavy loads – compared to BEV
- Cheap hydrogen and low costs needed for H2ICE and FCEV uptake
  - Cheap renewable electricity required for hydrogen production

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