Efuels event

Focus Association for Sustainable Development - 31 May 2022

TRANSPORT & ENVIRONMENT

T&E:

26 Countries

63 Members

6 National offices

Priorities

Cars

Road freight

Sustainable finance

Climate tools

Ships

Planes

Energy

Clean cities

Where to use green efuels?

Green hydrogen/efuels, indispensable for decarbonisation

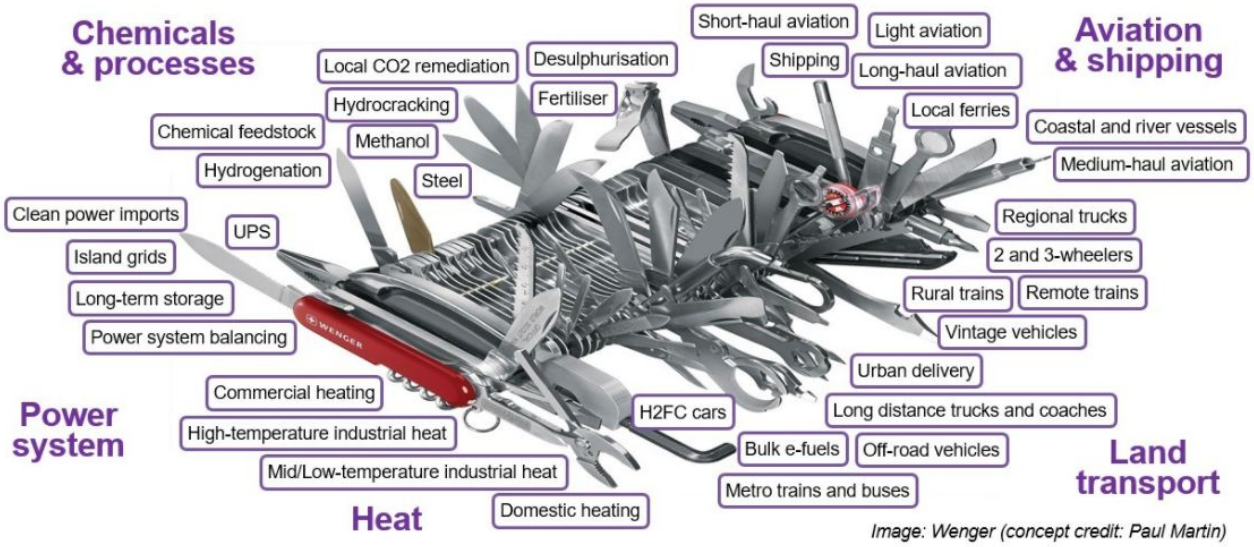


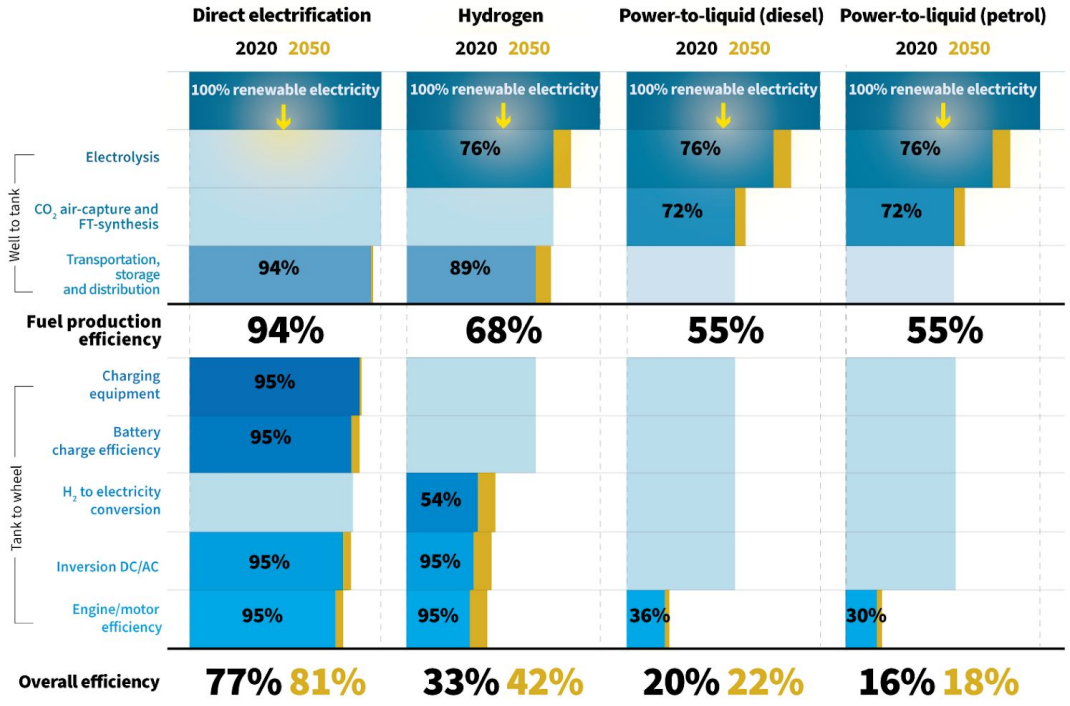
Image: Wenger (concept credit: Paul Martin)

Hydrogen & efuels is an energy carrier that can do anything …

But is it the best tool to do everything efficiently?

Source: [Linkedin post Liebreich associate]

Cars: direct electrification most efficient by far



Notes: To be understood as approximate mean values taking into account different production methods. Hydrogen includes onboard fuel compression. Excluding mechanical losses.

Sources: Worldbank (2014), Apostolaki-Iosifidou et al. (2017), Peters et al. (2017), Larmanie et al. (2012), Umweltbundesamt (2019), National Research Council (2013), Ricardo Energy & Environment (2020), DOE (no date), ACEA (2016).

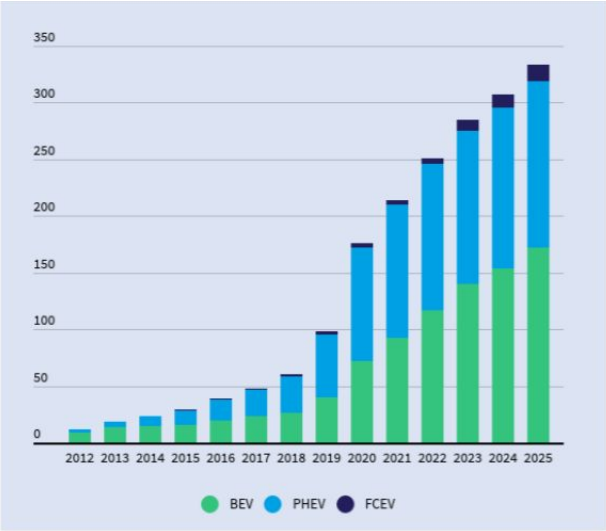


Figure 10: Total number of available EV models on the market in Europe

Just 4% of EV models are Fuel Cell EVs

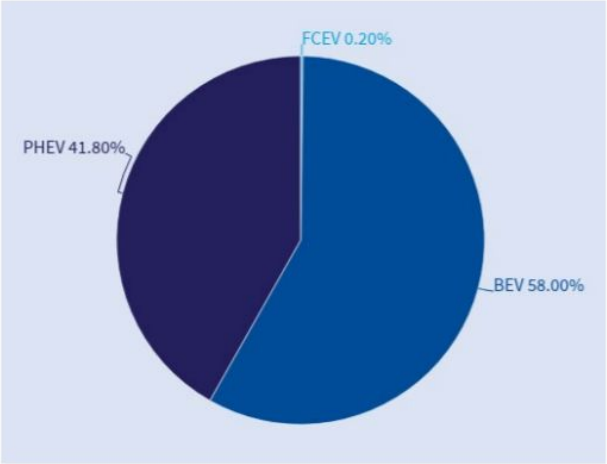


Figure 13 – Forecasted European production of EV per type in 2025 (Source: IHS Markit)

Little FCEV production in Europe:

Only 5,500 fuel cell passenger cars and 4,700 vans in 2025 (= 0.2% of EV production in Europe)

Road transport

Passenger cars, vans, urban buses:

- Battery Electric Vehicle - the most energy-efficient choice and lowest Total Cost of Ownership.
- Many Battery Electric Models and cost-parity in 2025

Trucks <16t:

- Similar conclusion as for cars.
- Suitable for local and regional deliveries - depot charging (60% are trips below 400km).

Trucks > 16t:

- Total Cost of Ownership of Fuel Cell Truck is higher.
- Refueling time is shorter and greater autonomy. Relevant for niche applications
- EU CO2 standards for trucks will support both zero-emission technologies.

Battery electric vs. hydrogen long-haul trucks

	2025	2030	2025	2030
TCO over first use period (based on Germany)	€ 494 K	€ 441 K	€ 588 K	€ 514 K
TCO cost parity with diesel with policy incentives	Mid 2020s		Around 2030	
Economies of scale with passenger cars	High		Low	
Range without refuelling / recharging[1]	800 km		800 km	
Refuelling / recharging time (full)	90 minutes (opportunity)		10 - 20 minutes	
Net payload loss (weight)[2]	440 kg	None	None	

1: Trips up to 800 km represent 78% of EU truck activity; FCEVs can have longer ranges of 1,000 + km which would also entail higher storage tank costs; range was aligned to allow for comparability

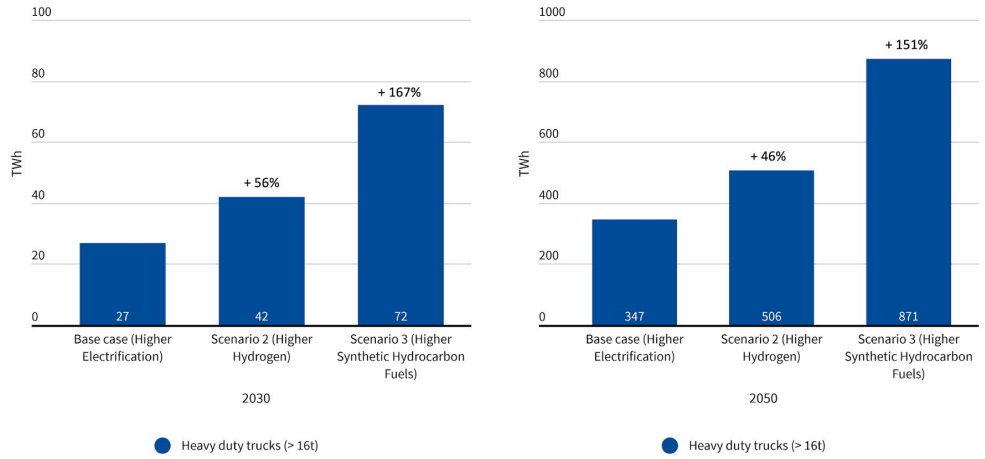
2: Assumed battery pack energy density of 245 Wh/kg in 2025 and 318 Wh/kg in 2030; additional battery weight is compensated by replacing the diesel with an electric powertrain (net 2.4 t) and the EU ZEV weight allowance (up to 2 t)

Better

For methodology and sources see also:
https://www.transportenvironment.org/sites/te/files/publications/2021_04_TE_how_to_decarbonise_long_haul_trucking_in_Germany_final.pdf

Lots of efuels? Unrealistic

Comparison of electricity requirements for heavy duty trucks (>16t) in EU27 countries



Note: Scenarios 2 & 3 correspond to higher hydrogen (HH) and higher synthetic hydrocarbon fuels (HSHC) respectively, but that doesn't mean decarbonization is achieved solely through hydrogen or synthetic fuels. In scenario 2, decarbonization is achieved through a 50:50 mix of hydrogen and electricity, and scenario 3 uses a 50:50 mix of synthetic fuels and hydrogen.

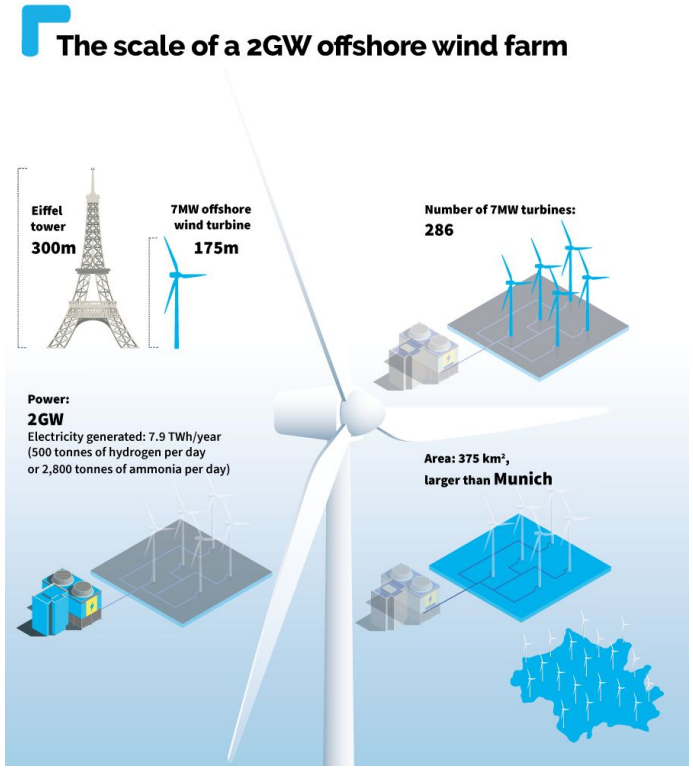
TRANSPORT & ENVIRONMENT transportenvironment.org

No direct electrification of heavy-duty zero-emission trucks, i.e. 50% hydrogen + 50% synthetic hydrocarbons

150+% more renewables needed

Source: link

An idea of scale



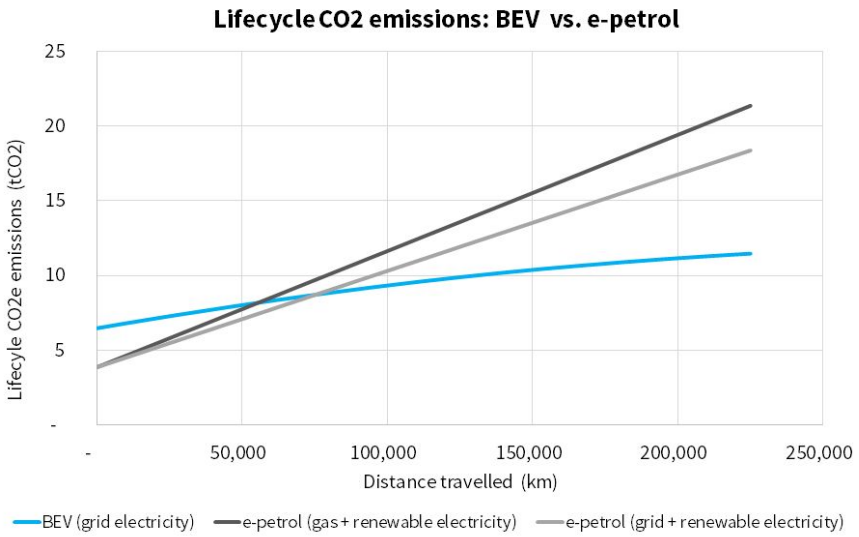
In 2030: Difference between electrification of heavy duty trucks and relying on mix of 50/50% hydrogen and ediesel is 45 TWh.

45 TWh? An *additional* 5.7 offshore wind farms of 2 GW capacity

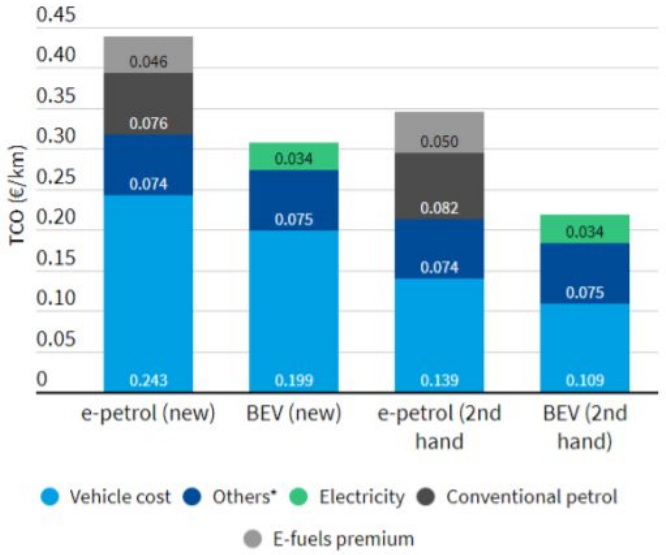
- 1630 wind turbines of 7 MW
- 7 times the area of Munich

E-fuels (in road transport)

Cars on e-petrol emit 40% more CO2 over lifetime than battery electric



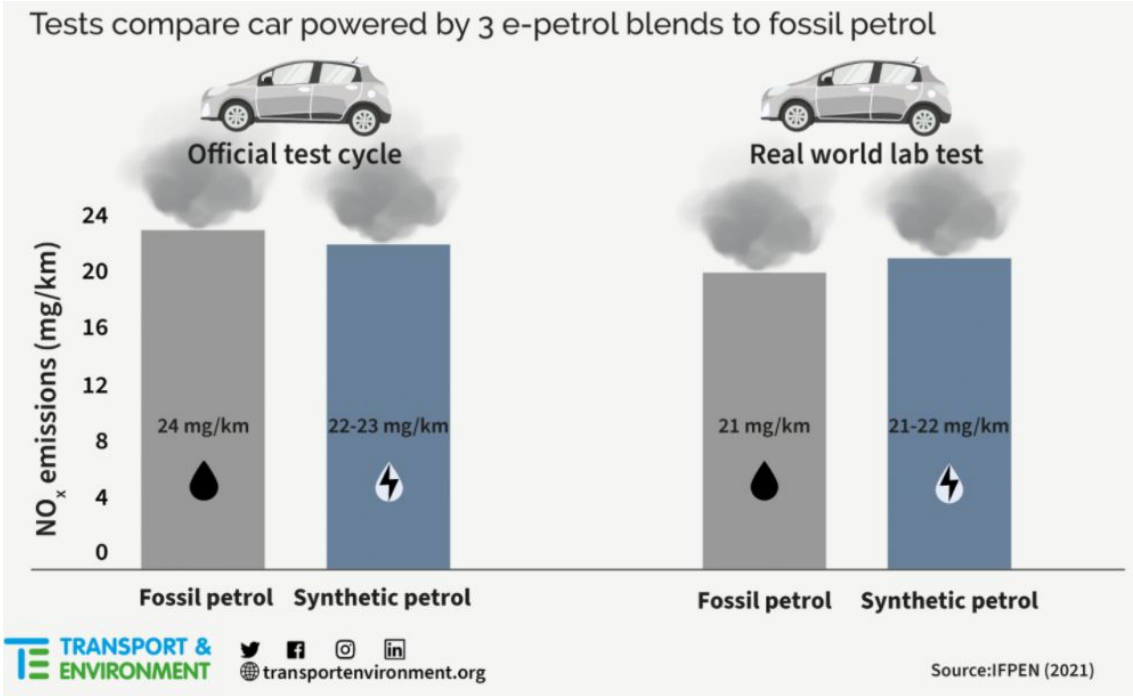
e-fuels would place a cost burden on drivers



* Others include insurance, maintenance and cost of a private charger
TCO comparison for a medium car, based on European averages and 5 year ownership period. E-fuel cost: T&E calculations based on Agora Verkehrswende et al. (2018) and Fasihi et al. (2016).

Source: Link T&E report

E-petrol emits as much poisonous NOx as fossil petrol



Also be aware:

> Mixing upstream (fuels) and downstream (vehicle engines) will result in unenforceable regulation

>> E-fuels urgently needed to decarbonise aviation, shipping and heavy industry; wasted in road transport.

Fuel credits should not be included in EU vehicle CO2 rules

Additional T&E materials on sustainable production of batteries

https://www.transportenvironment.org/discover/eu-ministers-weak-battery-recycling-targets-are-own-goal-for-economy/

https://www.transportenvironment.org/discover/batteries-will-need-to-comply-with-new-human-rights-and-green-rules/

https://www.transportenvironment.org/discover/will-there-be-enough-metals-for-the-electric-vehicle-revolution/

https://www.transportenvironment.org/discover/due-diligence-rules-for-batteries-making-them-work-for-the-environment-and-communities/

Key contact at T&E: Cecilia Mattea <cecilia.mattea@transportenvironment.org>

Aviation and shipping

- **EU ETS allowances and kerosene taxation .**
- **Advanced biofuels - limited availability** - maximum 11% in 2050.
- **Synthetic hydrocarbons ('ekerosene') : a promising alternative** - High renewable electricity demand during production and expensive.
- **ReFuelEU** under discussion.

- **Energy efficiency measures** - 30% reduction in GHG.
- **Electricity for short distances** (ferries, inland shipping).
- **Hydrogen and ammonia** have great potential to eliminate emissions of long-distance shipping.
- **FuelEU Maritime initiative** under discussion.

Key role for H2/efuels in decarbonising ships & planes

Aviation

Battery-electric limited to commuter max 500km and <20 pax (from 2026) bigger ranges + pax from 2030

Hydrogen limited to max 2,000 nm and 100-200 pax (from 2035 at the earliest)

E-kerosene for all aircraft and ranges (max 50% blend for now)

Shipping

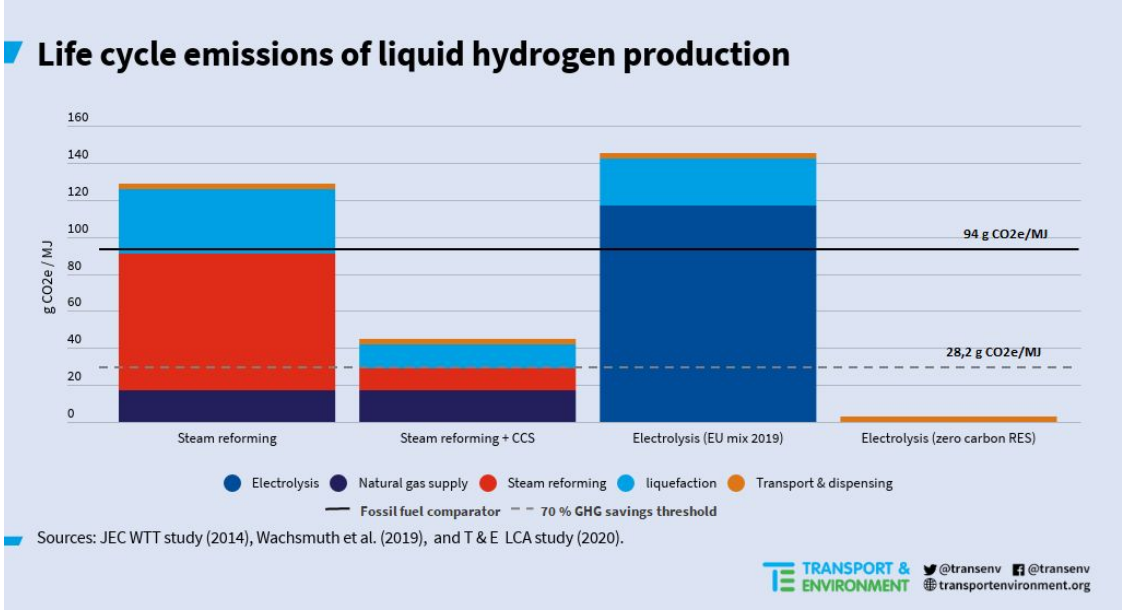
Battery-electric limited to small ships

Hydrogen fuel cells suitable for small-medium ships

E-ammonia / e-methanol / e-diesel / e-LNG for large ships)

What are green efuels?

Priority for renewable hydrogen

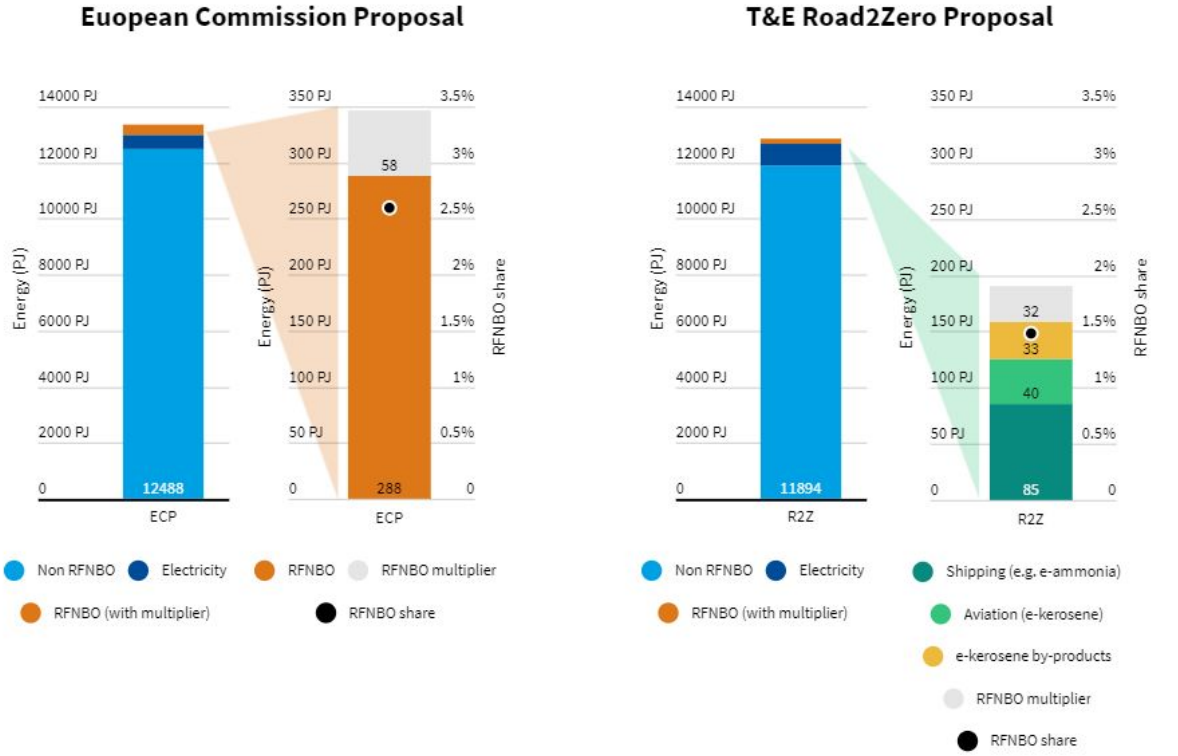


- **Renewable hydrogen-** least CO2-emitting option.
- **Blue Hydrogen -** less significant GHG savings & continued dependence on fossil gas.
- **Recommendations:**
  >exclusively support renewable H2
  >develop EU-level sustainability criteria for Renewable Fuels of Non-Biological Origin (additionality)

Blue H2 in transport is a dead-end street, not a bridge to green H2

	Blue Hydrogen	Green Hydrogen
Feedstock + technology	Steam methane reforming of fossil gas + carbon capture and storage	Renewable electricity powering electrolysis
GHG reduction	Low-carbon status questionable (due to fugitive methane)	If from additional RES-E, close to zero-carbon
Cost reduction potential	Limited, as it is a mature technology	Cheaper than blue H2 by 2030, with cheaper renewables and electrolysers
Rapid roll-out	CCS ? Despite subsidies, never happened	Ambitious, but feasible to meet 2030 demand (e.g. ships & planes)
Regulatory framework	Non-existent	Framework on Renewable Fuels of Non-Biological Origin in place by end of 2021

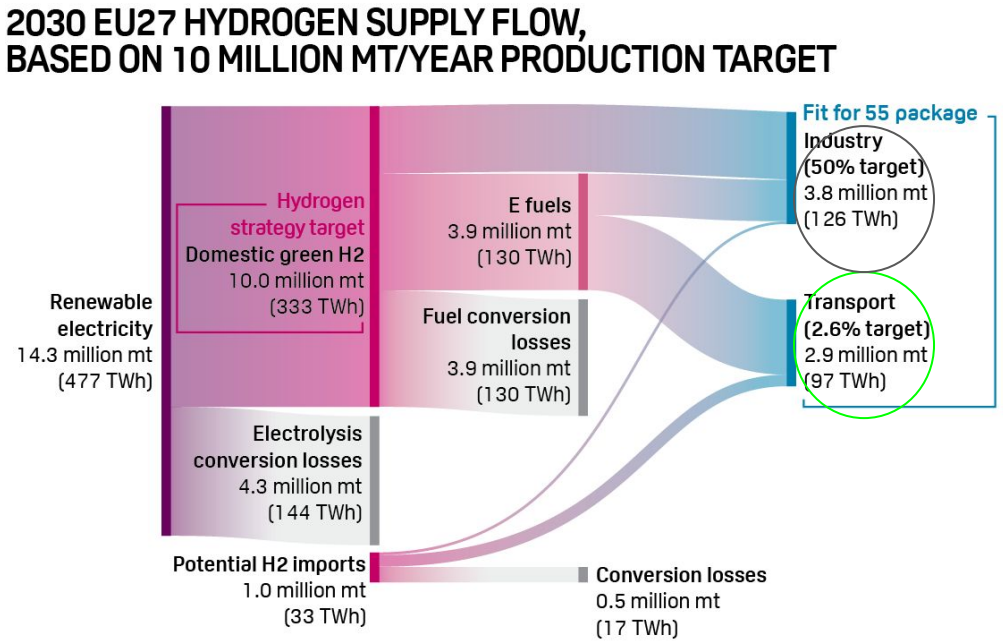
RFNBO in the RED III, 2030



VERY HIGH 2,6% RFNBO target - beyond needs of hard-to-decarbonise aviation & shipping

T&E: **1,6% RFNBO** target ambitious for aviation and shipping (source)

EU RFNBO ambitions (2.6% transport + 50% grey H2)
~ 500 TWh of additional RES-E demand



Source: Future Energy Outlooks, S&P Global Platts Analytics; EU Fit for 55 package

Source: SPGlobal

For comparison, equal to:

- More than all wind power in EU
- Electricity consumption of France
- Half of all RES-E in EU

RFNBO demand on top of 2x RES-E in power generation by 2030 (+/- 1000 TWh)

Price impact of weak RFNBO framework

+17% additional demand (500 TWh for RFNBOs), on top of electrifying heat & transport

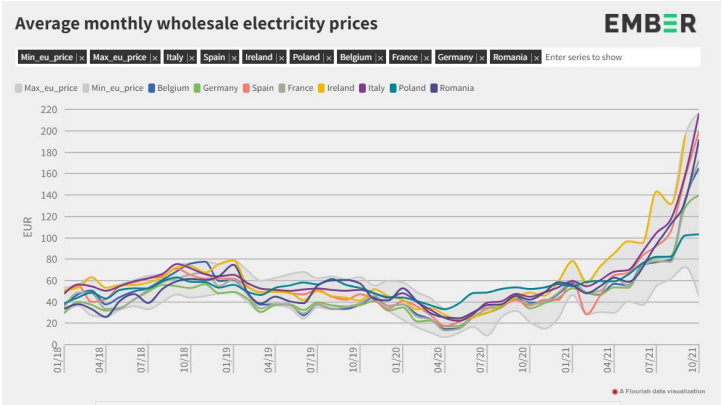
→

Electrolysers bring marginal fossil fuel /mostly gas plants 'in the money'

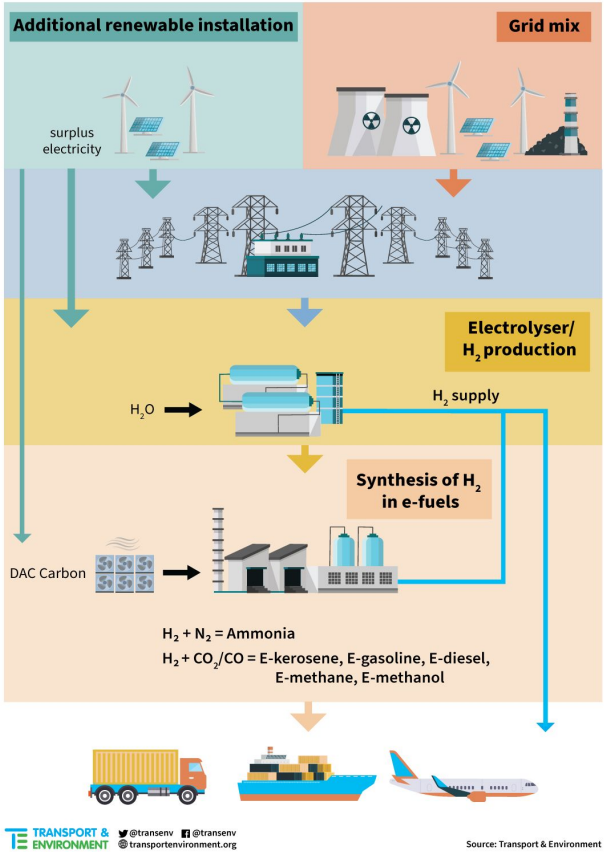
→

Price increase
More emissions

By comparison, direct electrification of 30 million passenger cars
→ 85 TWh or below 3%



Producing H2/efuels with grid-connected electrolysers



High 2,6% RFNBO target, but no sustainability criteria

RED II: At least - 70% GHG

Efuels are only as clean as the electricity used to produce them:

- *Additional* renewables to be used by electrolysers, when reliant on grid
- Avoid grid congestion

T&E briefing: “Getting it right from the start”

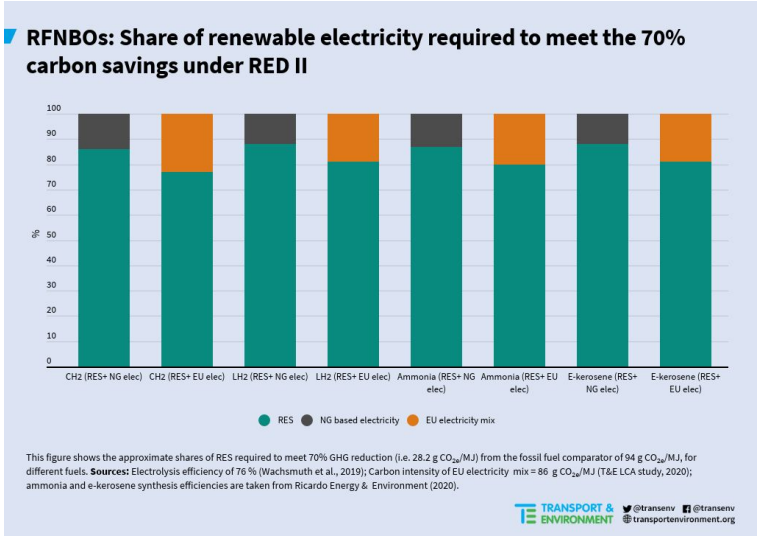
#RePowerEU - RFNBO targets doubled + Delegated acts!

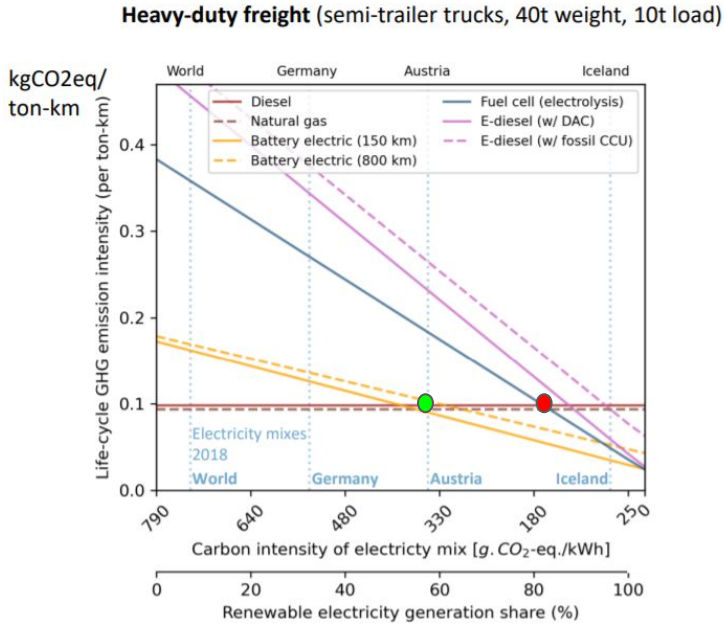
NEWS | 23 May 2022 | Brussels

Commission launches consultations on the regulatory framework for renewable hydrogen

2 delegated acts published after RePowerEU (EC website)

Additionality defined, **BUT grandfathering for pre-2027 electrolysers**





>80% RES-E needed to meet minus 70% GHG threshold in RED (Source: T&E briefing Getting it right from the start)

>80% RES-E required to reduce emissions with fuel-cell truck compared to diesel (Source: Prof Ueckerdt presentation)

Companies moving ahead, concerns about additionality overblown

Home > Clean fuel

Shell and Thyssenkrupp join in on Port of Rotterdam hydrogen facility

BUSINESS DEVELOPMENTS & PROJECTS

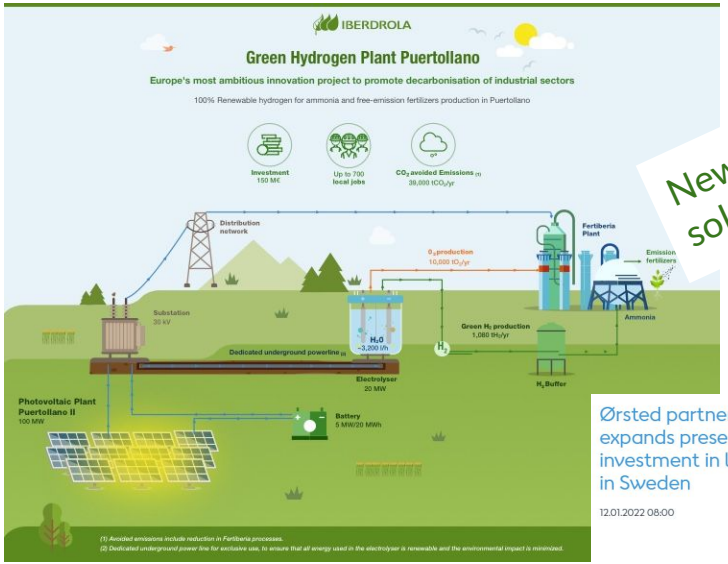
January 14, 2022, by Sanja Pekic

Shell and Thyssenkrupp have signed a supply contract for the large-scale green hydrogen production project 'Hydrogen Holland I' in the port of Rotterdam.

Holland Hydrogen I

The *Holland Hydrogen I* facility's location will be in Port second Maasvlakte. Specifically, the project is to be or **plants in the world** with a capacity of 200 MW. It also c

New, unsubsidised offshore wind in NL



New, unsubsidised solar PV in Spain

Ørsted partners with Liquid Wind and expands presence in green fuels with investment in large-scale e-methanol project in Sweden

12.01.2022 08:00

New, unsubsidised onshore wind in Sweden

Contact :

geert.dc@transportenvironment.org

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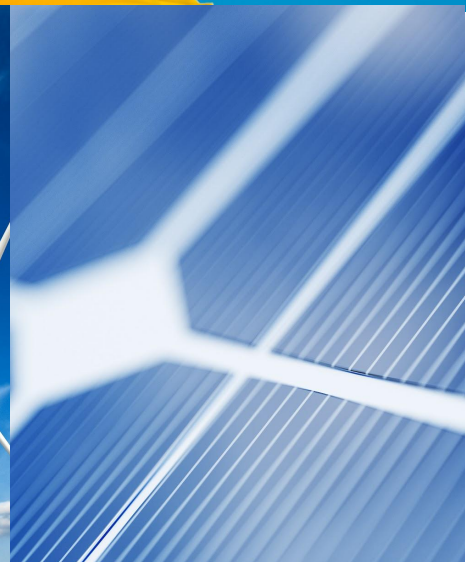
This presentation includes icons from Flaticon



Backup slides

3 cases of green H2/efuels production

Fraunhofer ISI

Case 1
Average grid electricity

Renewable share of grid mix
= renewable share of RFNBO

TU WIEN TECHNISCHE UNIVERSITÄT WIEN

Case 2
Direct connection

100% renewable RFNBO

Guidehouse

Case 3
Renewable grid electricity

100% renewable RFNBO

Scope of Delegated Act (DA)

E.g. Iceland with mix of geothermal + hydro

E.g. Electrolyser situated in areas with good renewables potential

Most electrolysers in Europe - grid needed to secure high # of operating hours

Key asks

Power Purchase Agreement For new and *unsupported* renewable electricity generation	**Guarantees of Origin** Not suitable to prove additionality, only renewability	**Temporal correlation** Hourly matching of electrolyser and RES
Geographic correlation Bidding zone	**Transition phase** Delaying additionality undermines real RFNBO's GHG savings	**Transition phase** No grandfathering

Additionality

= Power Purchase Agreement
for *new* and *unsupported* renewable electricity generation

Advantages:

- Price certainty for renewable projects ('bankable')
- Corporate PPAs well-established instrument for renewables
- 'Unsupported': PPA to cover all electricity generation and transmission costs (no feed-in tariffs, no exemption from grid tariffs)
  - Goal: no-cross subsidisation between transport & power sector
- GOs to be bundled under PPA and cancelled → "claimed only once"
- Verification of additionality via PPA straightforward
  - Smart meter data to confirm temporal correlation

Additionality

≠ Guarantees of Origin

Disadvantages:

- No price certainty for renewable projects - even for new RES-E, risk of oversupply
- Framework and market for GOs at national level varies
- No time stamp to verify e.g. temporal correlation

→ → Not in line with RED II “adding to the renewable deployment or to the financing of renewable energy”

	What?	Advantage	Disadvantage
GO	Certificate for renewable energy	Already exists	Low price due to oversupply, no guaranteed finance. No useful time stamp.
GOnew	GoO, but only for new RFNBO plants	New, but builds on current system	Same risk of oversupply as GoO, compared to RFNBO demand.No useful time stamp.
GO+	GoO, but only for new & unsupported plants	New, but builds on current system	If market builds more RES-E then RFNBO demands, GO+ value down and additionality at risk.No useful time stamp.
PPA	Agreement between purchaser and RES-E generator to pay price over an agreed period	Guarantees long-term financing, not dependent on value of certificates	Departs from GoO, easy verification of renewability

Temporal correlation

RED II recital 90

RFNBOs fully renewable *if they are produced when the contracted renewable generation unit is generating electricity*.

Initially, hourly matching of electrolyser and contracted RES

From 2025, 15' matching in line with imbalance settlement period

1h/15' **grid-level matching**, if average RES-E on grid is higher than previous years

Geographic correlation

Electrolyser and contracted RES to be in the **same bidding zone**

And not deteriorating congestion inside that bidding zone

Exception, if TSO allows it

One-way congestion - Electrolyser on oversupplied side and contracted RES on undersupplied side, improving grid balance