



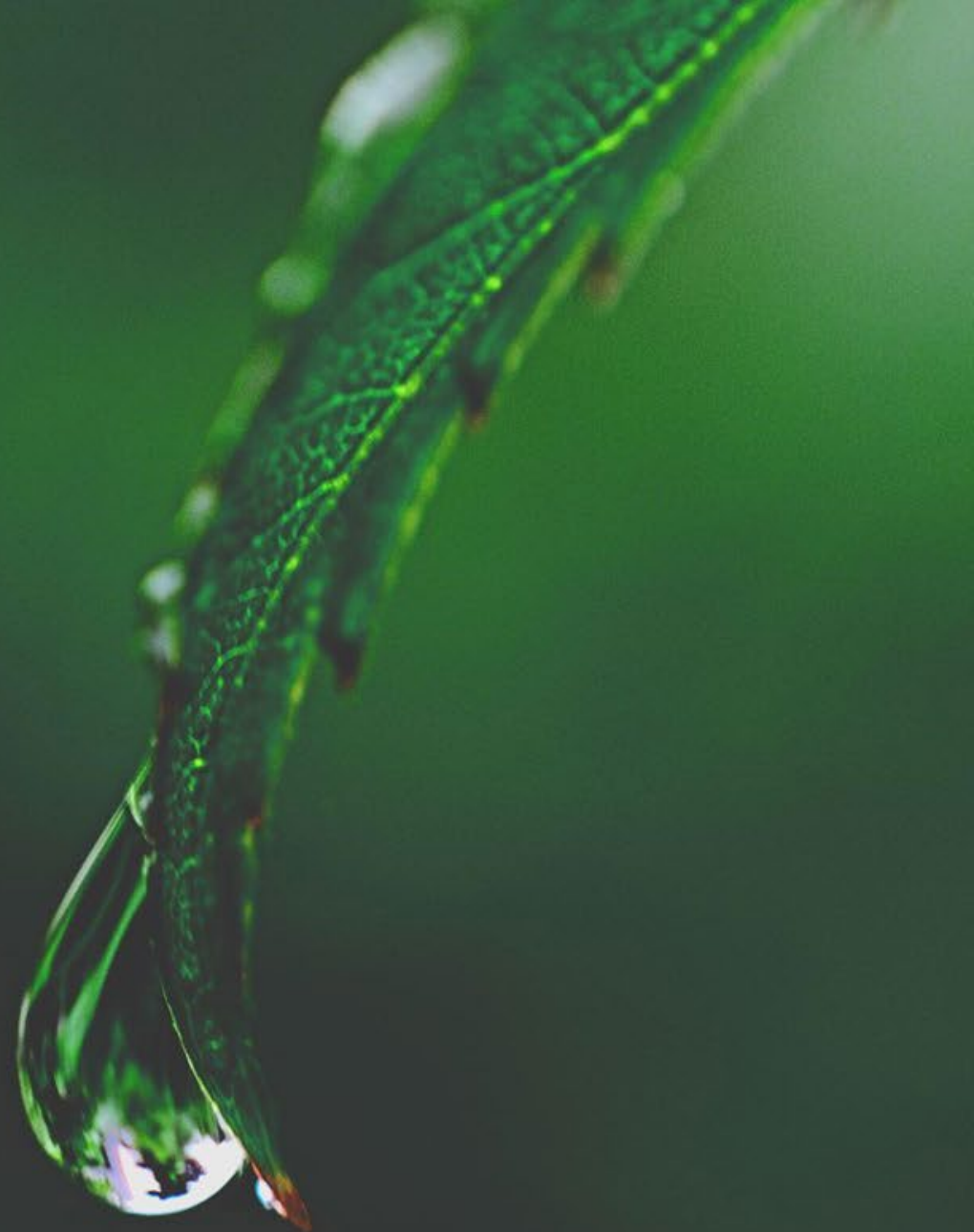
Value chain from hydrogen to CO₂ products

Bioenergiapäivä

27.9.2023

Tuomo Rinne

VP, Business development



P2X Solutions - Forerunner in hydrogen and synthetic fuels



P2X Solutions

- Private finnish company founded in 2020 by energy market experts
- Producer and distributor of hydrogen and synthetic fuels like e-methane, e-methanol and e-ammonia
- Green hydrogen is produced using renewable electricity and water
- Green hydrogen and its derivatives will be used in the future as a fuels and in industrial processes
- P2X Solutions' first 20MW green hydrogen production plant is under construction and operational in 2024
- Targeting to 1GW of electrolyser capacity by 2031

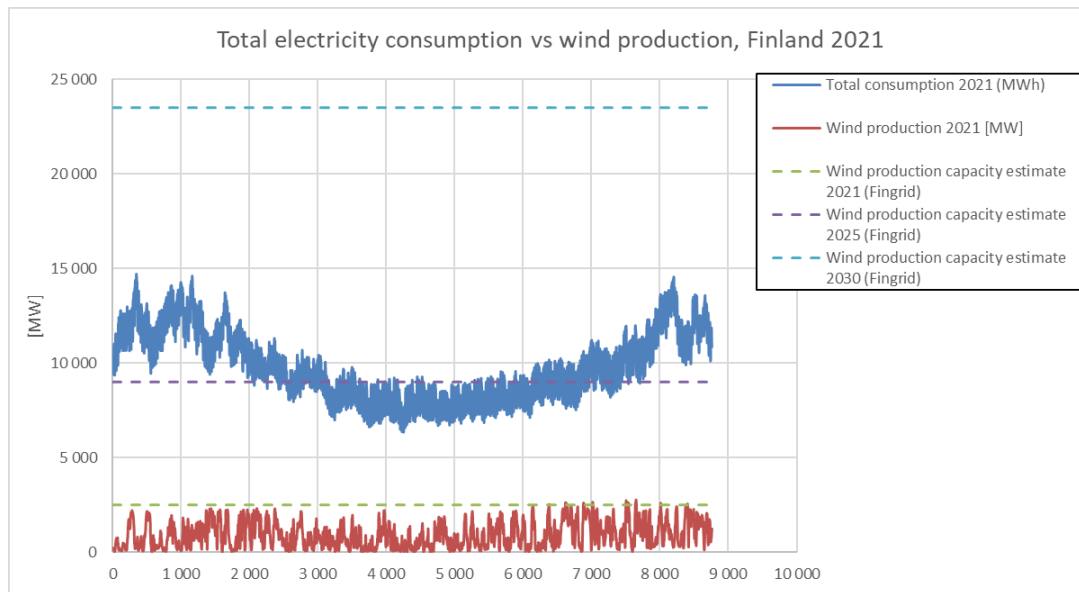


An aerial photograph showing a lush green forested coastline meeting a large body of water. The forest is dense and covers the land on the left and top of the image. The water is a deep blue, and there are some small islands or peninsulas visible. In the bottom left corner, there is a circular inset showing three wind turbines against a sunset sky.

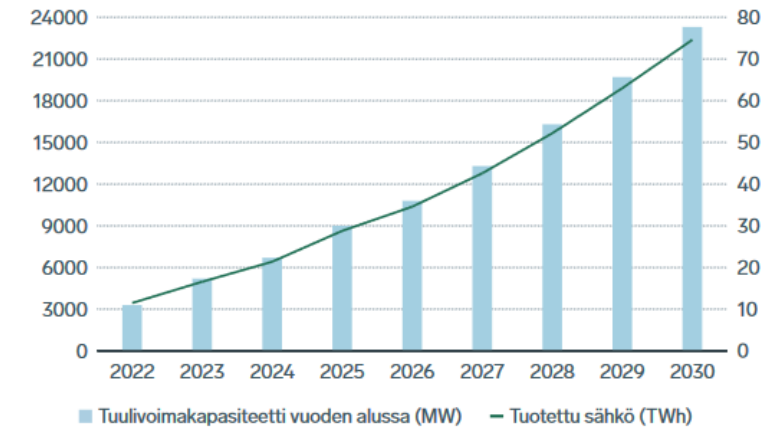
Gouvernement has adopted resolution on
hydrogen – Finland can manufacture 10% of
EU's green hydrogen by 2030

Electricity consumption and wind power in Finland

- Total consumption 6-15GW
- Export/Import capacity ca. 6GW by 2035 (without Russia)
 - Aurora line commissioning in 2025 (900MW)
- Stable nuclear production ~4,4GW

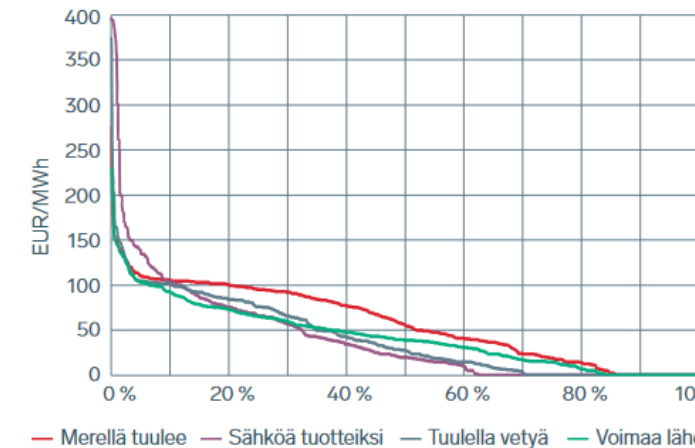


Tuulivoiman tuotantokapasiteetti ja sähköntuotanto



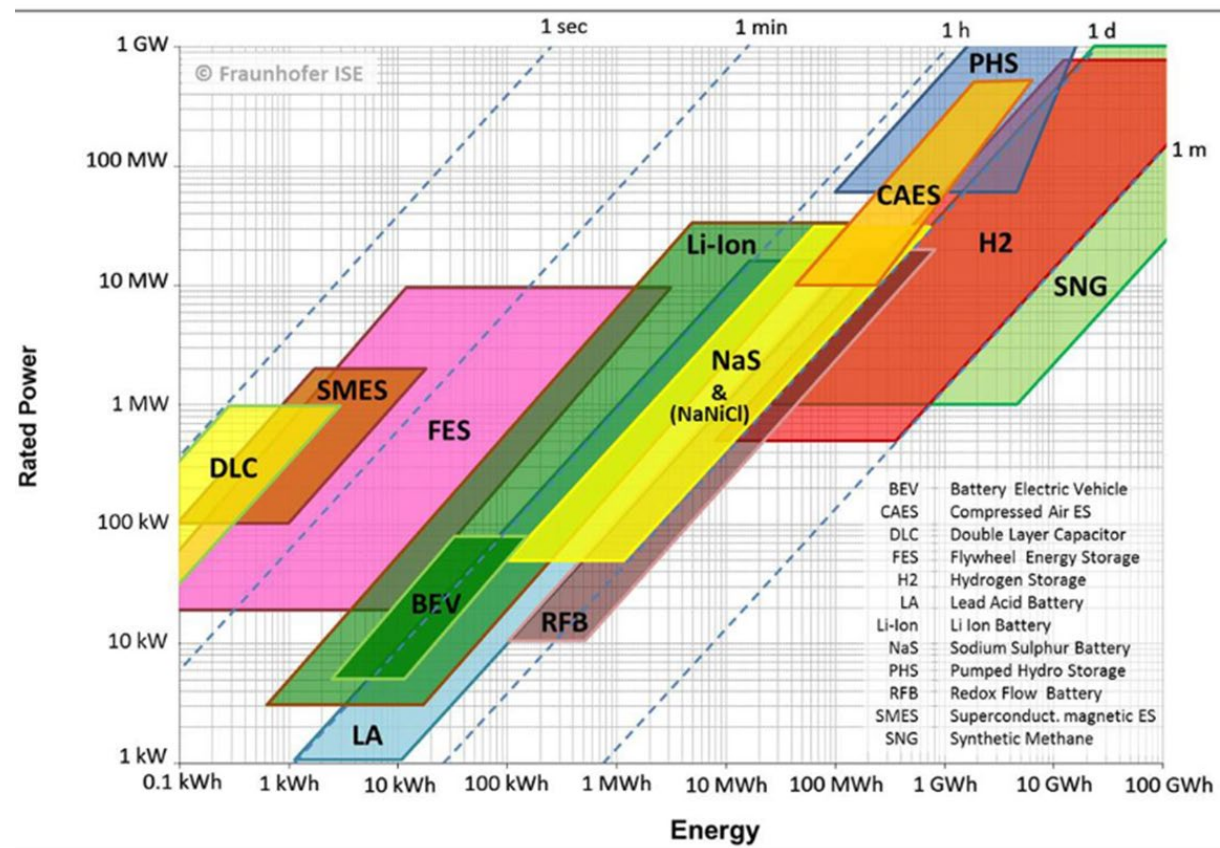
Kuva 26. Tuulivoiman kasvuskenaario.

Kuva 14 Sähkön hinnan pysyvyys vuoden 2035 -skenaarioissa (mediaani).



Source: Fingrid

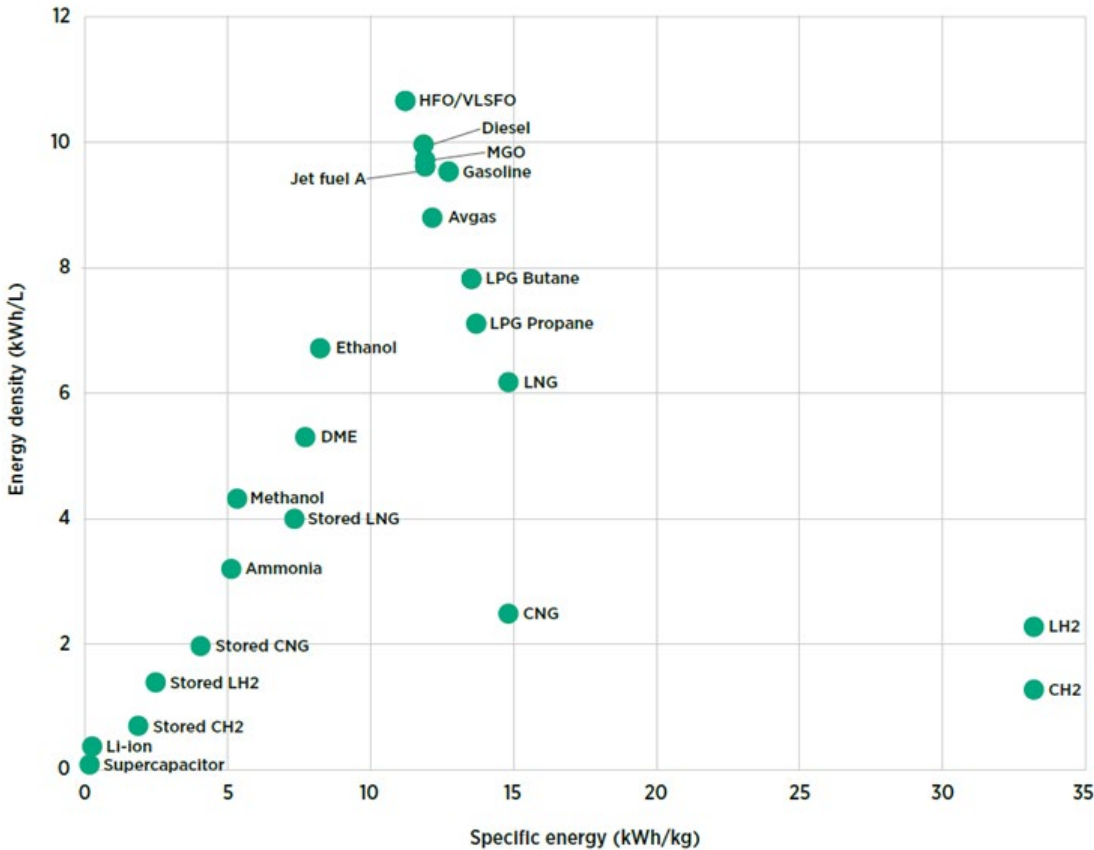
Energy storages



Sources:

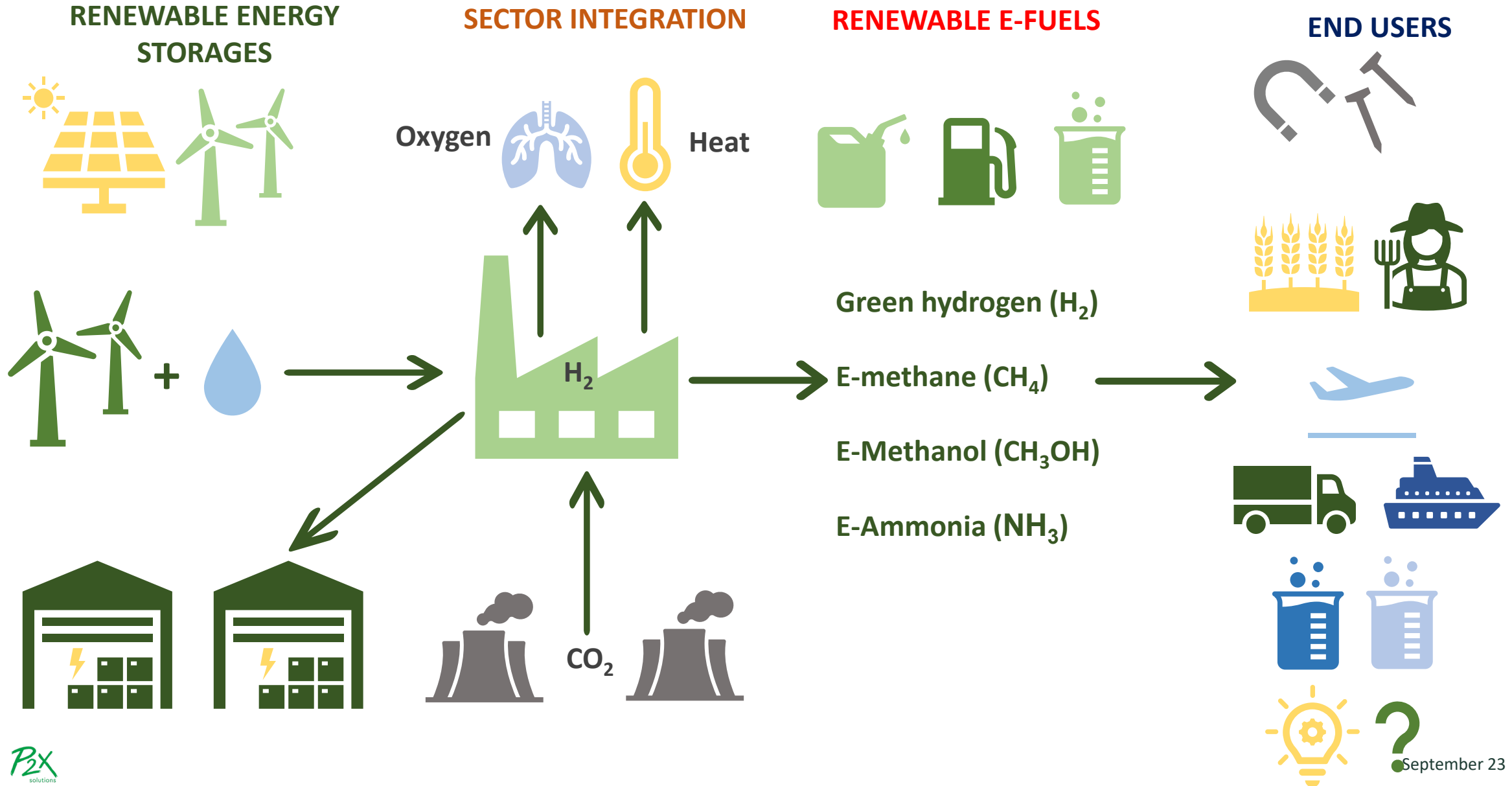
https://www.innoenergy.com/media/3668/pr-4_business-models.pdf

<https://www.irena.org/Energy-Transition/Technology/Hydrogen>



Notes: Avgas = aviation gasoline; CH2 = hydrogen compressed at 70 MPa; CNG = natural gas compressed at 25 MPa; DME = dimethyl ether; HFO/VLSFO = heavy fuel oil/very low sulphur fuel oil; LH2 = liquefied hydrogen; Li-ion = lithium-ion battery; LNG = liquefied natural gas; LPG = liquefied petroleum gas; Stored CNG = Type IV tank at 250 bar; Stored CH2 = best available CH2 tanks at 70 MPa; Stored LH2 = current small-scale LH2 on-board tanks; Stored LNG = small-scale storage at cryogenic conditions; MGO = maritime gasoil. Numbers are expressed on a lower heating value (LHV) basis. Weight of the storage equipment is included.

Green hydrogen enables energy transition



Hydrogen production - Electrolysis

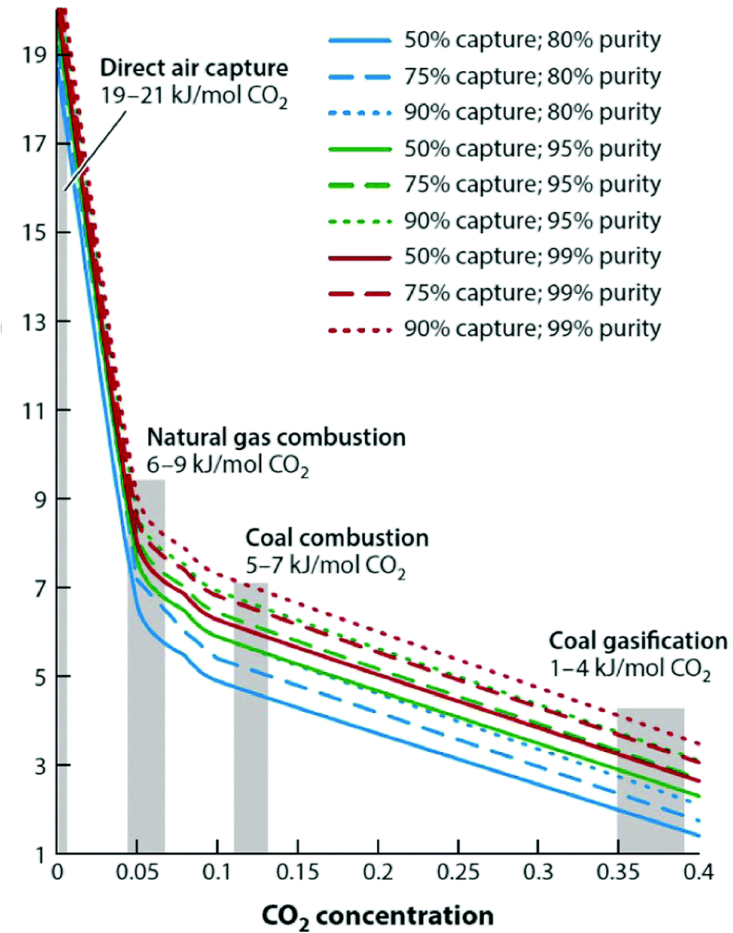
- Breaking water (H_2O) into hydrogen (H_2) and oxygen (O_2)
- As a by-product heat is created
 - Efficient use of heat will improve the business case
- Technologies
 - Alkaline electrolysis
 - Proton exchange membrane electrolysis (PEM)
 - Solid oxide eletrolysis cell, SOEC



CO₂ capture

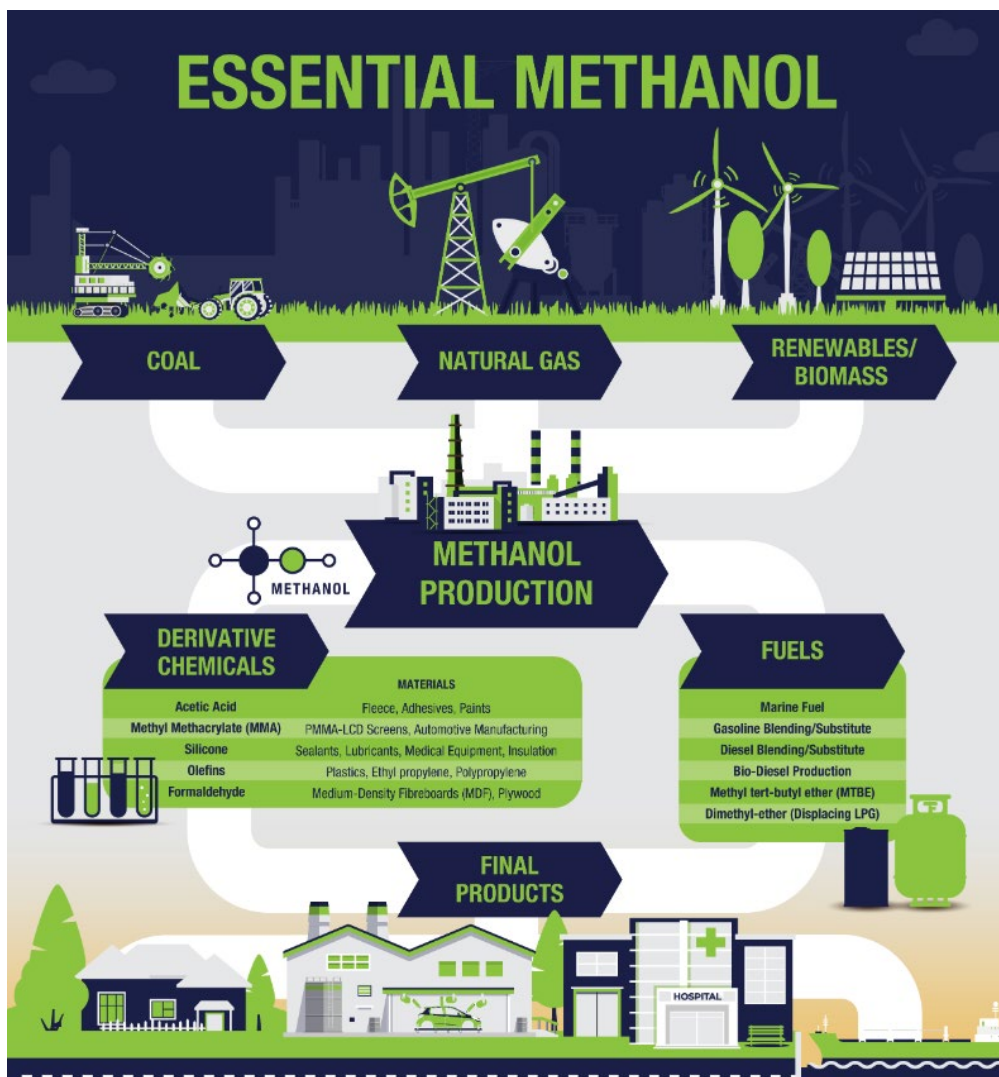


Direct air capture facility ORCA/Climeworks,
Iceland
Capacity: 4000tCO₂/year



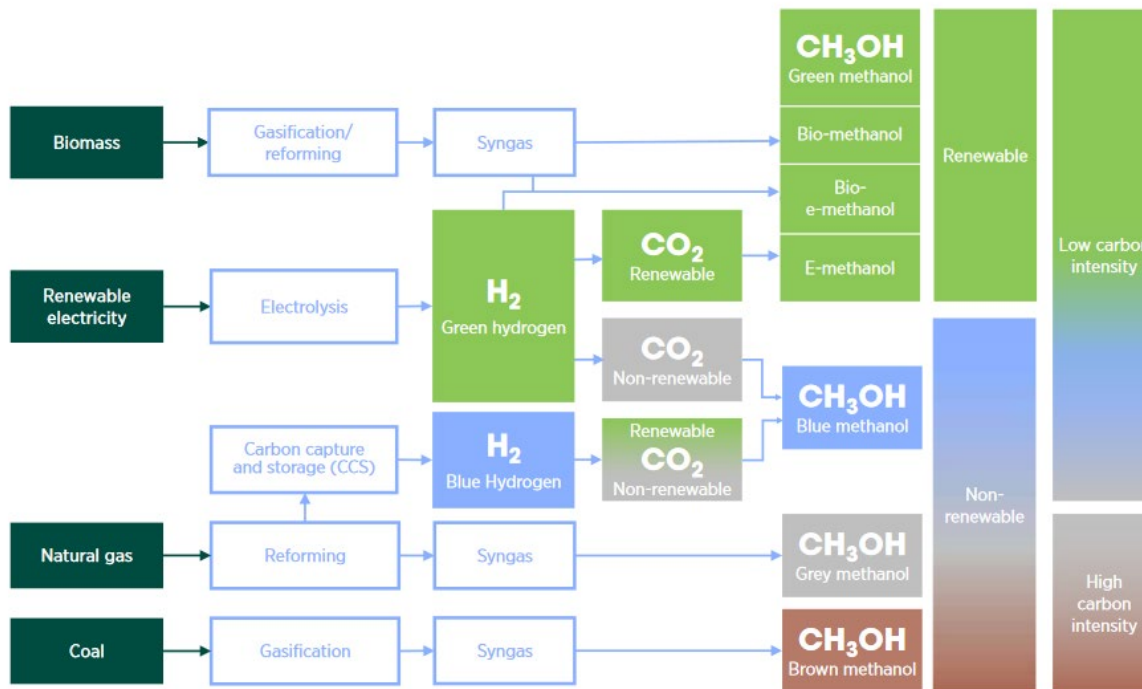
Petra Nova, CCU/EOR plant, Texas US
Capacity: 1 400 000tCO₂/year

Synthetic hydrocarbon example - Methanol



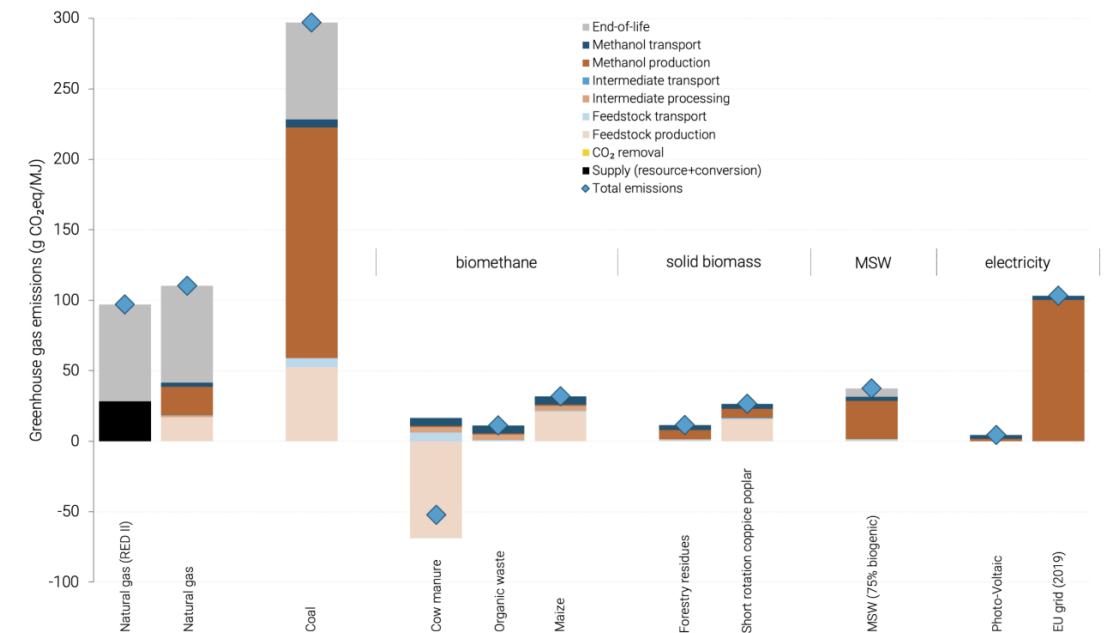
Methanol - emissions

Figure 2. Principal methanol production routes



Source:

https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/Jan/IRENA_Innovation_Renewable_Methanol_2021.pdf



Source: https://www.studiogearup.com/wp-content/uploads/2022/02/2022_Methanol-Institute_Carbon-Footprint-of-Methanol.pdf

Fossil fuels vs renewable alternatives - Costs

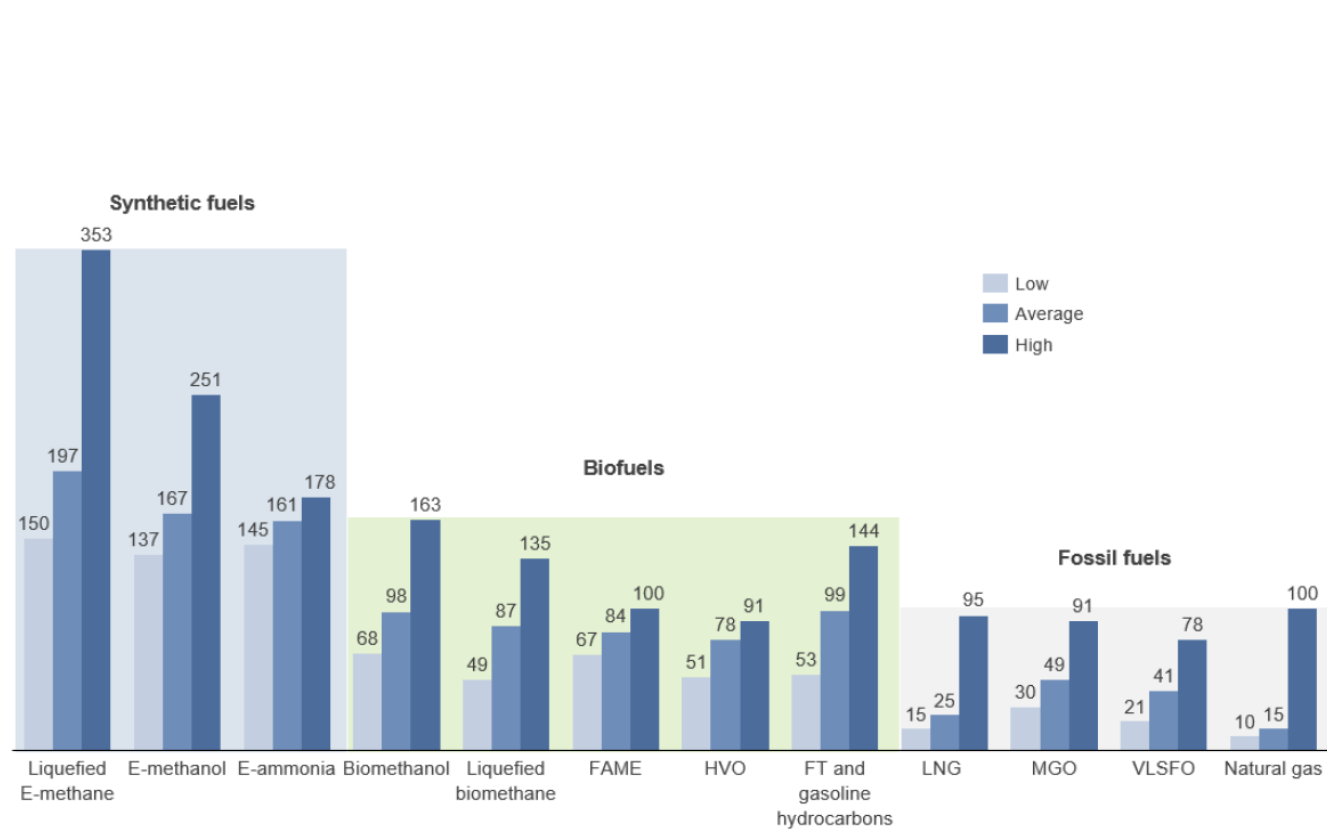
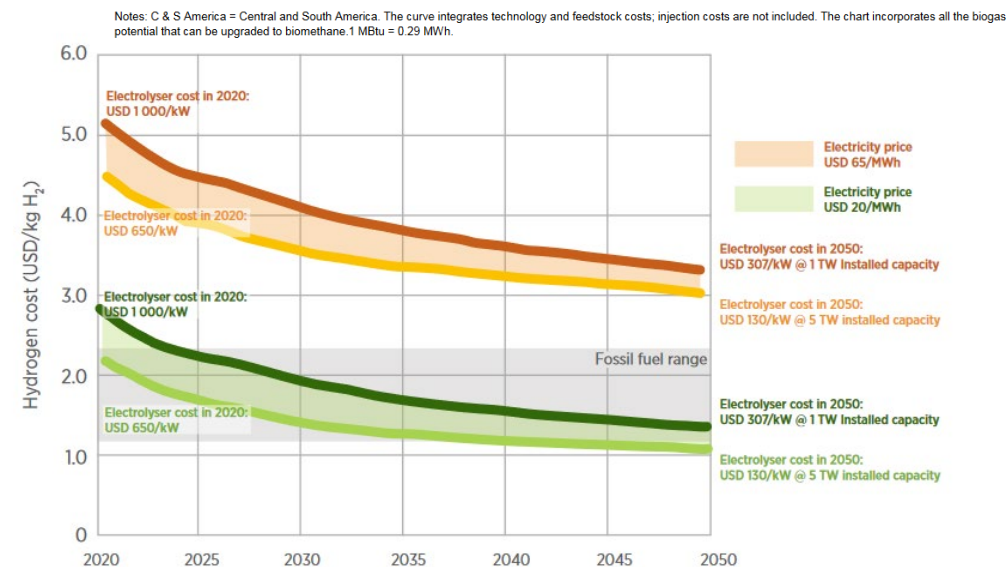
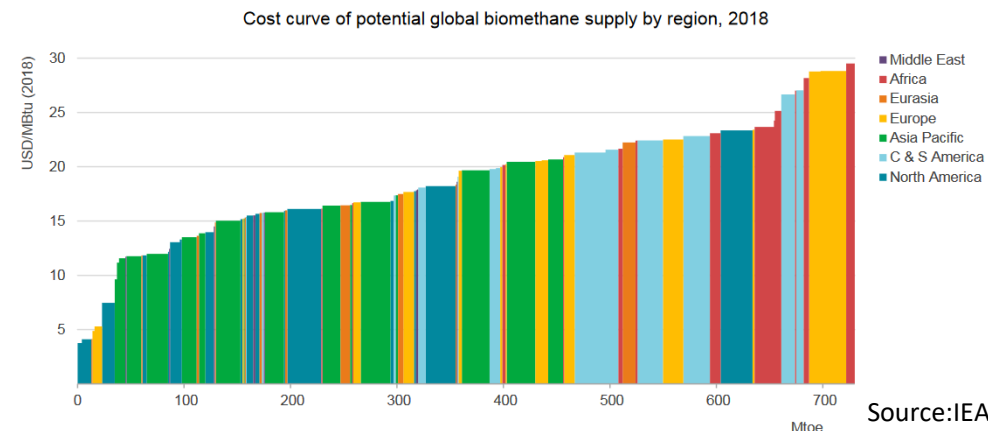


Figure 23. Levelized cost of fuel production in 2020 and fossil fuel price levels between 2017-2022, €/MWh.

Sources: Gaia/2022



Source: Irena

Introducing price for emissions - ETS



ETS current sectors



electricity and heat generation



energy-intensive industry sectors (e.g. oil refineries, steel industry, cement, glass and paper production)



commercial aviation (flights within the European Economic Area)

the ETS to cover new sectors:



→ extension to **maritime transport** (introduced gradually between 2024 and 2026)



→ a separate new ETS for **buildings, road transport and fuels** for additional sectors



Source:

<https://www.consilium.europa.eu/en/infographics/fit-for-55-eu-emissions-trading-system/>

<https://tradingeconomics.com/commodity/carbon>

We will open green hydrogen market in Finland with first 20MW production plant in Harjavalta

Summary

Green hydrogen	E-methane	20 MW	2024	~70M €
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- **Production plant:** 20 MW green hydrogen and synthetic e-methane production plant next to Industrial park Harjavalta
- **Products**
 - Green hydrogen from water and renewable electricity
 - Renewable synthetic methane from green hydrogen and CO₂
- **Investment decision:** January 2022
- **Public funding:** 26 MEUR grant from Ministry of economic affairs and employment and 10 MEUR capital loan from climate fund
- **Operational readiness:** Summer 2024
- **Technologies:** Pressurized alkaline electrolyzer from Sunfire GmbH:Ita, biological methanation plant from Q-power

Green hydrogen and synthetic methanol production plant in Joensuu

Summary

Green hydrogen E-methanol 30 MW 2025-2026



Picture: Yle Uutiset

- **Production plant:** 30 MW green hydrogen production plant at Iiksenvaara, Joensuu
- **Partner:** Local energy company Savon Voima.
- **Products**
 - Green hydrogen from water and renewable electricity
 - Oxygen and heat as by products to be used locally
 - Renewable synthetic methanol from green hydrogen and CO₂
- **Investment decision:** January 2022
- **Public funding:** Joensuu plant has been notified by EU Commission as part of the IPCEI-framework. Public funding process ongoing.
- **Operational readiness:** H1/2026

2 minute read · January 20, 2023 4:46 PM GMT+2 · Last Updated 4 days ago

Construction of Finland's first green hydrogen plant begins

Reuters



Harjavalta Green hydrogen production plant is under construction – Hydrogen production starts in summer 2024

We change the world to become
cleaner – together



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