Stanje na področju uporabe vodika in vodikovih tehnologij v Sloveniji

mag. Marko Bahor
vodja službe za strateško
inovacijske programe in koncepte

ELES, d.o.o.
Področje za strateške inovacije

ELES

Osebna predstavitev – mag. Marko Bahor

ISKRA Kondenzatorji, d.d.
okt.1994 – jan.2001 (6y 4m)

CABLEX, d.o.o.
jan.2001 – dec.2008 (8y -m)

VPK, d.o.o.
jan.2009 – avg.2010 (1y 8m)

ECI Electrical Components International Inc.
sep.2010 – dec.2011 (1y 3m)

RIKO, d.o.o., industrijski gradbeni inženiring in leasing
dec.2011 – okt.2019 (7y 11m)

HSE, d.o.o.
nov.2019 – jul.2024 (4y 9m)

ELES, d.o.o.
avg.2024 – danes (1y 10m)

mag. Marko BAHOR, univ.dipl.inž.str., MBA

- magister strojništva
  UNI LJ, Fakulteta za strojništvo, 1998;
- magister organizacije in poslovodenja
  UNI LJ, Ekonomska fakulteta, 1998;
- certifikat ZNS;
- EUREM Evropski energetski menedžer;
- …

Namen in vsebina

- Predstaviti stanje na področju vodika v tujini in pri nas
- Razbliniti kakšen mit glede vodikovih tehnologij

Vodik – osnovne vrednosti energetske pretvorbe

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Hydrogen | Basic math

Hydrogen physics

- 1 kg ↔ 11,1 Nm³ ↔ 33,3 kWh (LHV) and 39,4 kWh (HHV)
- High mass energy density (1 kg H_2 = 3,77 l gasoline)
- Low volumetric density (1 Nm³ H_2 = 0,34 l gasoline)

Hydrogen production from water electrolysis (~5 kWh/Nm³ H_2)

- **Power:** 1 MW electrolyser ↔ 200 Nm³/h H_2 ↔ ± 18 kg/h H_2
- **Energy:** +/- 55 kWh of electricity → 1 kg H_2 ↔ 11.1 Nm³ ↔ ± 10 liters demineralized water

Power production from a hydrogen PEM fuel cell from hydrogen (+/- 50% efficiency)

- **Energy:** 1 kg H_2 → 16 kWh

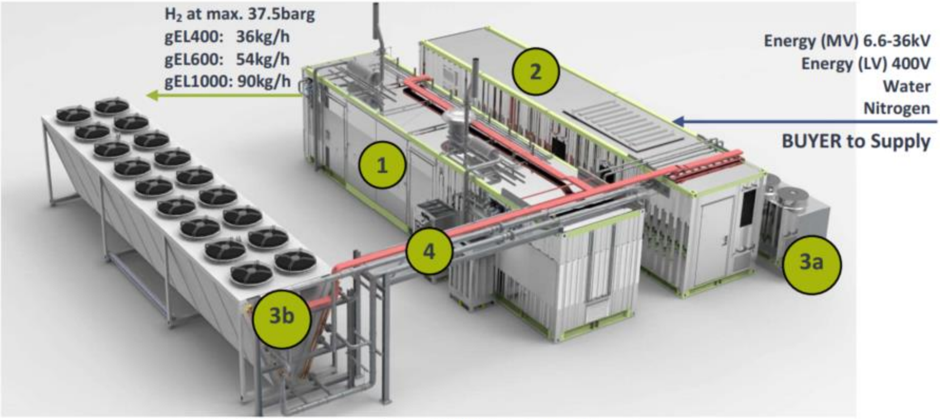
$\eta \sim 30\%$

Cars and buses

FCEV	H_2 tank	H_2 consumption	Driving range	Annual driving distance	Annual H_2 consumption
Car (passenger)	5 kg	1 kg/100 km	500 km	15.000 km	150 kg
Bus (12 m)	35 kg	8 kg/100 km	350 km	60.000 km	5 tons

***Vir:** HYDROGENICS, ETIP Wind – Wind2H$_2$,Brussels, februar 2019*

Vodik – proizvodnja vodika z elektrolizo



Typical representation of a 2 and 3MW electrolyser equipment

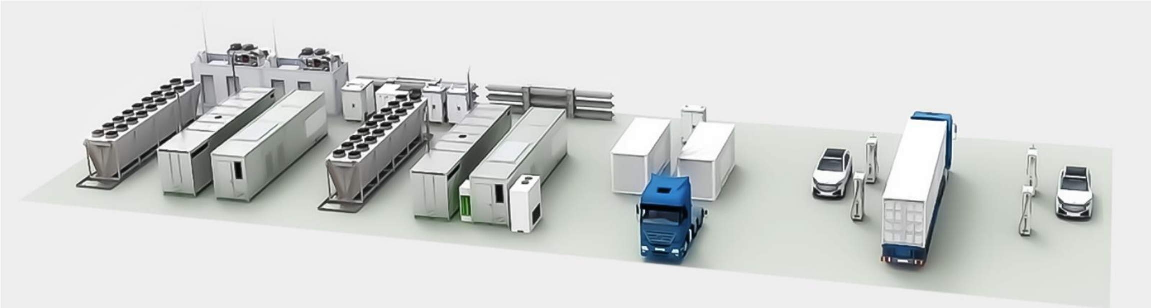
1 **Power to gas container:**
PEM stacks, H2 process, Deoxo-dryer

2 **Power container:**
transformer, rectifier, controls, RO/EDI

3a **Chiller** (gas cooling)

3b **Air/water re-cooler** (process & rectifiers)

4 **Interconnecting piping/cabling**



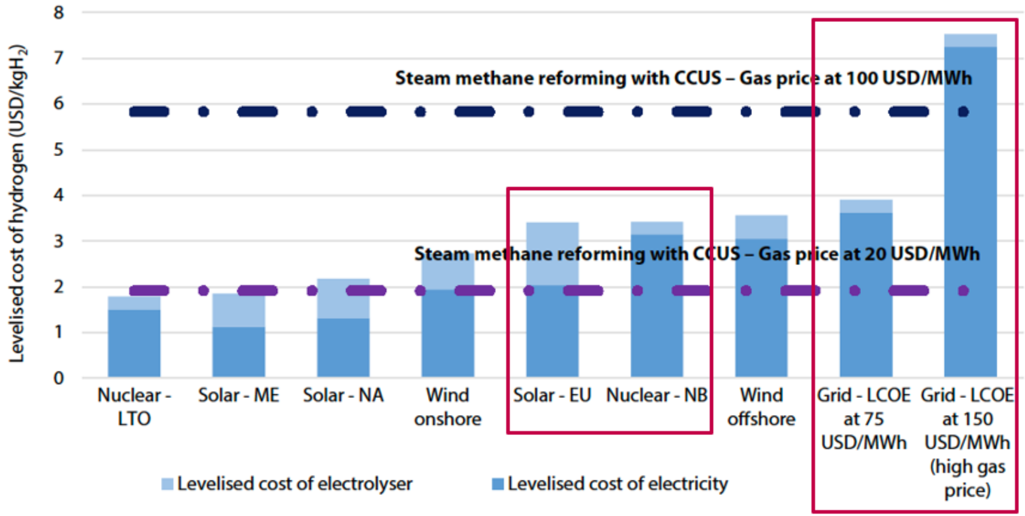
6 MW + Trailer Filling + Hydrogen Refueling Station

Vir: *FEST GmbH, https://fest-group.de/loesungen/integrierte-wasserstoff-elektrolyseanlagen/*

Vodik – cena glede na tehnologijo

Cene vodika iz različnih tehnologij (NEA, 2022)

Proizvodna cena vodika - LCOH ($/kg), 2035

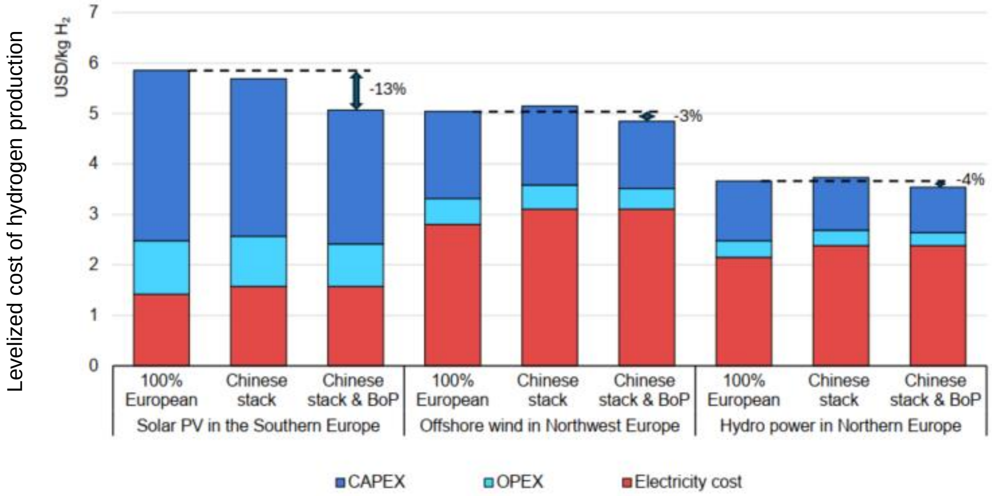


Note: LTO = long-term operation; ME = Middle East; NA = North America; EU = European Union; NB = new build.

- Glavni dejavnik cene H2: cena EE (kjer je load factor >35%)
- Ob primerljivo nizkih cenah EE in plina je elektroliza lahko konkurenčna SMR
- V primeru utility scale SE in visokega load factorja je vodik iz EE iz SE v nekaterih regijah (NA, ME) lahko konkurenčen vodiku iz obstoječih JE, ne pa v EU (JE !)
- Vodik na osnovi cene EE iz omrežja ni konkurenčen

Vir: *Vodikova strategija Republike Slovenije, Center poslovne odličnosti, Ekonomska fakulteta Univerze v Ljubljani, november 2023*

Vodik – cena glede na lokacijo in poreklo



Notes: BoP = balance of plant. "100% European" refers to a project configuration which only uses equipment manufactured in Europe, with an electrolyser CAPEX of USD 2 300/kW. "Chinese stack" refers to a project configuration using electrolyser stacks imported from China with all the rest of the equipment procured from original equipment manufacturers (OEMs) from Europe, with an electrolyser CAPEX of USD 2 150/kW. "Chinese stack & BoP" refers to a project configuration using electrolyser stacks and the rest of BoP components imported from China, with an electrolyser CAPEX of USD 1 800/kW. Electrolyser efficiency is 62% for "100% European" and 56% for the other two cases. The total import cost of Chinese components includes the manufacturing cost in China, shipping costs and an import tariff of 3.7% tariff on electrolyser stacks and 2% on BoP components. Engineering, procurement and construction (EPC) and contingency costs are considered to be at European prices for all project configurations.

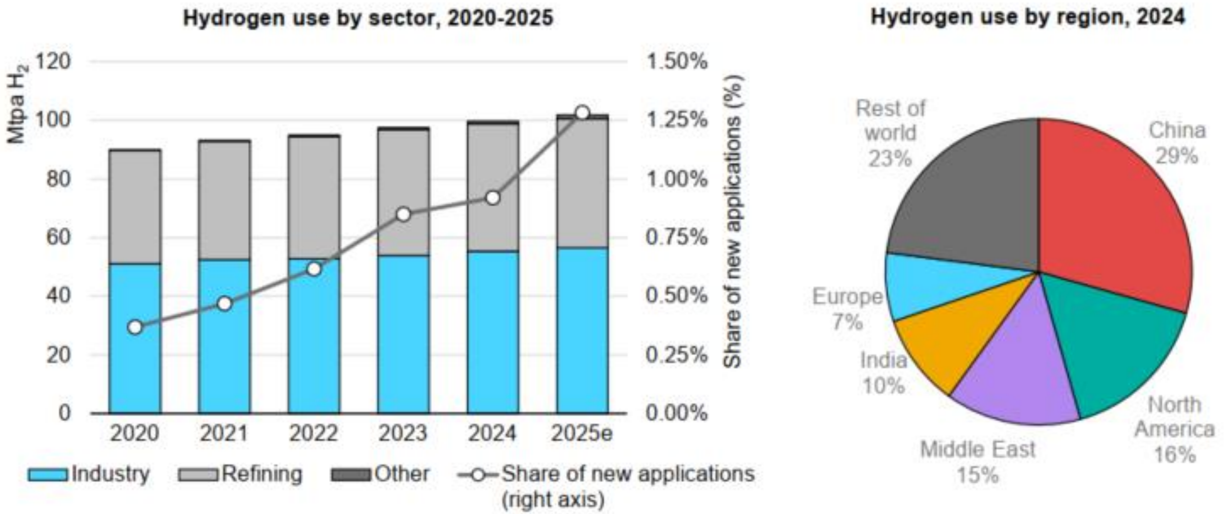
Sources: IEA analysis based on data collected through a survey to original equipment manufacturers, EPC companies and project developers, data from McKinsey & Company and the Hydrogen Council; BloombergNEF, Argus Media Group,

Despite the significantly lower CAPEX of Chinese electrolysers, their use in projects outside of China leads to only small reductions in the cost of producing hydrogen.

Vir: *IEA, Global Hydrogen Review 2025, september 2025*

Poraba vodika v svetu

Hydrogen demand by sector and by region, 2020-2025



Notes: "Other" includes transport, power generation, production of hydrogen-based fuels, buildings and biofuels upgrading. The estimated value for 2025 (2025e) is a projection based on trends observed until July 2025.

Sources: IEA analysis based on data from Argus Media Group, All rights reserved, International Fertilizer Association, World Steel Association.

Global hydrogen demand keeps rising but remains concentrated in traditional applications in refining and the chemical sector.

Vir: *IEA, Global Hydrogen Review 2025, september 2025*

Proizvodnja vodika v svetu

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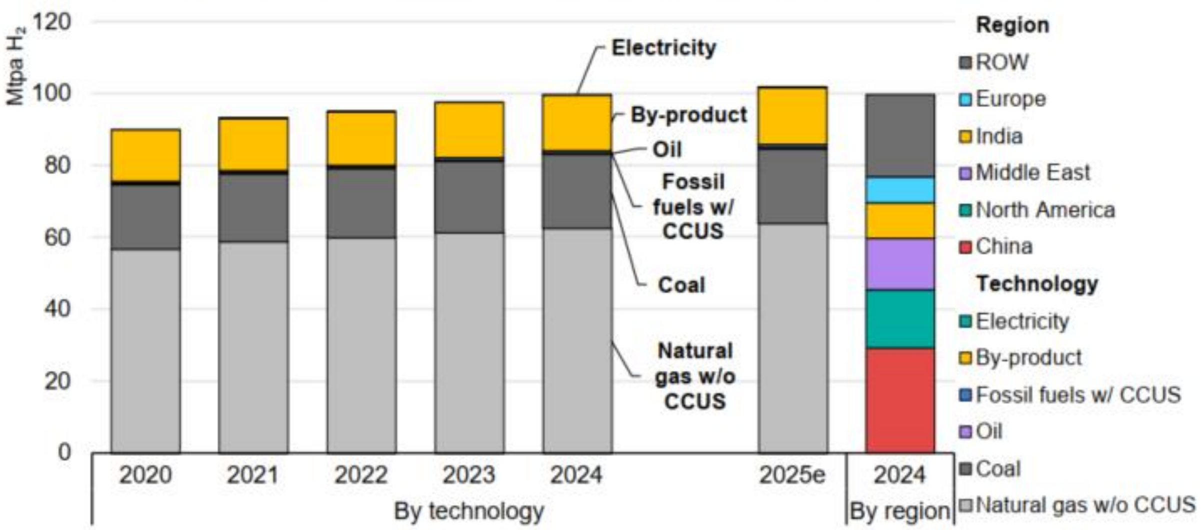
Hydrogen production by technology and by region, 2020-2025e



Notes: CCUS = carbon capture, utilisation and storage; ROW = rest of world; 2025e= estimate for 2025, based on trends observed until July 2025. By-product hydrogen includes production in catalytic naphtha crackers and steam crackers which is subsequently used in refining.

Hydrogen production remains dominated by unabated fossil fuels and is largely concentrated in a few key regions.

Vir: *IEA, Global Hydrogen Review 2025, september 2025*

Proizvodnja vodika v svetu

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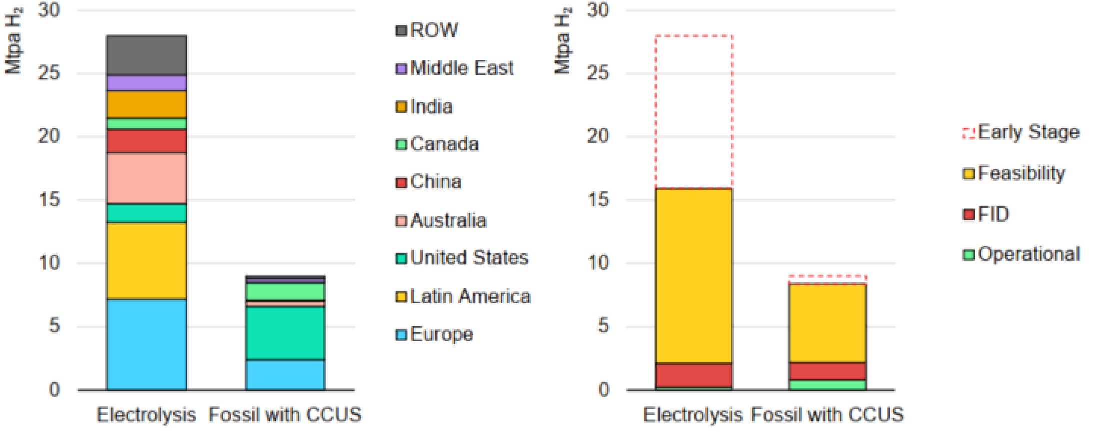
Low-emissions hydrogen production by technology, region and status based on announced projects, 2030



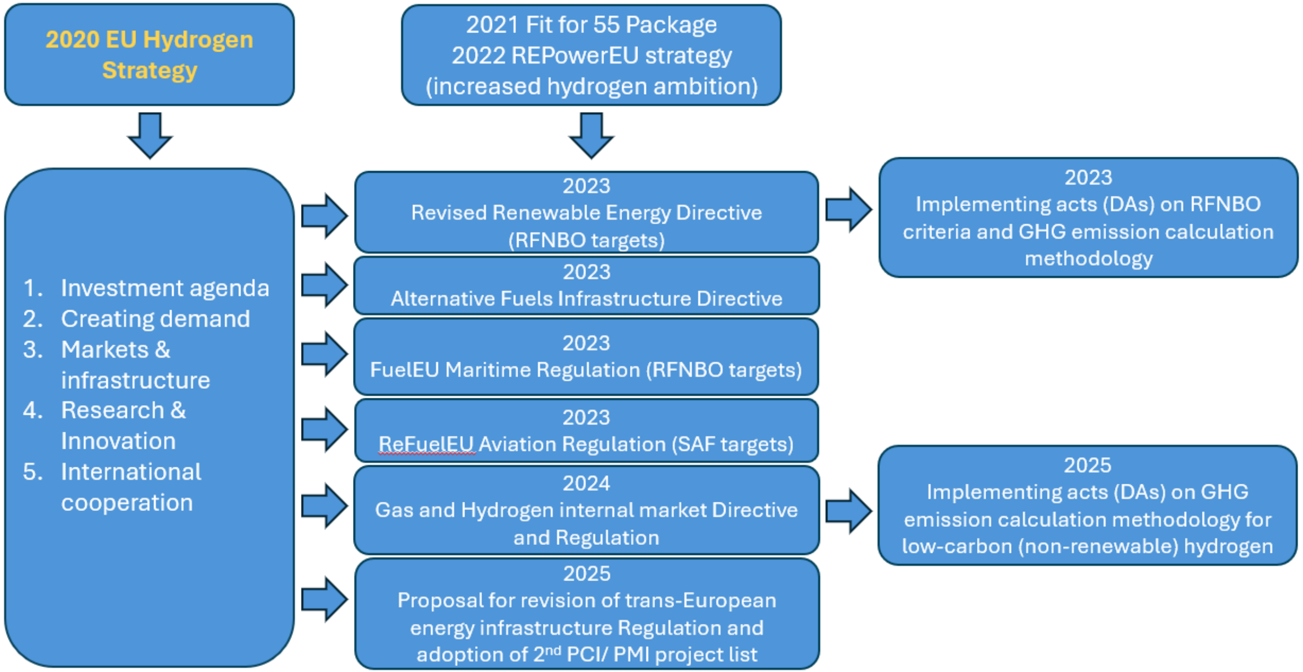
Notes: CCUS = carbon capture, utilisation and storage; FID = final investment decision; ROW = rest of world. FID 2030 includes projects that have reached FID and those that are under construction. "Feasibility" includes projects undergoing a feasibility study; "Early stage" includes projects at early stages of development, such as those for which only a co-operation agreement among stakeholders has been announced. Only planned projects with a disclosed start year of operation are included. More details about announced projects for low-emissions hydrogen production can be found in the new Hydrogen Tracker available on the IEA website.

Source: IEA Hydrogen Production Projects Database (September 2025).

Low-emissions hydrogen production could reach 27 Mtpa by 2030, but only 4.2 Mtpa are operational, under construction or have reached FID.

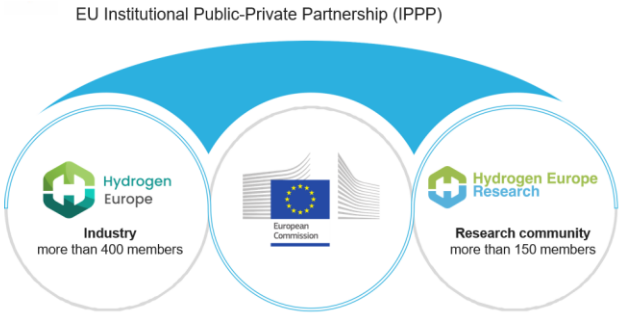
Vir: *IEA, Global Hydrogen Review 2025, september 2025*

Okvirji EU politik na področju vodika

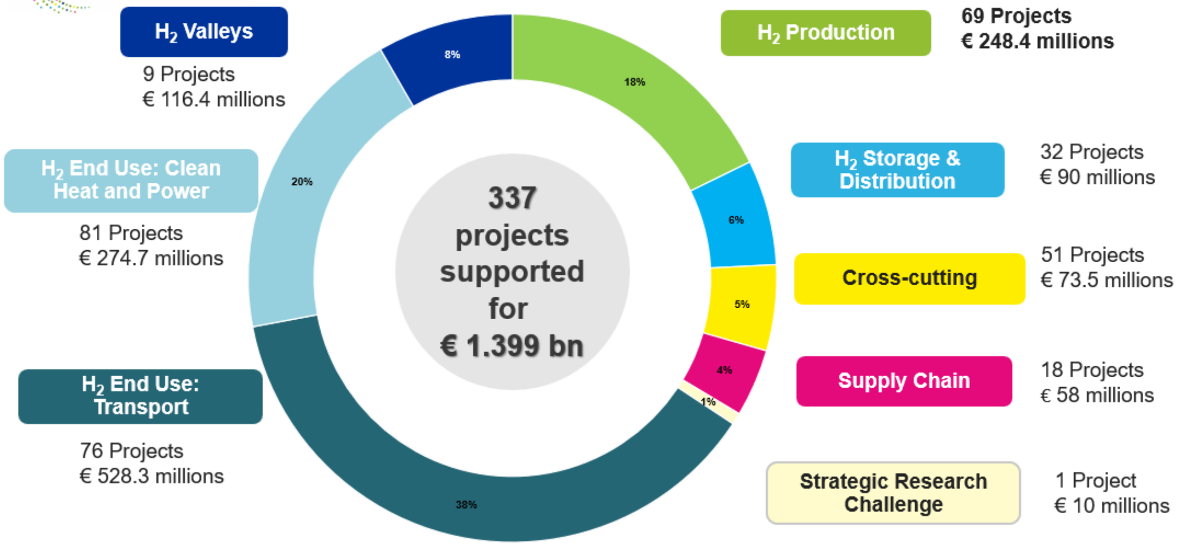


Vir: *Lelde Kiela Vilumsone, EC, DG ENER.C1, H2 Talk, Hydrogen Europe, junij 2026*

Clean Hydrogen Partnership JU

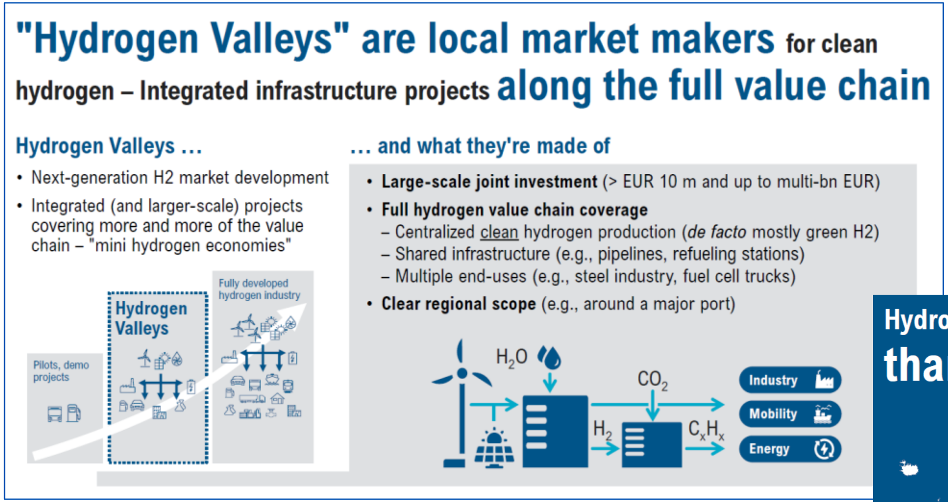


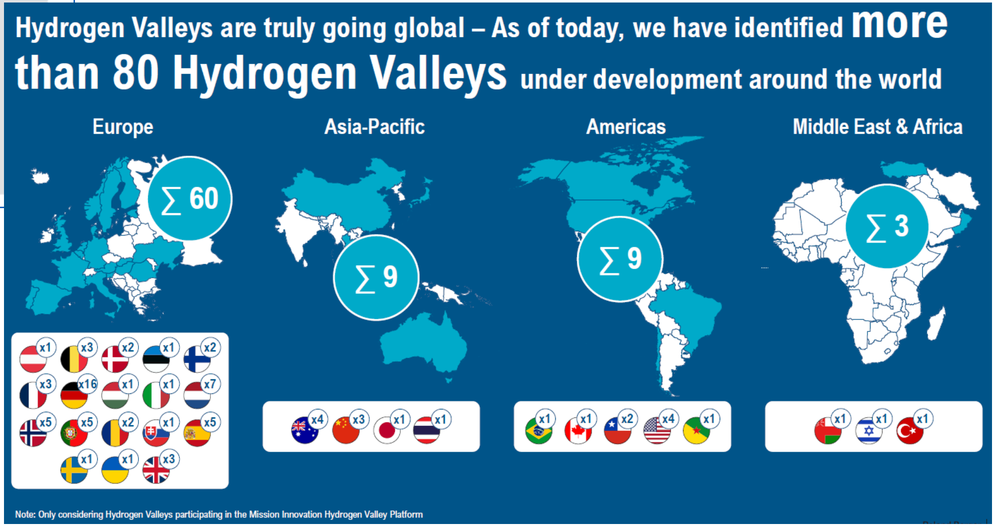
Clean Hydrogen JU Programme



__Vir:__ Clean Hydrogen Partnership JU, 2022

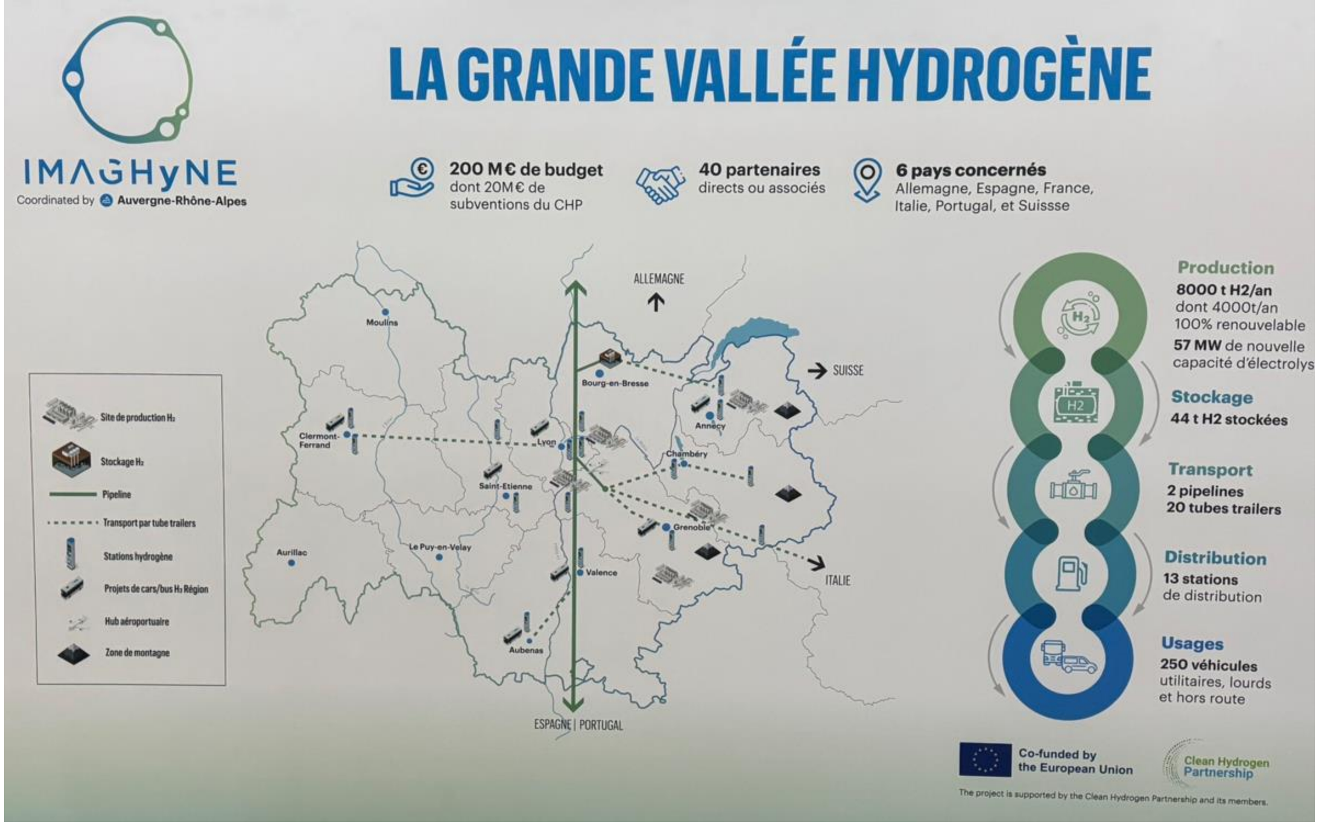
Vodikove doline

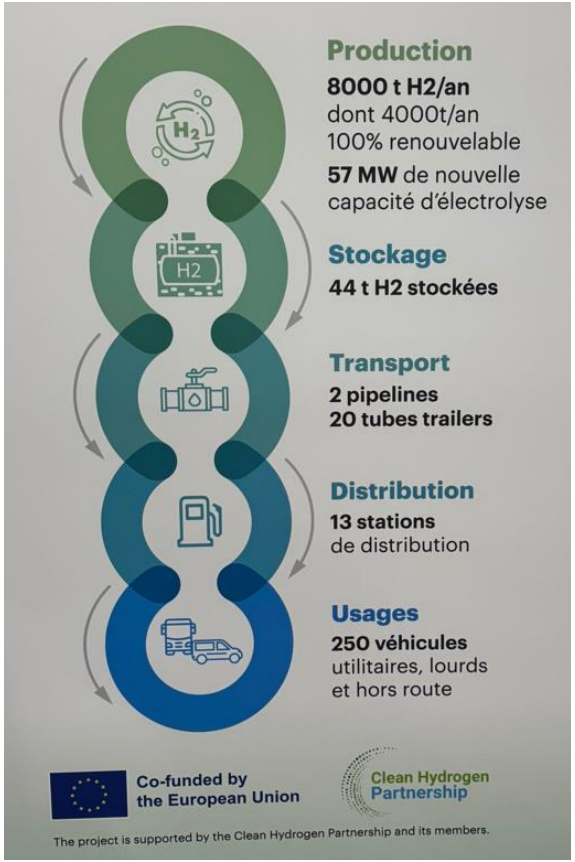




Vir: Clean Hydrogen Partnership JU / Roland Berger, 2022

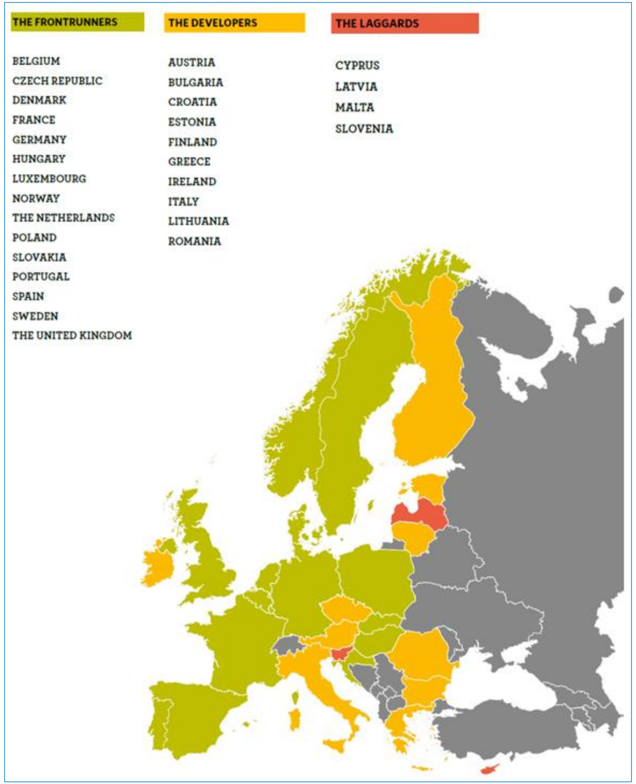
Vodikove doline



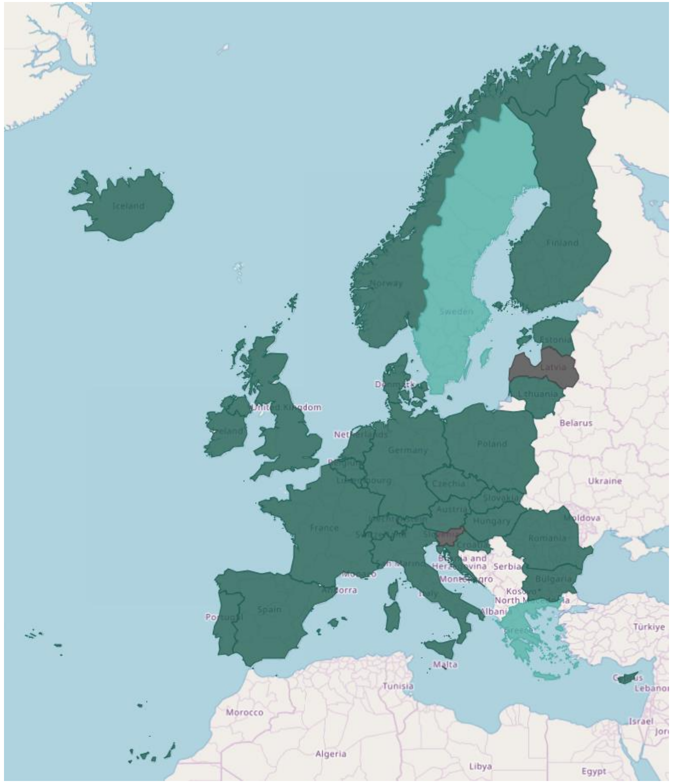


***Vir:** IMAGHyne, Auvergne-Rhone-Alpes**,** Hyvolution Paris 2025, januar 2025*

Vodikova strategija EU članic



Vir: *FleishmanHillard, National Hydrogen Strategies in the EU Member States, februar 2022*



Vir: *European Hydrogen Observatory, december 2025*

Vodikova strategija EU članic

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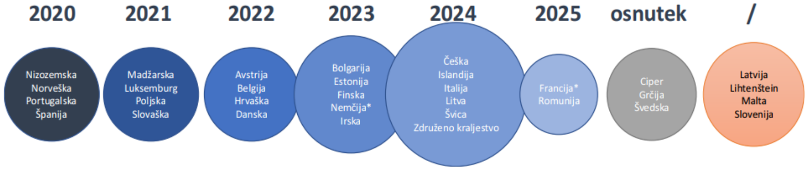


Država	Ključni izvleček	Poudarki koristni za Slovenijo
Nemčija	• 10 GW elektrolize do 2030 • poudarek na industriji • uvozna strategija • ogljikova pogodba na razliko (CCfD)	• **Poenostavljeni in hitri postopki za gradnjo elektrolizerjev** • Zgodnje načrtovanje omrežij (elektrika in plin) • **Manjši izvedljivi koraki so učinkovitejši od mega projektov**, če slednji nimajo pripravljenih ustreznih temeljev za izvedbo
Francija	• 4.5 GW elektrolize do 2030 • 500 km omrežja • podpora za mobilnost in e-goriva • IPCEI projekti	• **Zagotoviti usklajenost med državo in lokalnimi akterji** • Poskrbeti za čim bolj **zanesljivo povpraševanje** (npr. javni promet, industrija), ki spremlja proizvodnjo vodika • Država pripravi razpise, ki bodo jasni, pregledni in dostopni tudi za manjša podjetja.
Belgija	• uvoz 20 TWh obnovljivega vodika letno • izgradnja 100–160 km vodikovodov	• Nujna je **skupna nacionalna vizija** (namesto razdrobljenih regionalnih teženj), po domači rabi vodika, ne le tranzitne vloge • Ne sme se spregledati **izobraževanja in strokovnih kadrov**, ki so eden ključnih elementov za uspeh uvajanja uporabe vodika.
Nizozemska	• 6–8 GW elektrolize do 2030 • 1000 km omrežja • močna vloga pristanišč • H_2 kot izvozni produkt	• Realno oceniti logistične zmogljivosti in pravočasno vključiti in ozaveščati lokalne skupnosti • **Cena energije je ključna**, saj elektrolizerji niso ekonomični brez dostopa do poceni OVE • **Uvoženi vodik je tekmec**, kateremu je potrebno prilagoditi svoje cilje in **ciljati tudi na nišne uporabe vodika pri mobilnost in v industriji**, ne le na masovne rešitve.

Država	Ključni izvleček	Poudarki koristni za Slovenijo
Avstrija	• 1 GW elektrolize • zamenjava sivega H_2 80 % v industriji do 2030 • HyPA platforma	• Brez **pravočasne vzpostavitve regulative** pride do tveganj in zamud pri uvajanju • Potrebna je **standardizacije novega področja in varnostnih smernic**, • **Ovira so nejasnosti pri klasifikaciji vodika** kot energenta in kemikalije, pri pridobivanju dovoljenj za proizvodnjo, priklopu na omrežje (brez dovolj velike kapacitete) in pri plačevanju omrežnine.
Hrvaška	• 70 GW elektrolize do 2030	
Italija	• 5 GW elektrolize do 2030 • vodikove doline • železniški pilotni projekti • čezmejna infrastruktura	• Časovno usklajeni in jasni razpisi. • Pravočasno **vzpostavitev medresorskega sodelovanja**, pri čemer je ključno, da resorji, ki pokrivajo energijo, promet in okolje, delujejo usklajeno • Gradnja na **zaupanju javnosti** in pravočasna vzpostavitev dobre komunikacije
Madžarska	• 240 MW elektrolize • uporaba vodika v industriji in prometu	• Privabljanje **mednarodnih investicij** v tehnologijo vodika, na primer avtomobilsko industrijo • **Ne zamujati s proizvodnjo zelenega vodika** • Prenos pilotskih projektov iz laboratorijev v komercializacijo

Vir: *Analiza EU in tujih strategij ter domačega stanja na področju vodika, Konzorcij za pripravo Akcijskega načrta za doseganje ciljev v NEPN na področju vodika do leta 2030 in s pogledom do leta 2040, december 2025.*

REDIII – RFNBO cilji za industrijo in

Binding target for RFNBO (renewable fuels of non-biological origin): **42% in 2030** and **60% in 2035**

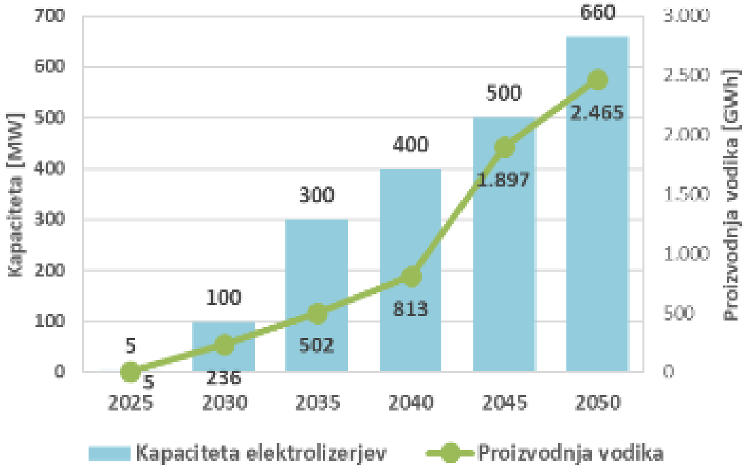
Under Art. 22b - possible discount of 20% in 2030 for Member States on track towards their expected contribution to the overall Union target of 42.5% with a low share of hydrogen from fossil fuels consumed (no more than 23% in 2030 and 20% in 2035)

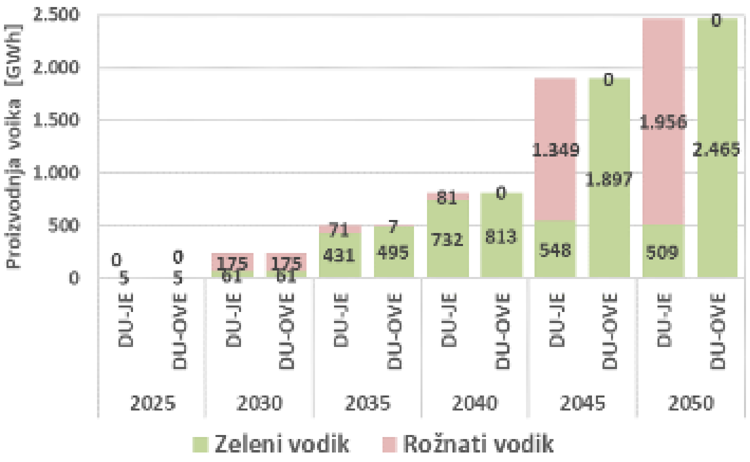
Binding target of at least **1%** of RFNBOs (combined target of **5.5%** for advanced biofuels and RFNBOs)

Commission Guidance (C/2025/2983) on the targets for the consumption of renewable fuels of non-biological origin in the industry and transport sectors laid down in Articles 22a, 22b and 25 of Directive (EU) 2018/2001 as amended

Vir: *Lelde Kiela Vilumsone, EC, DG ENER.C1, H2 Talk, Hydrogen Europe, junij 2026*

Cilji in napovedi za Slovenijo





Vir: *Posodobljeni celoviti nacionalni energetski in podnebni načrt Republike Slovenije, NEPN, december 2024*

Cilji in napovedi za Slovenijo – REDIII

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RED III

- Prispevek RFNBO, ki se uporablja za končno energijo in neenergetske namene do leta 2030 znaša vsaj 42% in do leta 2035 vsaj 60% vodika, uporabljenega za končno energijo in ne energetske namene v industriji.
- Skupni delež naprednih pogonskih goriv in bioplina, proizvedenih iz surovin iz seznama A priloge IX in RFNBO goriv, ki se dobavlja prometnemu sektorju znaša vsaj 1% do leta 2025 in 5.5% do leta 2030, pri čemer je delež RFNBO goriv v letu 2030 vsaj 1%

Ne-energetska raba v industriji

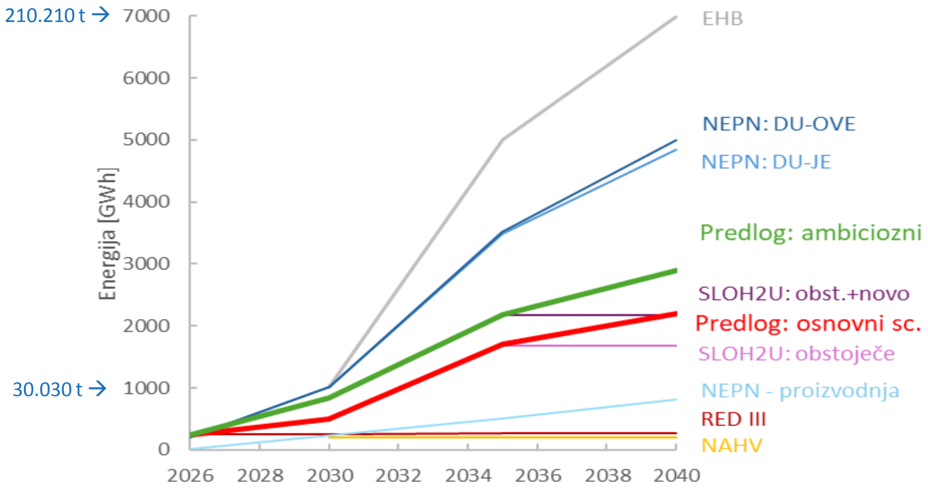
Upoštevaje trenutno ne-energetsko rabo v Sloveniji (57 GWh letno):
23.8 GWh (850 ton) letno v **2030** in **34 GWh** (1.020 ton) letno v **2035**.

Promet

Glede na podatke SURS za 2024: 1% predstavlja **227 GWh** (6.800 ton) -> 1% RFNBO **v 2030**.

Cilji in napovedi za Slovenijo

Energija GWh	2026	2030	2035	2040
EHB		1.000	5.000	7.000
RED III	251	251	261	261
SLOH2U obstoječe			1.680	1.680
SLOH2U obstoječe + novo			2.180	2.180
NAHV		197	197	197
NEPN proizvodnja H2	5	236	502	813
NEPN odjem OVE in NO plinov (DU-OVE)	198	1.012	3.477	4.838
NEPN odjem OVE in NO plinov (DU-JE)	198	1.012	3.524	5.001
Osnovni scenarij	250	500	1.700	2.200
Ambiciozni scenarij	250	840	2.180	2.900

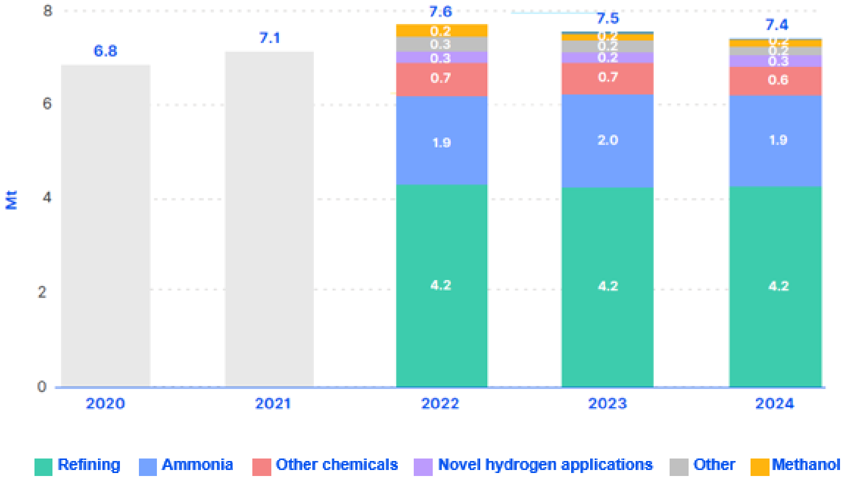


poraba danes: 2.200 t/a (73,3 GWh)

***Vir:** PLINOVODI d.o.o., Posvetovanje Akcijski načrt za vodik, marec 2026*

Trenutno stanje porabe vodika v EU

Total hydrogen consumption by end use in the EU – 2020-2024 (Mt)



Existing EU demand

- Currently >90% of hydrogen is produced from fossil sources (mostly natural gas)
- Only 0.5% is produced from electrolysis or natural gas with CCS
- ~ 8 Mt H2 / year used mainly in refineries and fertiliser production

Vir: *H2 Talk REDIII Implementation – Where are we now?, Hydrogen Europe, junij 2026*

Stanje napredka RFNBO v industriji

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Growth dynamics

The trajectory is characterized
- by a slow ramp-up until 2030 (pilot phase)
- followed by scaling up by 2035

Overall, a large portion of domestic production planned by 2030 is earmarked for refineries and transport sector

Broader use in industry is anticipated by 2035

RFNBOs share in industry

Reaching 42% RFNBO target in industry by 2030 is viewed by many MS as a

Significant challenge

Estimates/projections by 2030 vary a lot, often not backed up by projects/measures

Supply-Side Funding Focus

Many MS use various EU funding instruments (Innovation Fund, IPCEI, Hydrogen Bank)

These and national measures are largely focused on production and infrastructure rather than industrial offtake

***Vir:** Lelde Kiela Vilumsone, EC, DG ENER.C1, H2 Talk, Hydrogen Europe, junij 2026*

Potreba po posodobitvi EU vodikove strategije

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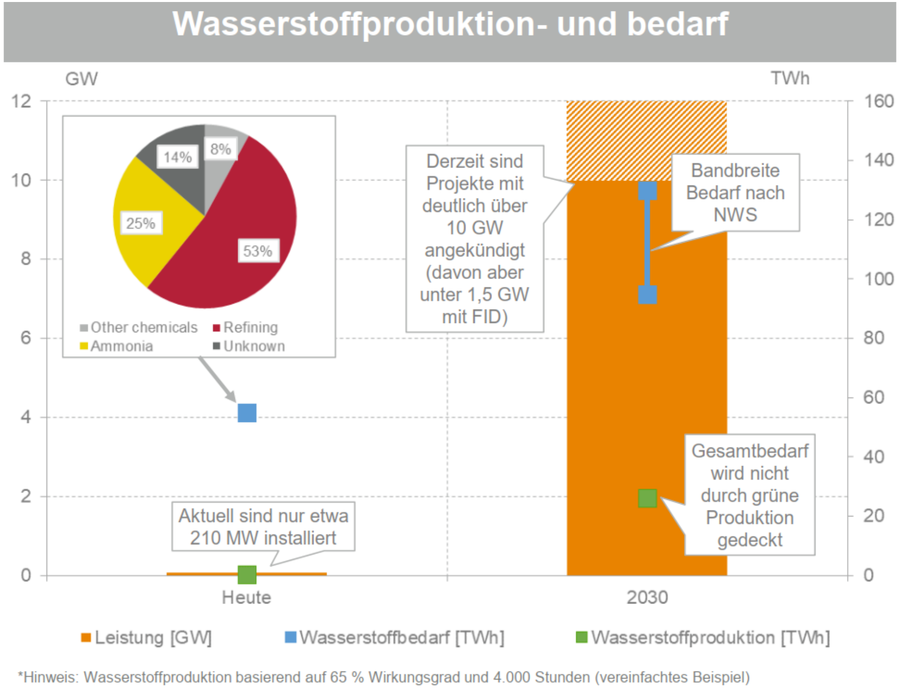
The hydrogen landscape has evolved significantly since the adoption of the 2020 Hydrogen Strategy

Legislative and enabling framework for hydrogen in place	Slower than expected development of the hydrogen market	Clear mandates
• REDIII, maritime and aviation mandates • Gas and Hydrogen Package • RFNBOs and low-carbon Delegated Acts • Infrastructure priorities (PCI/PMIs) • Multiple support tools (European Hydrogen Bank, Mechanism, auctions and other funding)	Electrolyser capacity: 600 MW installed and 3.3 GW past FID (total of ~0.4 mt) which is far below the 3-4 mt needed to meet the industry and transport targets for RNFBOs **Main drivers are:** • Higher than expected production costs • Limited/uncertain demand • Delayed infrastructure development • Investment and regulatory uncertainty • Slow supply chain developments	• REDIII: strategy for imported and domestic hydrogen • European Court of Auditors: we accepted recommendation to update hydrogen strategy; need for a reality check (targets, financing)

Vir: *Lelde Kiela Vilumsone, EC, DG ENER.C1, H2 Talk, Hydrogen Europe, junij 2026*

Trenutno stanje v Nemčiji



Fortschreibung Nationale Wasserstoffstrategie (2023):

- Ursprüngliches Ziel: 10 GW in 2030 (ca. 26 TWh grüner Wasserstoff*)
- Bedarf in 2030 liegt laut Bundesregierung bei 95 bis 130 TWh
- Verbleibende Mengen müssen importiert bzw. fossilbasiert produziert werden

Der Ausbau geht deutlich langsamer voran als geplant:

- Kosten sind kaum gesunken
- Regulatorische/bürokratische Hürden
- Fehlende Infrastruktur
- Fehlende Preis- und Abnahmesicherheit

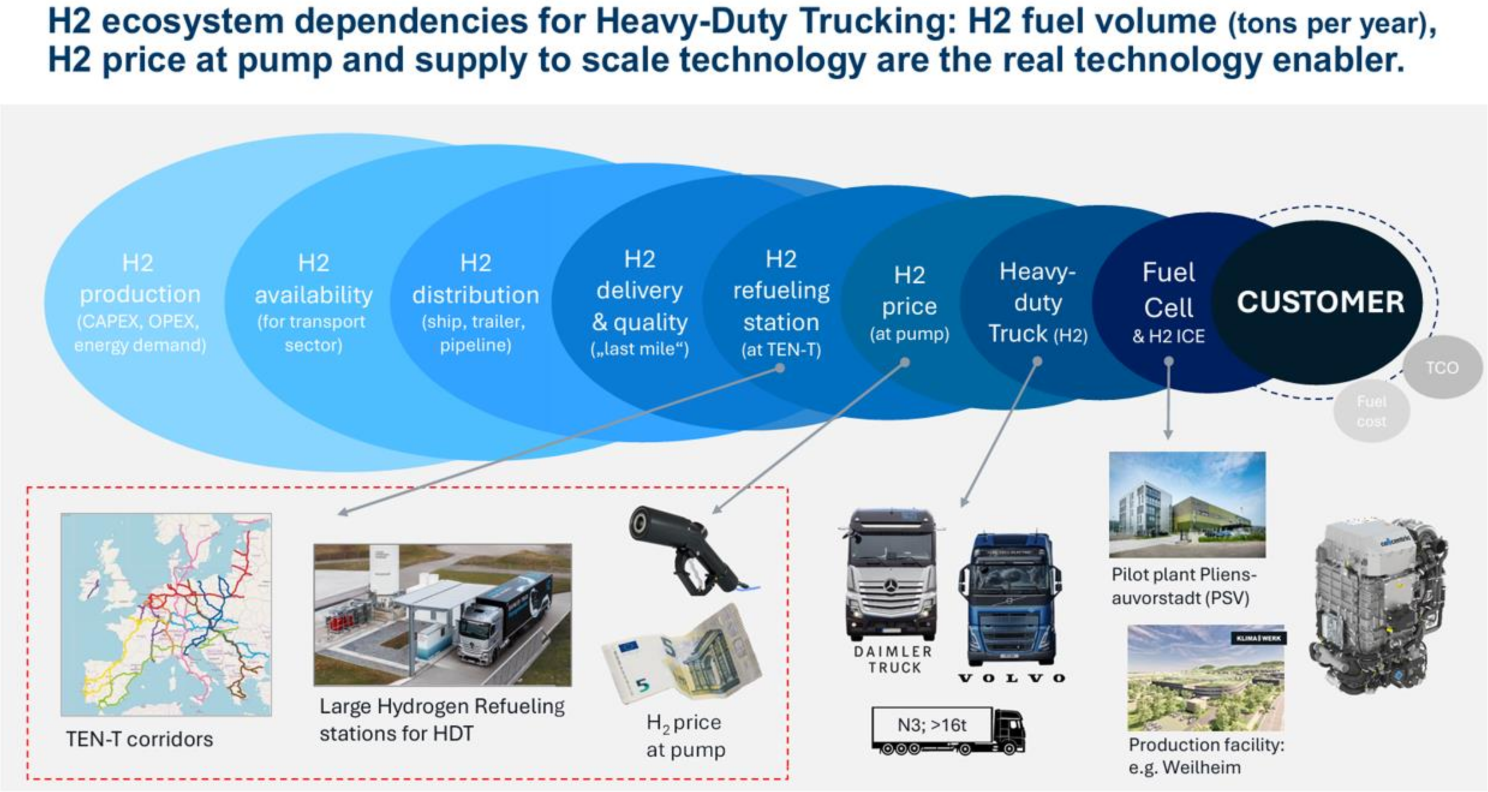
***Vir:** ENERVIS, Grüner Wasserstoff in Deutschland, maj 2026*

Načrtovane spremembe EU politik

- **Targeted revision of the hydrogen production criteria to extend the ramp-up phase** and facilitate market development during the crucial early stage (end June 2026)
- **A new hydrogen strategy** to reflect the evolution of the market, technological and policy developments (Q4 2026)
- **A renewable energy framework for the post-2030** period (Q4 2026)

***Vir:** Lelde Kiela Vilumsone, EC, DG ENER.C1, H2 Talk, Hydrogen Europe, junij 2026*

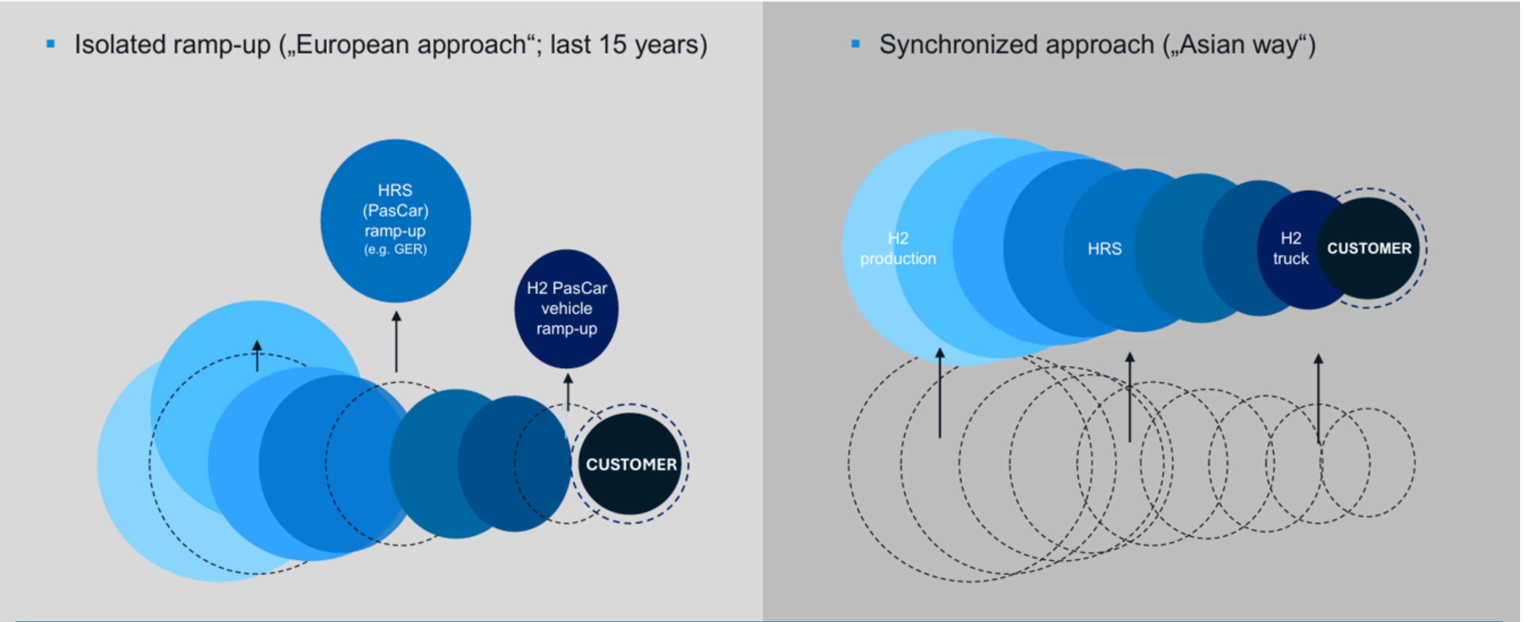
Transport: veriga vrednosti



Vir: *Dr. Florian Henkel, CELLCENTRIC, H2 Talk, Hydrogen Europe, marec 2026*

Transport: Razlika med EU in Azijskim pristopom

Synchronized ramp-up of all H2 elements is key to success („no hen-and-egg“).



For synchronization, one has to consider the entire H2 production chain, and align all partners along the chain. **H2 vehicles** will **only** become a **commercial success**, if **all** subsequent **elements** of the chain are **operational**.

Vir: *Dr. Florian Henkel, CELLCENTRIC, H2 Talk, Hydrogen Europe, marec 2026*

Transport: Razlika med EU in Azijskim pristopom

History of China's 5-year plans: Hydrogen as energy carrier for resilience, Fuel Cells and New Energy Vehicle (NEV) ramp-up.

Fuel Cells are explicitly mentioned being NEVs.

Time	Progress
10th Plan (2000-2005)	• Launched the "Electric Vehicles" major science and technology project. FCV technology has been identified as one of the **key R&D priorities**.
11th Plan (2006-2010)	• **Encourage** the development and use of energy-efficient, environmentally friendly, and new FCV. Start **early R&D** in key technology of FCV.
12th Plan (2010-2015)	• The NEV industry will focus on **developing** plug-in hybrid electric vehicles, pure electric vehicles, and **FCV technologies**.
13th Plan (2016-2020)	• Key tasks for energy technology innovation: **R&D breakthrough** in Hydrogen Energy and FC technology
14th Plan (2020-2025)	• Accelerate future industries include Hydrogen energy, establish national technology research institutes, implement cross-industry integration **demonstration projects**. • Released China's **first medium-to-long term plan** for Hydrogen energy industry (2021-2035), **first time sets clear quantitative targets:** FCV＞50,000; Renewable energy hydrogen production reaches 100,000–200,000 tons per year until end of 2025.
15th Plan (2025-2030)	• Hydrogen is explicitly defined as a **new economic growth driver**. (further data see Roadmap 3.0). Hydrogen is one of the 6 strategic economic core pillars.

Vir: *Dr. Florian Henkel, CELLCENTRIC, H2 Talk, Hydrogen Europe, marec 2026*

Transport: Razlika med EU in Azijskim pristopom

ELES

China has a clear plan, is fully committed and execution is fully ongoing

15th Five-Year Plan (2025-2030)

China will **accelerate** the development of **emerging strategic industries** including: **new energy,** intelligent connected **new energy vehicles**

The 15th Five-Year Plan also urges efforts to foster **new drivers of economic growth. Hydrogen is one.**

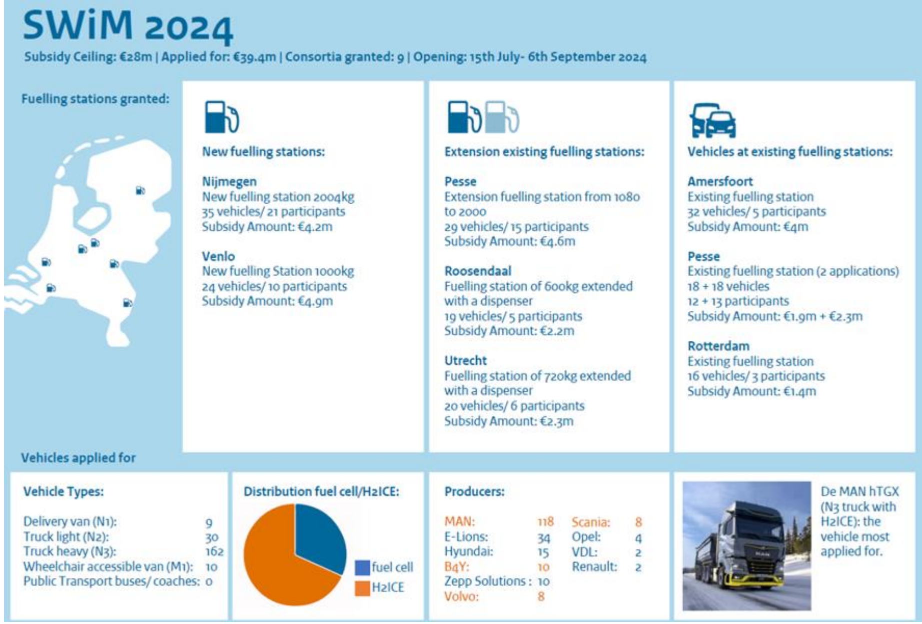
NEV Technology Roadmap 3.0
by Chinese Society of Automotive Engineers

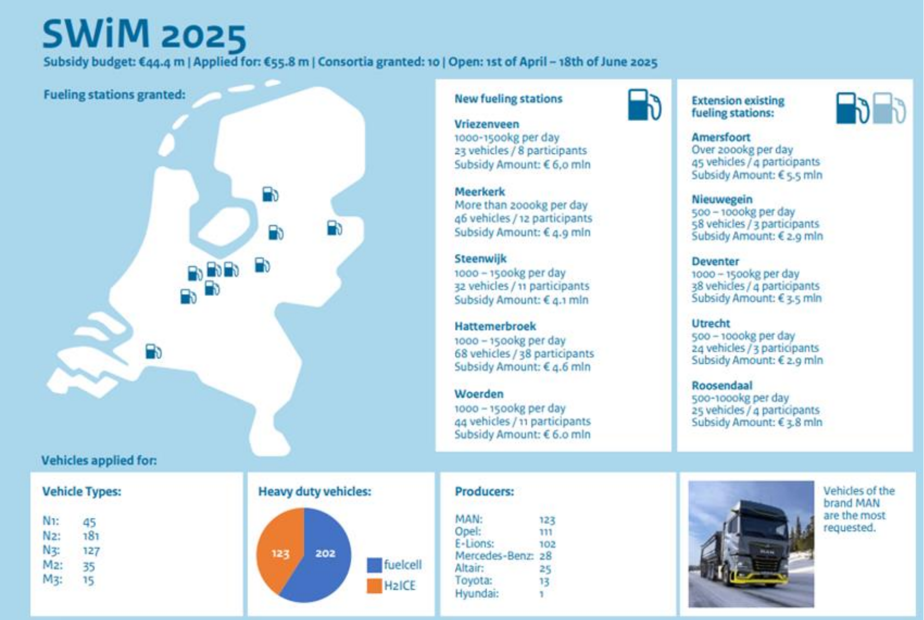
	2030	2035	2040
§	NEV[3] CVs account for **~30%** of annual new CV sales	NEV[3] CVs account for **~55%** of annual new CV sales	NEV[3] CVs account for **~75%** of annual new CV sales
	500,000 Commercial FCEV	**> 1 Million** Commercial FCEV	**> 4 Million** Commercial FCEV
	3,000 HRS	5,000 HRS	10,000 – 20,000 HRS
!	**Commercial demonstration operation** of liquid H2 storage and H2 refueling stations	**Large-scale operation** of liquid H2 storage and H2 refueling stations	**Large-scale promotion** of liquid H2 storage and H2 refueling stations
	• H2 driving range: **≥ 1000km** • Average H2 consumption (CHTC[2]): **≤ 8kg/100km**[1] • *And more…*	• H2 driving range: ≥ 1000km[1] • Average H2 consumption (CHTC[2]): **≤ 7kg/100km**[1] • *And more…*	• H2 driving range: ≥ 1000km[1] • Average H2 consumption (CHTC[2]): **≤ 6kg/100km**[1] • *And more…*

15th Five-Year Plan (2025-2030) is now **confirmed** in the official governmental sessions (March 2026).
China clearly sets **ambitious targets** and shows **commitment,**
with focus on **hydrogen** as part of the **“new energy system”**

Vir: *Dr. Florian Henkel, CELLCENTRIC, H2 Talk, Hydrogen Europe, marec 2026*

Spodbude za HRS in FCEV na Nizozemskem





Sofinanciranje: **HRS:** 40% oz. max. 2 mio €

FCEV N1, N2, N3, M1*, M2, M3:

pol vozil tovorna vozila, max. 80% razlike, do 5 mio € skupne vrednosti vloge

Vir: *Rijksdienst voor Ondernemend Nederland, Roos Geelhoed, marec 2026*

Konzorcij SLOH2U (PLINOVODI)

- Družba Plinovodi d.o.o. je pobudnica iniciative vodik za uporabnike SloH2U
- Iniciativa združuje 56 podjetij in inštitucij
- Največja do sedaj znana platforma za vodikove projekte v Sloveniji
- „Bottom-up" pristop z identifikacijo prihodnjih potreb po vodiku v Sloveniji

Plinovodi
Povezani z energijo
20let

Vir: PLINOVODI d.o.o., marec 2026

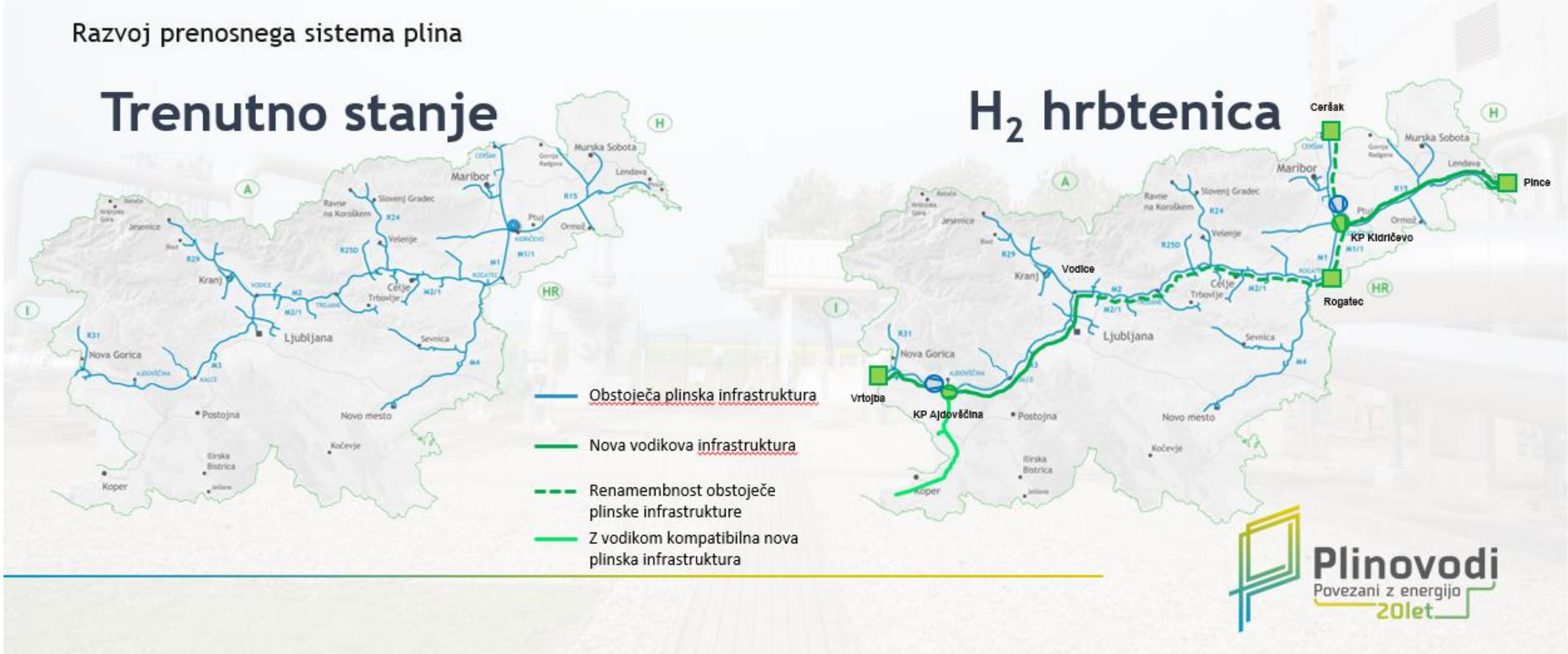
Konzorcij SLOH2U (PLINOVODI)

ELES

Vir: PLINOVODI d.o.o., marec 2026

SLOH2U
SLOVENSKA INICIATIVA VODIKA ZA UPORABNIKE

Vodikova hrbtenica (PLINOVODI)

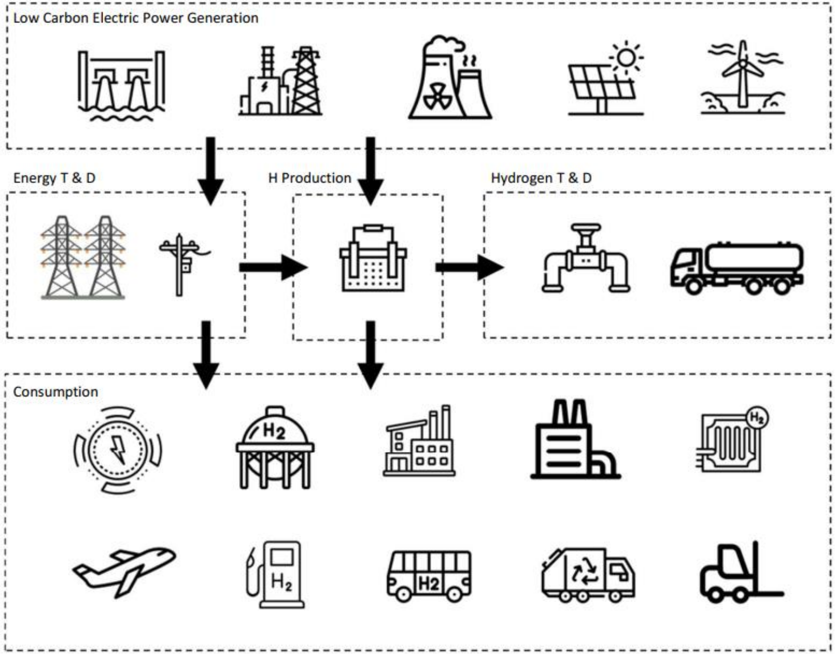


Vir: *PLINOVODI d.o.o., marec 2026*

Konzorcij SIH2 (ELES)

ELES

Konzorcij za vzpostavitev ekosistema vodika iz nizkoogljičnih virov



gen
hse
energetika ljubljana

ELES
elektro gorenjska
Elektro Ljubljana
Plinovodi

Slovenske železnice
SOLVERA LYNX
PETROL
TALUM
BTC
MESTNA OBČINA KRANJ
OBČINA AJDOVŠČINA
Mestna občina Ljubljana

Konzorcij SIH2 (ELES)

ELES

Konzorcij za vzpostavitev ekosistema vodika iz nizkoogljičnih virov

Namen konzorcija

- promocija in pospešitev vzpostavitve ekosistema vodika iz nizkoogljičnih virov v slovenski energetiki in javnem prostoru s ciljem razogljičenja Slovenije do leta 2050;
- priprava predlogov projektov za sodelovanje z domačimi in tujimi partnerji iz ciljnih regij sveta.

Aktivnosti konzorcija

- izvajanje raziskovalnih, razvojno inovacijskih in pilotnih projektov;
- pridobivanje predhodnih študij in izračunov za potrebe izvedbe projektov;
- izvedba skupnih promocijskih aktivnosti za izvedbo projektov.

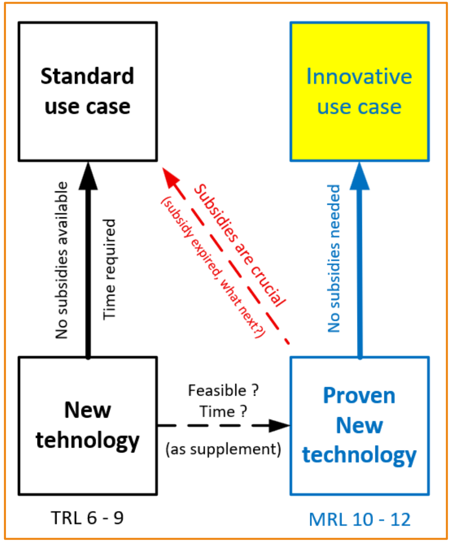
#	Konzorcijski partner	Položaj v vrednostni verigi	Vsebina projektov
1	ELES	dostop do prenosnega omrežja, zagotavljanje stabilnosti EES	podpora upravljanju kritične energetske infrastrukture
2	HSE	proizvodnja H2, prodaja H2	Severno jadranska čezmejna vodikova dolina (NAHV)
3	GEN	proizvodnja H2, prodaja H2	pilotni projekt zelenega vodika HE Arto-Blanca
4	Elektro Gorenjska	dostop do distribucijskega omrežja, proizvodnja H2, hramba H2	inovacijski center Zlato Polje (sezonska hramba, avtonomija objekta)
5	Elektro Ljubljana	dostop do distribucijskega omrežja	proizvodnja EE mobilni FC generator
6	PLINOVODI	primešavanje H2 v plinsko omrežje, hramba H2, vodikov koridor	podpora upravljanju kritične energetske infrastrukture
7	PETROL	proizvodnja H2, hramba H2, distribucija H2, prodaja H2	uporaba viškov EE iz OVE za proizvodnjo H2, sezonska hramba H2
8	JP Energetika Ljubljana	proizvodnja H2, distribucija H2, prodaja H2, javni transport	Koseze - proizvodnja in skladiščenje H2, Stanežiče - distribucija H2
9	TALUM	proizvodnja H2, prodaja H2	proizvodnja H2, sistemske storitve, uporaba & hramba H2 in O2, primešavanje v plinsko omrežje
10	Slovenske železnice	proizvodnja H2, poraba H2, železniški transport	pilotni projekt potniške FCEV garniture na ne-elektrificiranih progah
11	TPV AUTOMOTIVE	proizvodnja H2, lastna raba H2, primešavanje v plinsko omrežje	pilotni projekt lastne rabe
12	SOLVERA LYNX	proizvodnja H2, lastna raba H2	demonstracija mikro-kogeneracijske naprave za male poslovne odjemalce in gospodinjstva
13	BTC	proizvodnja H2, lastna raba H2	polnilna postaja za FCEV, backup FC generator EE
14	Mestna občina Kranj	poraba H2	polnilna infrastruktura za EV in FCEV
15	Občina Ajdovščina	razvojni center H2	uporaba H2 v Parku znanja (proizvodnja H2, hramba H2)

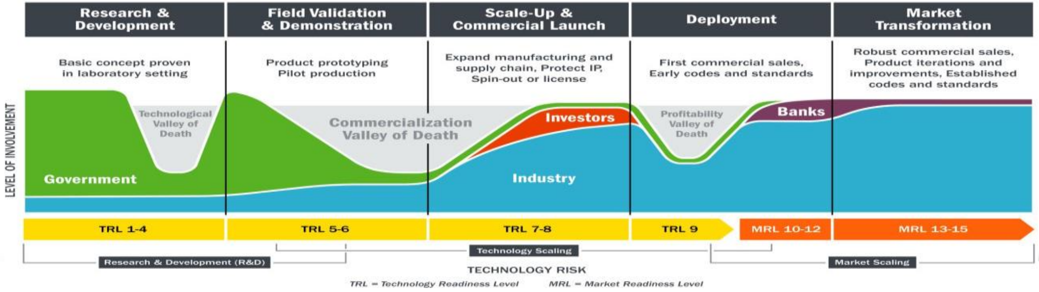
Upravljanje energetske kritične infrastrukture

Upravljanje energetske kritične infrastrukture

ELES

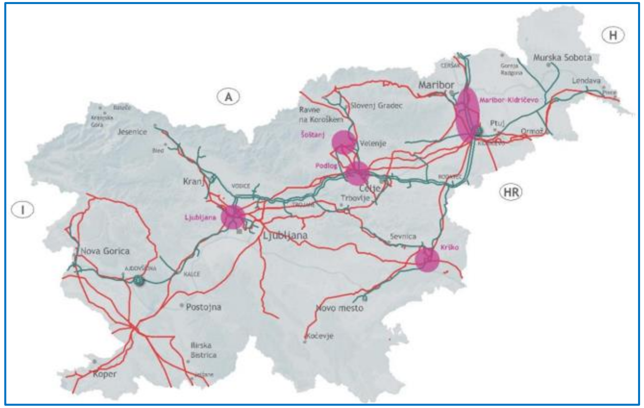
Osnovni princip:

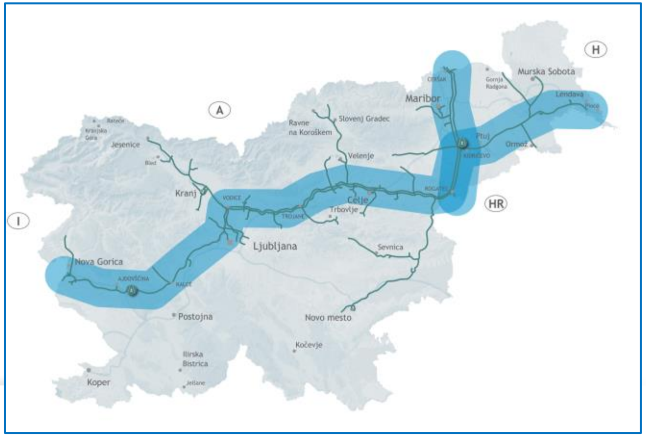




https://www.energy.gov/eere/buildings/technology-market

Povezovanje sektorjev električne energije in plina:





Upravljanje energetske kritične infrastrukture

„Use cases“ znotraj regulatornega okvirja:

- **Increasing cross-border transmission capacities (Redispatch)**
  - Purpose: **TSO intervention in eliminating grid congestions**
  - Technology deployment: **Electrolyzer, Storage, HRS, Trailers**
  - Capacity: **5 MW** / 50 MW / 250 MW
  - Operation: **2.300 h/a**

- **(Seasonal) energy storage**
  - Purpose: **(Seasonal) energy storage**
  - Technology deployment: **H2 pipeline, H2 storage**
  - Capacity: **1 GWh**
  - Operation: **utility scale**

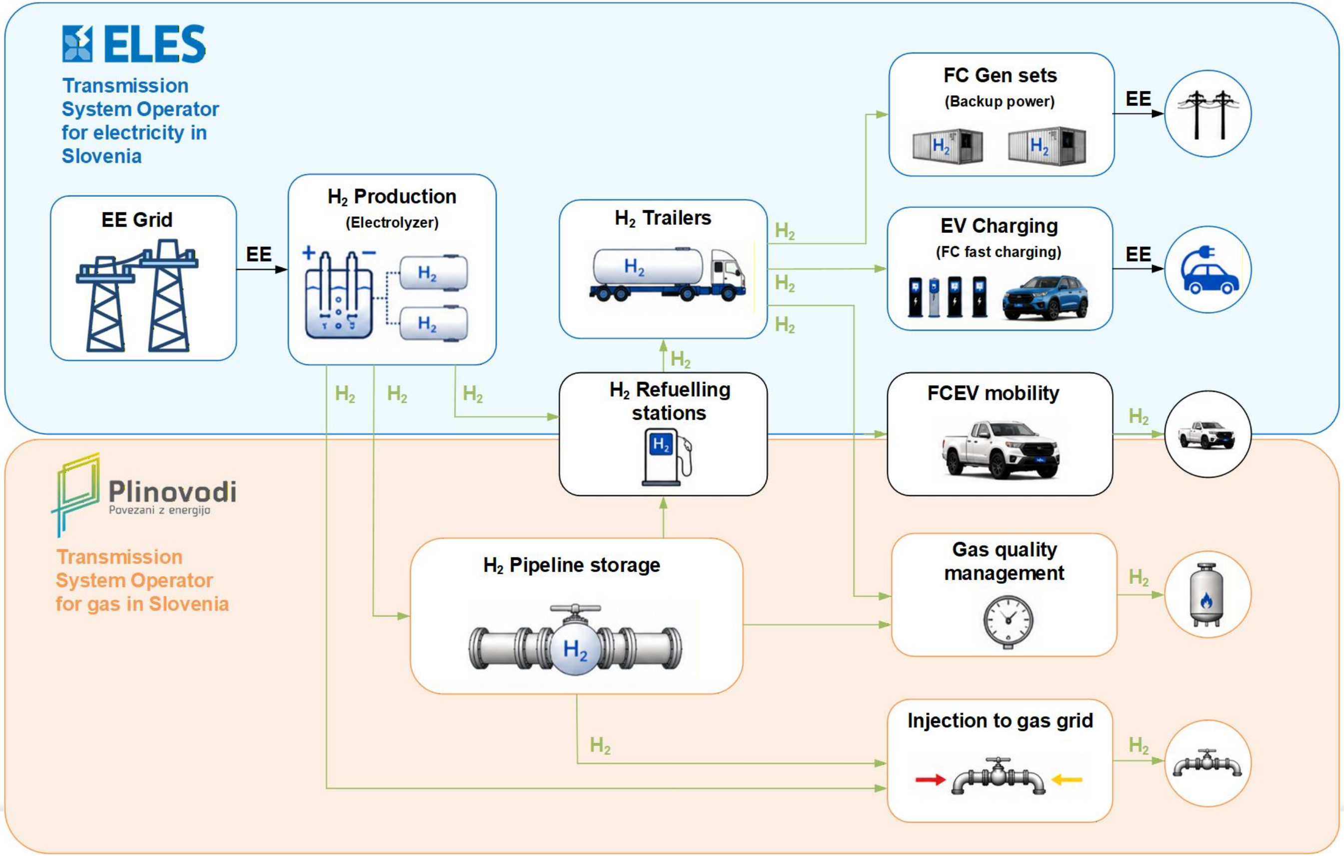
- **Autonomous power supply**
  - Purpose: **Backup and grid application (for critical infrastructure)**
  - Technology deployment: **FC generator, Trailers**
  - Capacity: **5x2 MW, 5x0,5 MWh**
  - Operation: **72 h autonomy**

- **Seasonal capacities for fast charging of EV**
  - Purpose: **EV rapid charge HFC system (peak demand, emergency situations)**
  - Technology deployment: **FC generator, Trailers**
  - Capacity: **5x1 MW, 5x0,5 MWh / 1 MW, 0,25 MWh**
  - Operation: **48 h autonomy / 10 h autonomy (highway emergency situations)**
- **FCEV**
  - Purpose: **FCEV for critical infrastructure**
  - Technology deployment: **FCEV, HRS, Trailer**
  - Capacity: **50 vehicles / 30 vehicles**
  - Operation: **dual use / utility scale**

- **Decarbonization of self-consumption of gas TSO**
  - Purpose: **Gas heating at the pressure reduction at metering and control stations**
  - Technology deployment: **Blending with gas in existing gas transmission system**
  - Capacity: **up to 70 GWh per year**
  - Operation: **various consumption profiles, operation will not be limited with the hydrogen availability**

Upravljanje energetske kritične infrastrukture

„Use cases“ znotraj regulatornega okvirja:



Končni poudarki

- Vodik je pomembna pretvorba energije, potrebno mu je poiskati ustrezno mesto.
- Vodik je v uporabi že veliko časa, sledi prehod na obnovljivi vodik.
- Zastoj pri doseganju ciljev se bo skušal premostiti z revizijo vodikove strategije, definicijo RFNBO in mehanizmi spodbud.
- Slovenija vodikove strategije nima, v pripravi je Akcijski načrt za doseganje ciljev NEPN.
- Vzpostavljena sta dva močna konzorcija, ki sta ključna za razvoj uporabe vodikovih tehnologij.
- ELES in PLINOVODI sta začela s projektom uporabe vodikov tehnologij za upravljanje kritične energetske infrastrukture (medsektorski TSO-TSO projekt).

Hvala

mag. Marko Bahor
vodja službe za strateško inovacijske programe in koncepte

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