# CLEAN HYDROGEN MONITOR

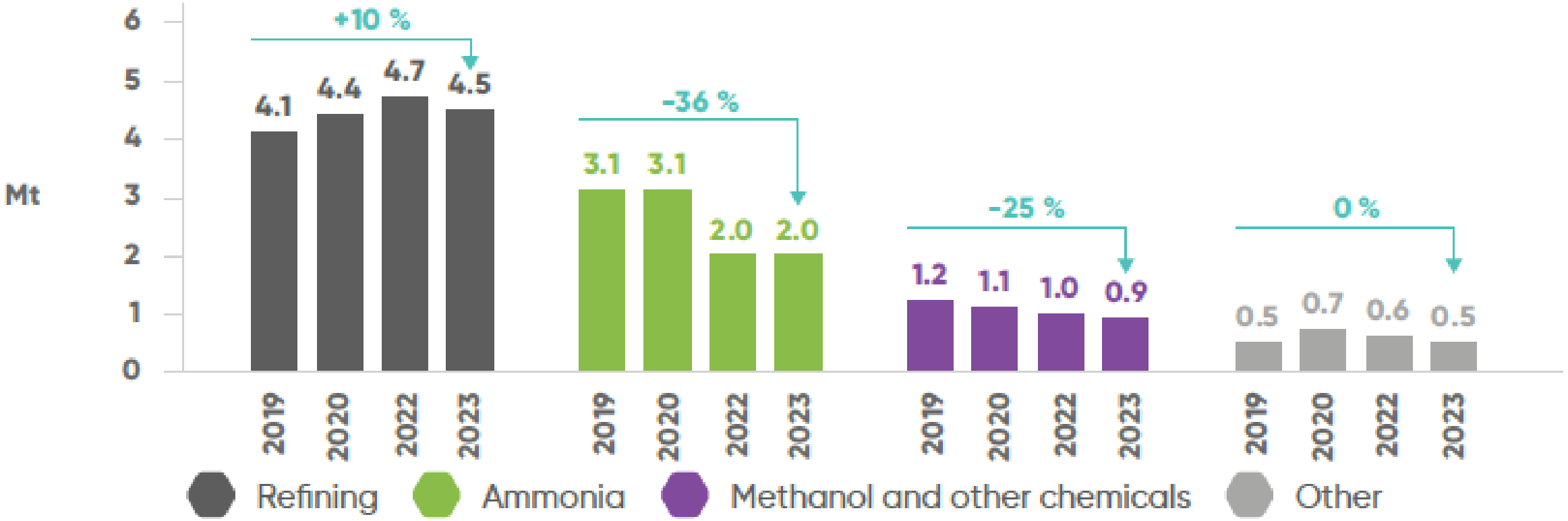
## 2024

Hydrogen Europe

# Consumption of hydrogen in industry has not yet recovered after the gas prices increase in 2022

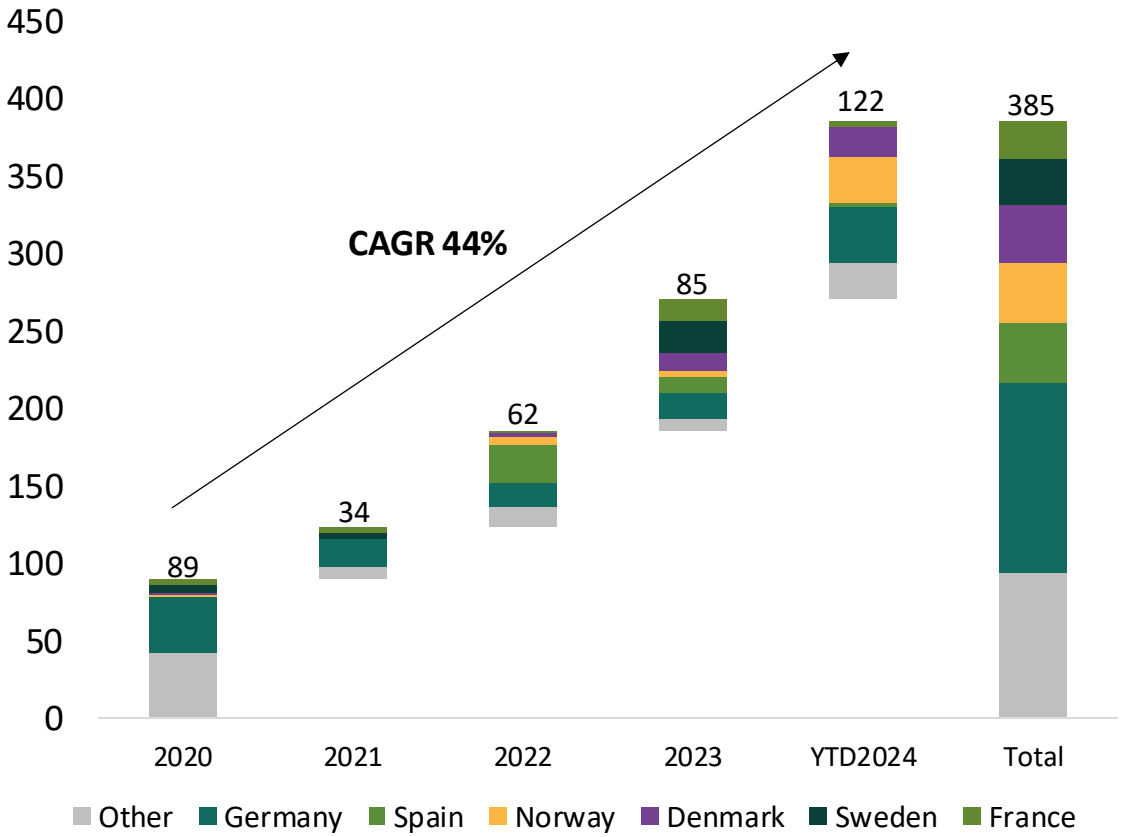
Hydrogen demand in the Europe was **7.9 Mt in 2023**, a 3% decrease compared to the 8.2 Mt reported for 2022 and close to a 15% fall since 2020.

## European hydrogen demand per sector 2019-2023

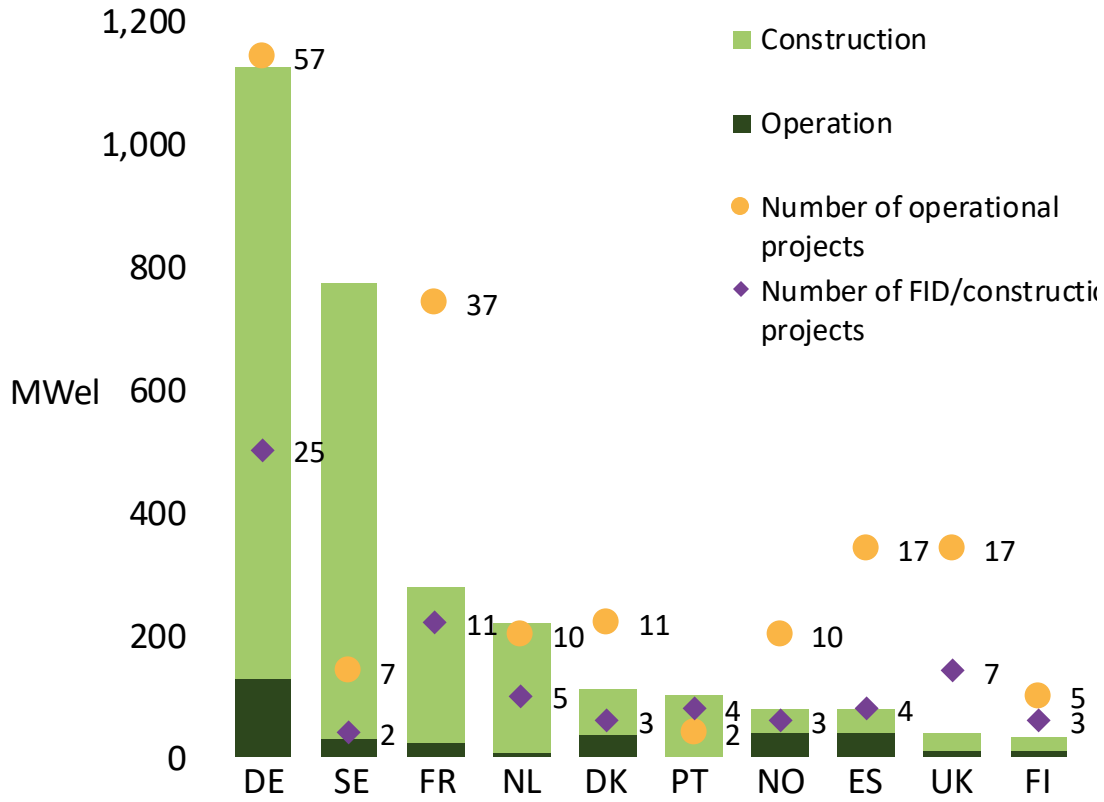


# Electrolyser capacity in Europe more than doubled in the past two years, but only 3% of the project pipeline capacity is under construction (2.6 $GW_{el}$ )

**Installed and operational water electrolysis capacity installed in ($MW_{el}$)**



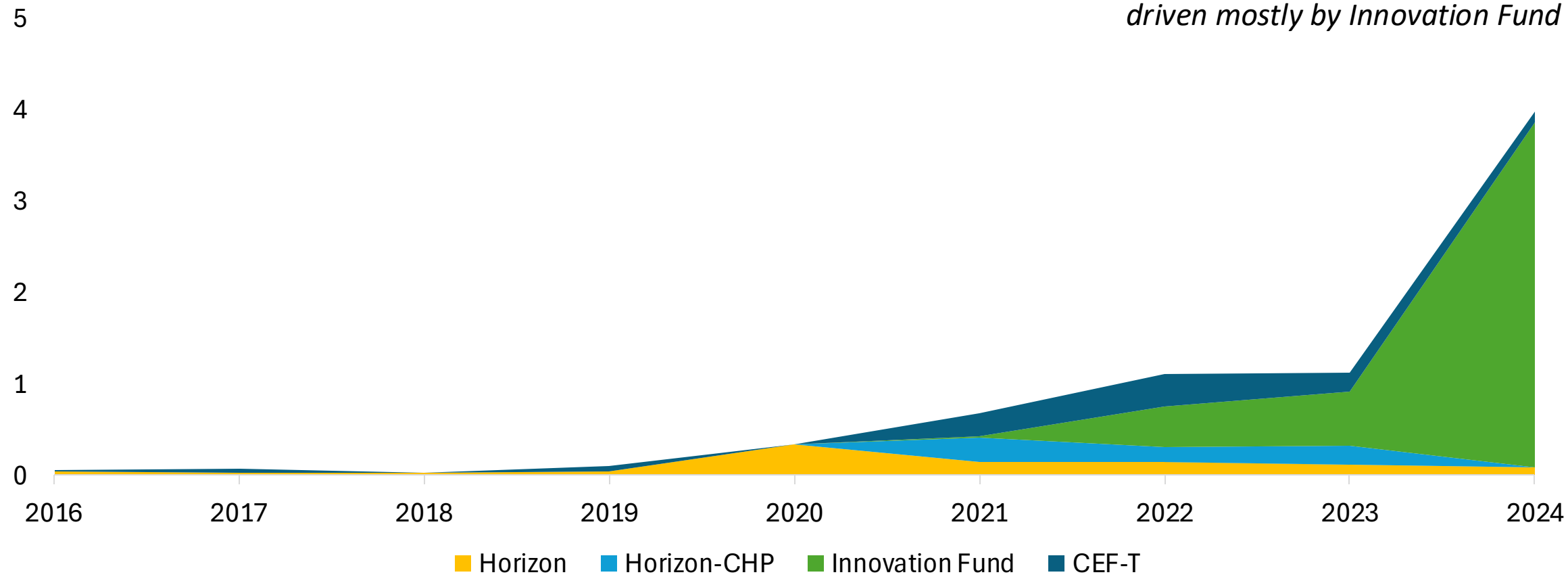

**Top 10 countries in Europe with largest operational and under construction water electrolysis capacity and number of projects by September 2024 ($MW_{el}$)**




Notes: Actual capacity is slightly higher due to untracked small-scale electrolysers of less than 0.3 MW.

# EU support for clean hydrogen has grown over the last few years, but more is needed

*More than 7bn EUR allocated to hydrogen projects since 2020, driven mostly by Innovation Fund*




Notes: CEF-E, LIFE, EMFAF not taken into consideration as their investments are negligible Assumption for IF 4th call is 30% of EUR 4.8bn = EUR1.44 bn (although contracts not signed yet )

# In Europe, Germany leads the way in funding for hydrogen, followed by the Netherlands and France

We **estimate EUR 37bn in cumulative national commitments (plus EUR 18.9 bn from IPCEIs)** including ongoing and known future mechanisms.

## Highlights from national funding

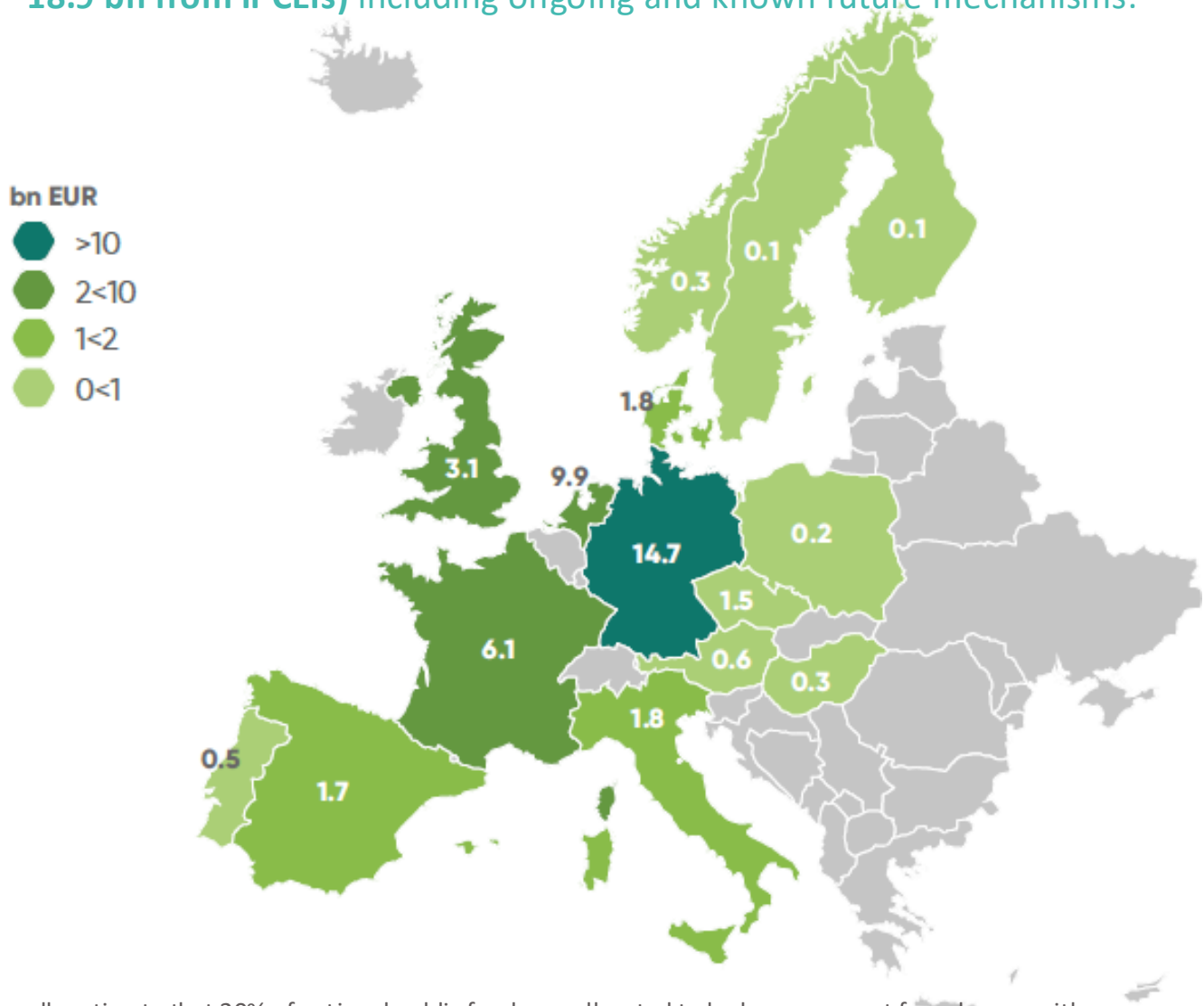
**Germany** leads Europe with several innovative schemes resulting in EUR 14.7 billion committed to clean hydrogen. E.g. H2Global (EUR 4.9 billion) with double-sided auction and offtaker CCfD.

**The Netherlands** has multiple schemes, resulting to EUR 9.9 billion subsidy. E.g. OWE scheme, with 7-15-year CfD for renewable H2 production (EUR 1 billion budget).

**France's** Production opex scheme of EUR 4.2 billion for low-carbon h2 facing delays

**Denmark's** PtX program for a total of 180 Mwel. Unclear renewal.

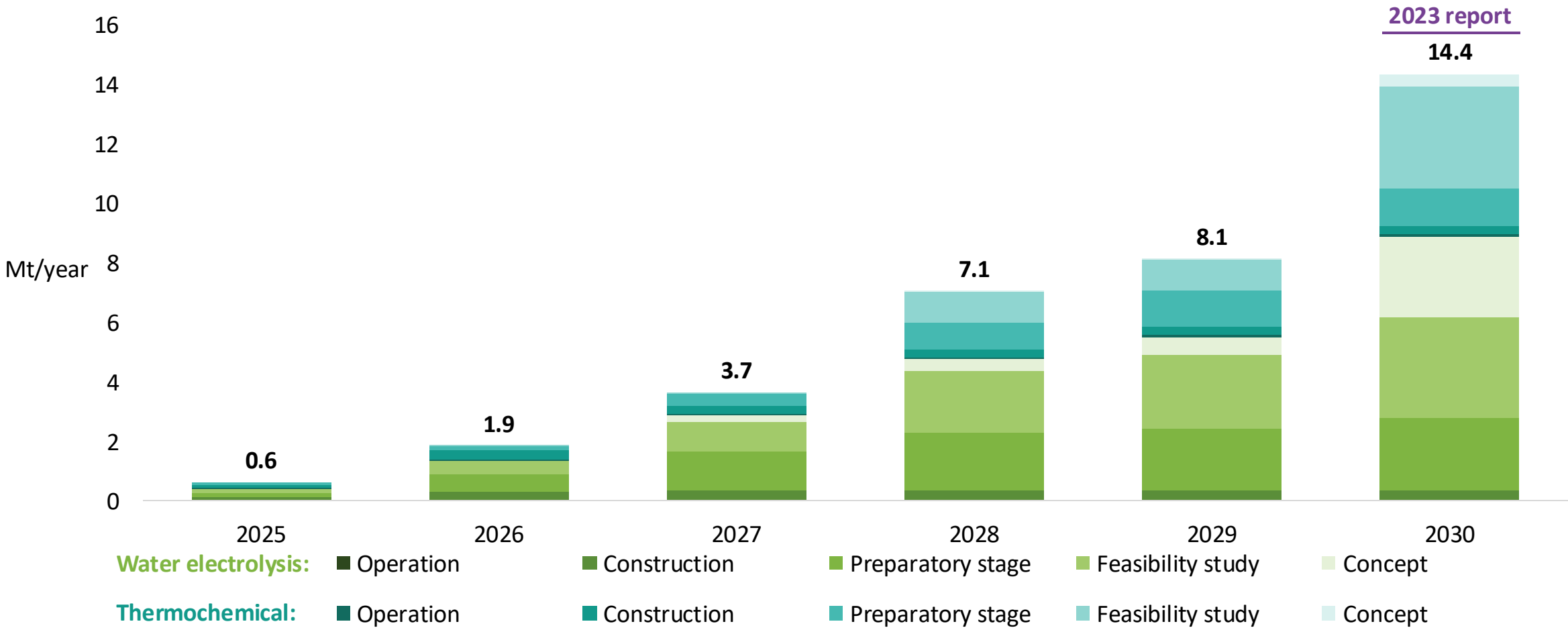
**Spain** launched in 2024 a EUR 1.2 billion scheme for hydrogen production in clusters or valleys.




Notes: Selected national funding schemes often target more than just hydrogen. The authors generally estimate that 20% of national public funds are allocated to hydrogen, except for schemes with specific funding targets. This estimate is based on the average 20% investment in hydrogen related projects from The EU Innovation Fund (Grant, excluding IF23 results, as grants are not signed at publication of the report). A detailed list of national schemes and assumptions is provided in Annex 1 of the report.

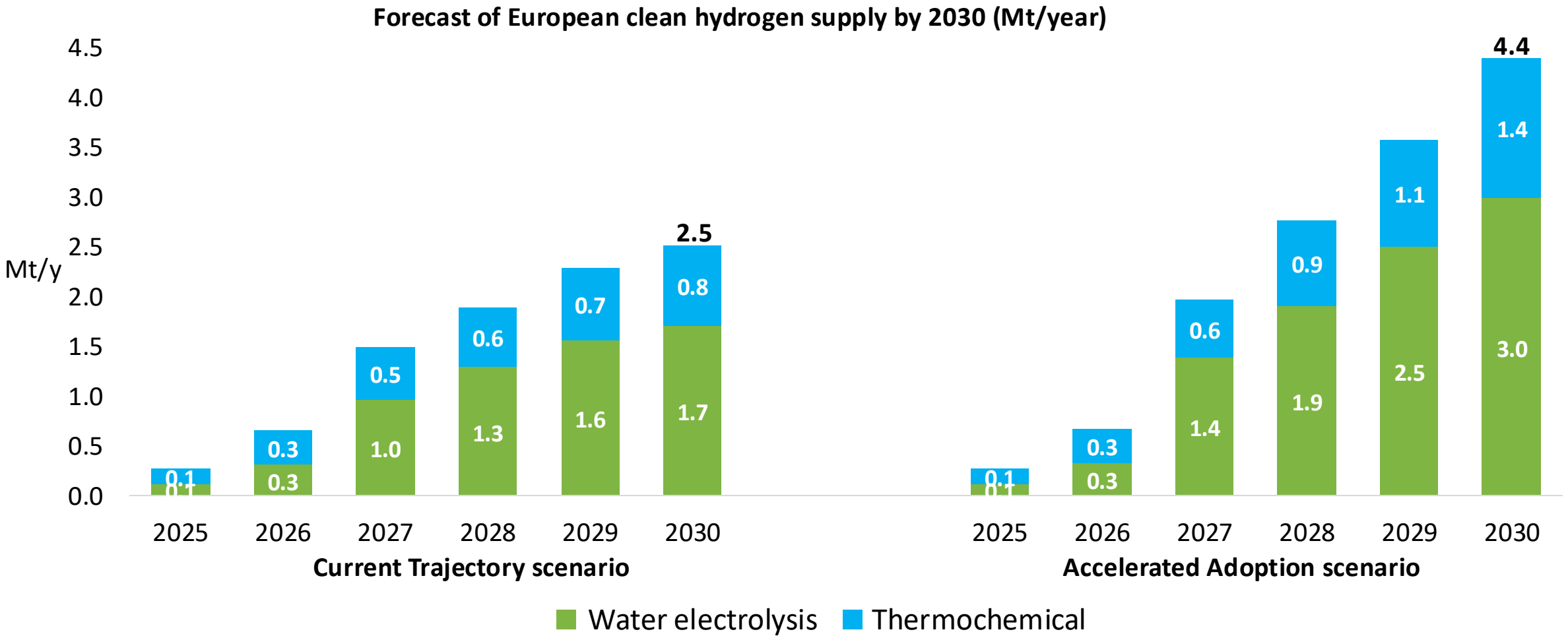
# 4% of the project pipeline in Europe is under construction and 1/3 of the project pipeline is in an advanced stage

**Cumulative announced clean hydrogen production capacity up to 2030 by current development stage (Mt/year)**




Notes: Data does not represent a forecast, but announced production project pipeline; For methodology and terminology clarifications, please consult the methodological note at the end of the chapter and the terminology section at the end of the report.

# Europe can expect a supply of 2.5 to 4.4 Mt of clean hydrogen by 2030, driven by regulatory demand but highly dependent on regulatory constraints, access to funding, and the development of pan-European infrastructure



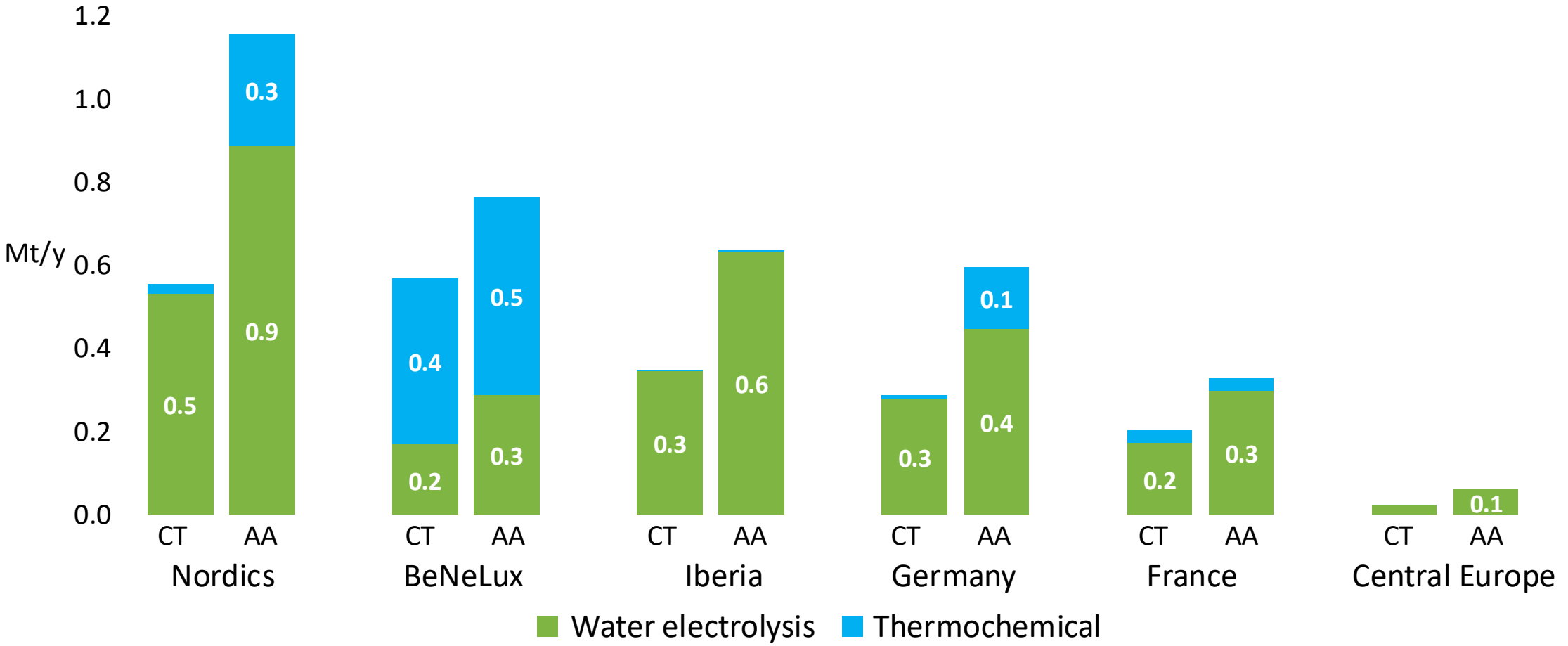

Notes: Methodology and terminology explanations can be found in the Clean Hydrogen Monitor 2024 report.

# Levers to reach the Accelerated Adoption scenario and 4.4 Mt of clean hydrogen produced in Europe by 2030

| | ISSUE: | |
|---|---|---|
| **EU regulatory framework** | COMPLICATED OR MISSING REGULATORY FRAMEWORK FOR CLEAN HYDROGEN PRODUCTION | • **EU regulatory framework** – Keep targets, keep certainty<br>• **Renewable fuels of non-biological origin (RFNBO) DA** – Review<br>• **Low-carbon hydrogen DA** – Fast adoption |
| **National implementation** | LACKING NATIONAL REGULATORY FRAMEWORKS | • **Target structure** – Provide visibility<br>• **Penalties** – The EC to clarify penalties for Member States for non-compliance<br>• **Certification** – Fast adoption of schemes endorsed by the EC<br>• **Book and claim** – Book and claim system for RED3 compliance |
| **Funding** | INADEQUATE FUNDING MECHANISMS AT EU AND NATIONAL LEVEL | • **European funding** – H2 bank to support offtaker risks and to include imports<br>• **National funding** – Continue R&I and reinforce OPEX schemes |
| **Infrastructure** | SLOW DEVELOPMENT OF HYDROGEN TRANSPORT, STORAGE, AND IMPORT INFRASTRUCTURE PREVENTING CONNECTING CLEAN HYDROGEN SUPPLIERS AND INDUSTRIAL CONSUMERS | • **Implementation** – H2 & Gas Package impl.: H2 network operator, 3rd party access, and regulated funding framework<br>• **Planning and modelling** – Strengthen cross-sectoral system planning, incorporate energy storage, better scenarios<br>• **Strategy** – EU H2 grid and storage strategy |

# Nordics and Iberia lead the supply of electrolytic hydrogen by 2030 in both scenarios while most thermochemical volumes are expected in BeNeLux and UK

**Clean hydrogen supply by 2030 in selected regions under Current trajectory (CT) and Accelerated Adoption (AA) scenarios**

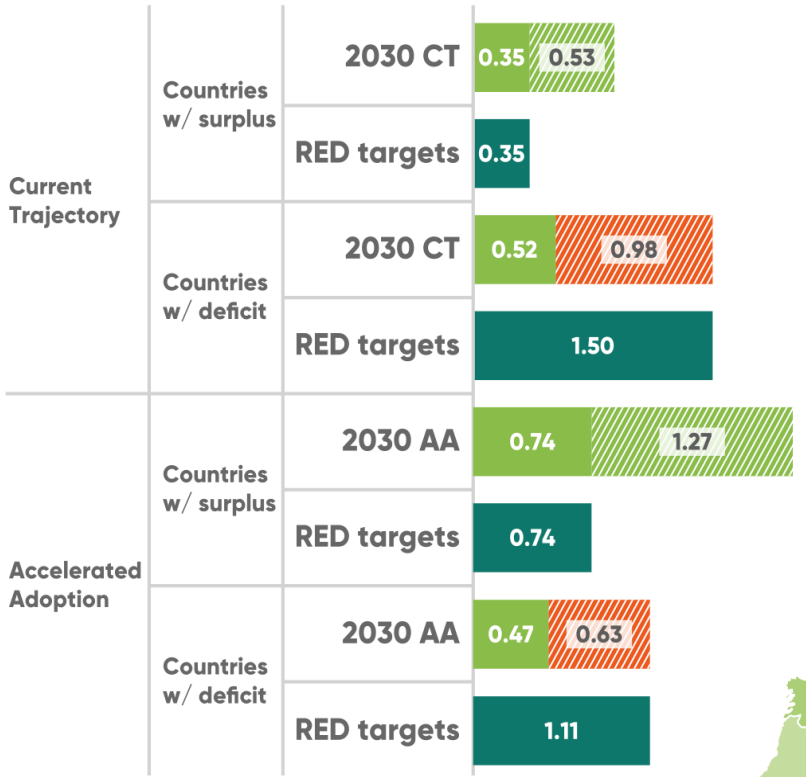


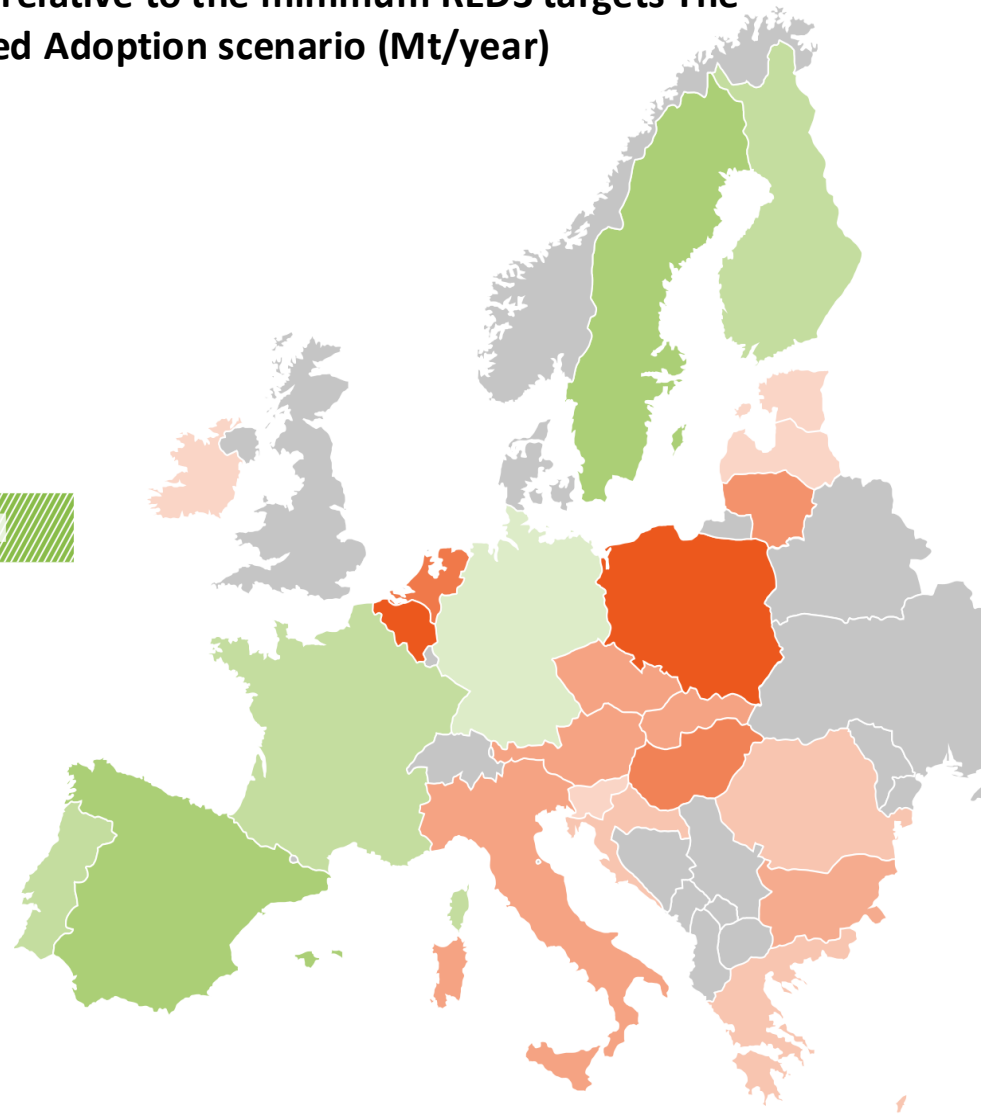

Notes: Nordics includes Denmark, Finland, Norway, and Sweden; Iberia includes Spain and Portugal; Central Europe includes Poland, Czechia, Slovakia, Hungary

# Hydrogen trade could enable achieving Europe's 2030 RED3 targets if the infrastructure is built on time to support trade flows from within and outside Europe

- Compliance with **RED3** could require around **1.85 Mt of RFNBO by 2030**.
- However, targets must be met at Member State level and results show varying progress across countries.
- Infrastructure is key
- Imports are key

**Hydrogen supply deficit and surplus relative to the minimum RED3 targets The map shows results for the Accelerated Adoption scenario (Mt/year)**



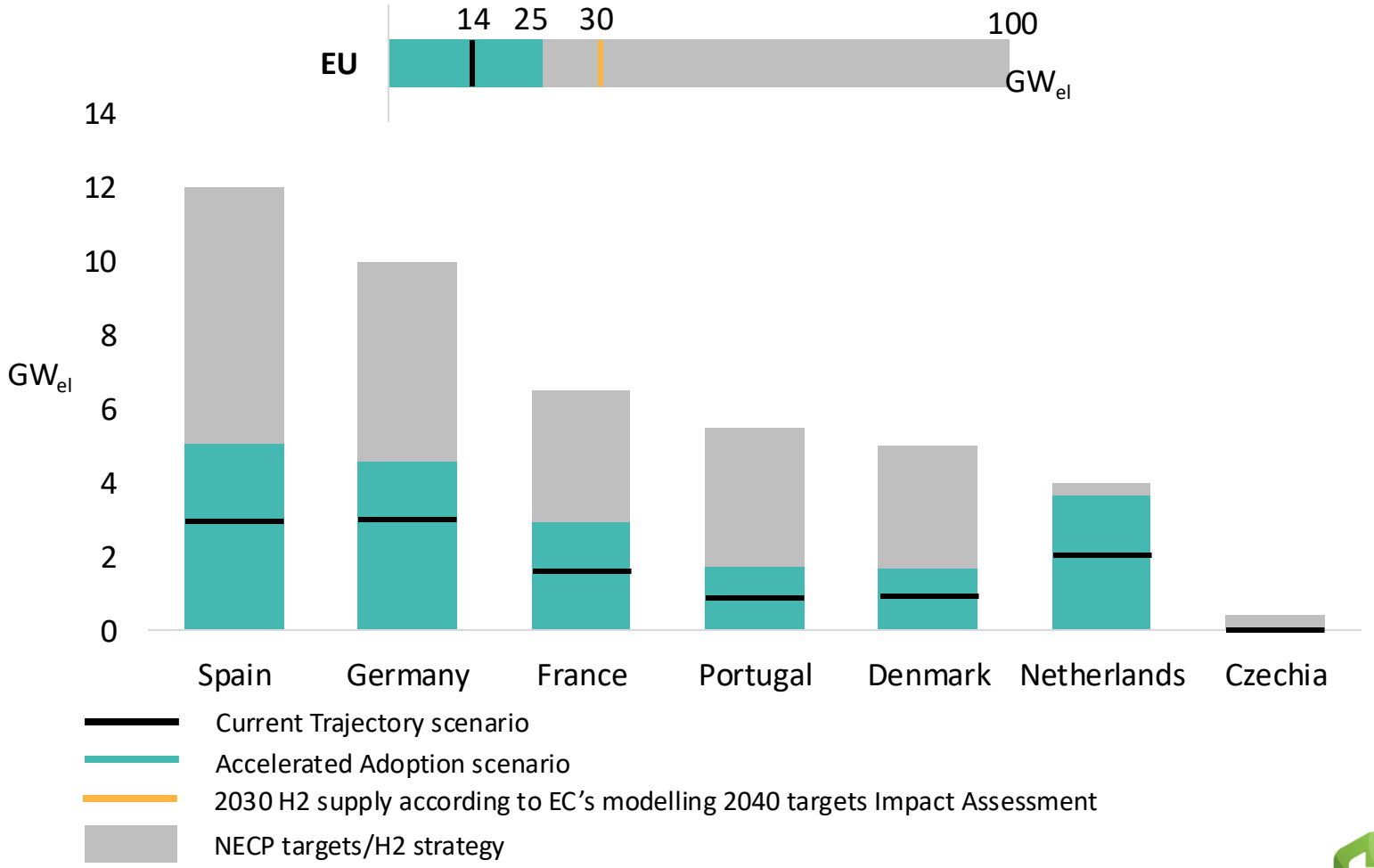




Notes: RED3 targets are calculated based on 2023 consumption and do no any volumes from the target due to specific exclusions. For the purposes calculation, electrolytic hydrogen supply from the two scenarios equals F hydrogen supply.

# The supply outlook across the EU is far from reaching national and EU ambitions, more efforts are needed to ramp-up the clean hydrogen market

**Comparison of NECPs, EU Hydrogen Strategy, and electrolytic supply scenarios by 2030**

- most countries' NECPs have significantly higher objectives than what is likely to be deployed.
- Ambitious goals are set, and this is very positive, but existing market and regulatory conditions are not sufficient to trigger the needed investments in clean hydrogen.
- Most countries will likely achieve only 30–40% of their NECP ambition by 2030.

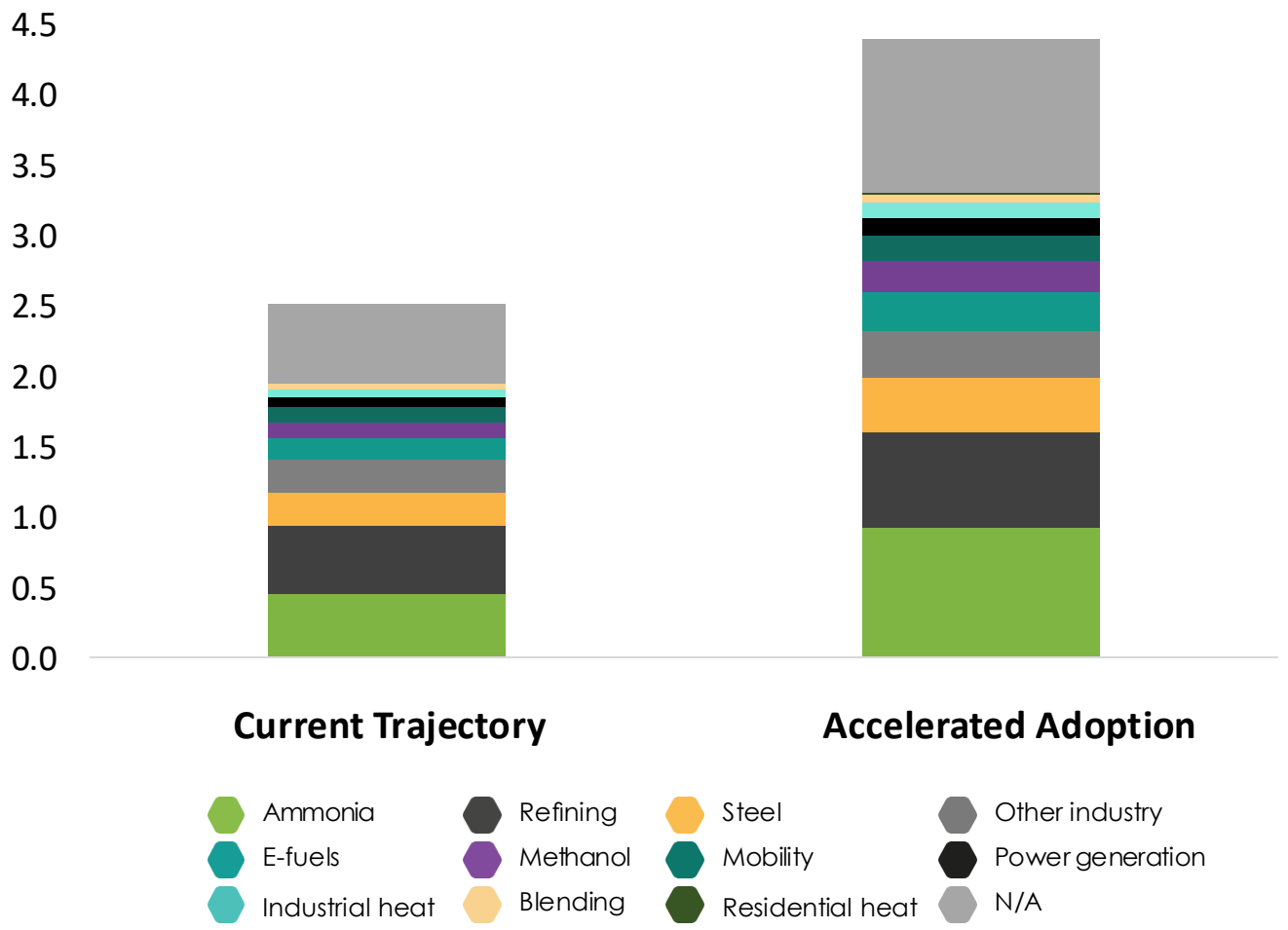



Notes: Europe's 2040 climate targets document refers to the "Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society" communication. The European Commission's modelling forecasts 3.15 Mt per year of renewable hydrogen supplied by 2030, for which this report assumes 30 $GW_{el}$ of installed electrolyser capacity to be needed. The EU Hydrogen Strategy calls for the supply of at least 40 GW in hydrogen output and up to 10 Mt by 2030, for which 100 $GW_{el}$ of installed electrolyser capacity would be required.

# Ammonia, refining, and steel constitute ~45% of the declared end-uses in the two supply scenarios

**Intended end-uses of the two clean hydrogen supply scenarios by 2030**

- Under the Accelerated Adoption scenario, around 0.92 Mt of hydrogen is expected for **ammonia** production by 2030, with 0.6 Mt coming from electrolysis, insufficient to replace the 0.84 Mt from RED3 industry target.
- **Refineries**, the largest current hydrogen consumer will be key offtaker of clean hydrogen by 2030 with 0.5-0.7 Mt in the two scenarios.
- **Clean methanol** demand will be driven mostly by shipping.
- Only 10% of hydrogen supply has been announced for **e-fuels and mobility**, with more volumes expected post-2030. However, securing long-term e-SAF offtaker agreements remains a challenge.
- **Steel** could decarbonize around 6% of the sector with the 0.4 Mt/year of hydrogen in the AA scenario.




Notes: No assumptions regarding how much hydrogen supply will be assigned to a specific end-use were made by Hydrogen Europe. End-uses for the Current Trajectory and Accelerated Adoption scenarios are based on the announced projects' end-uses. See methodological notes for more details

# Clean Hydrogen Monitor 2024 conclusions

The ambitious European Hydrogen Strategy and most of the countries' NECPs targets will not be reached.

The two European clean hydrogen supply scenarios are less ambitious than EC modelled volumes for 2030 from 2040 GHG targets Impact assessment.

Some member states might reach their NECP/RED3 targets, but the EU as a whole will not without the necessary cross border infrastructure. National progress is needed in terms of strategy, modelling, planning and implementation of hydrogen transport, storage and imports infrastructure .

To unlock more clean hydrogen supply in Europe and meet EU targets, production framework should be simplified and legislation needs to be transposed on the national level.

Available EU funding needs to evolve to be fit for purpose and member states should take a more prominent role with national funding.

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2024

Hydrogen Europe

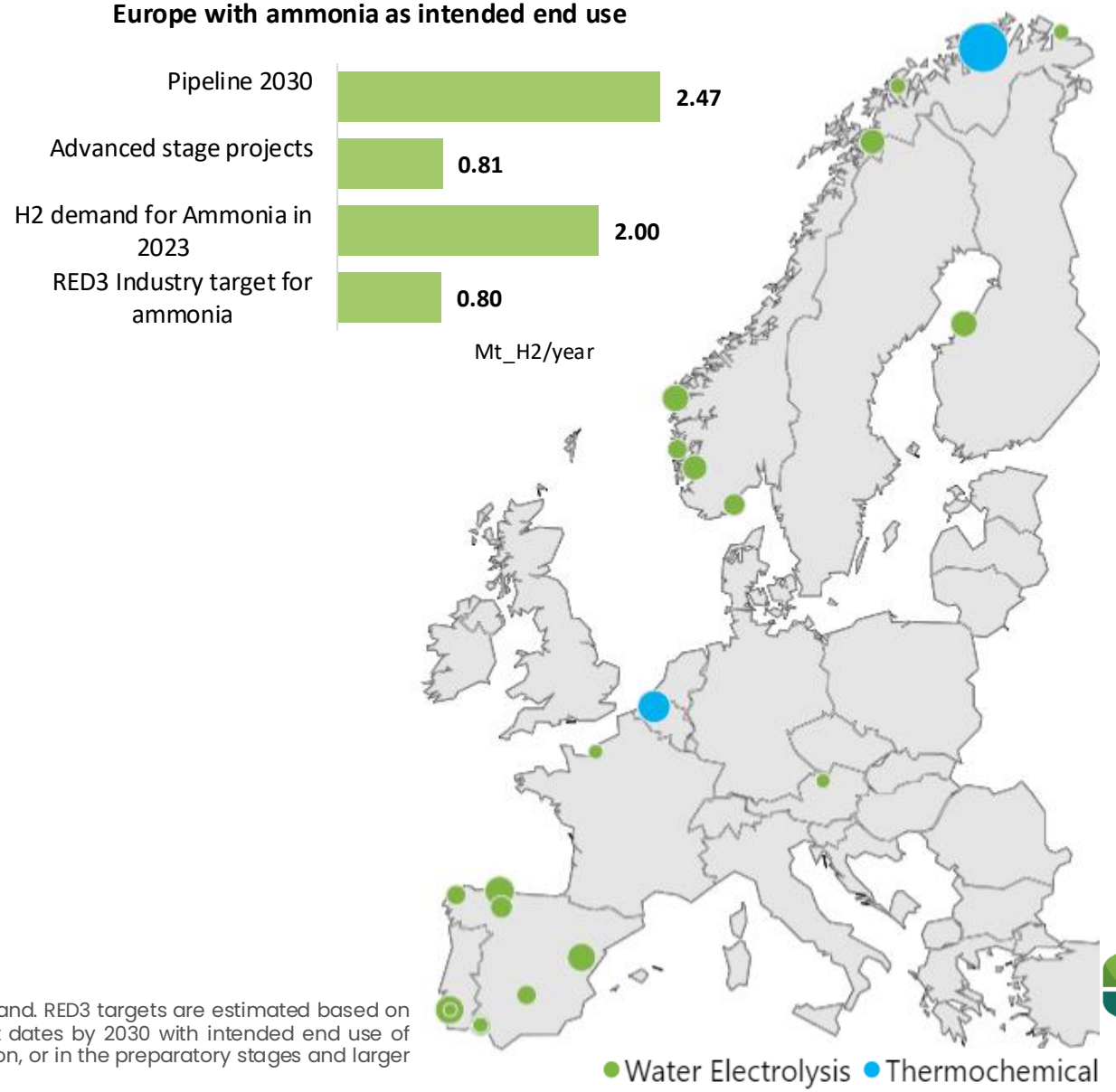
# Ammonia projects concentration in Iberia and Nordics is driven by low renewable electricity prices and orientation towards exports

Europe has around 32 ammonia production facilities, generating around 17.7 $Mt_{NH3}$/year, and **consuming about 2 Mt/year of hydrogen, accounting for 25% of Europe's total hydrogen demand.**

Decarbonising this sector is reinforced by the EU's RED3 industry targets.

Notable green ammonia projects include H2F Fertiberia in Spain (20 $MW_{el}$ operational + 200 $MW_{el}$ under development) and Catalina (500$MW_{el}$), and SKREI Yara (24 $MW_{el}$ operational) for the decarbonisation of existing plants. Norwegian project Holmaneset as well as H2 bank auction winners Hysencia, Madoquoa, and Skiga are planning to build new ammonia production facilities, with much of it likely destined for exports.

**Fig X – Selection of large scale clean hydrogen production projects in advanced stage in Europe with ammonia as intended end use**




Notes: Hydrogen demand estimated for 2023 in Europe including United Kingdom, Norway, Switzerland and Iceland. RED3 targets are estimated based on EU-27 2023 consumption. Pipeline 2030 refers to the total number of announced projects with expected start dates by 2030 with intended end use of hydrogen to ammonia. Advanced projects on the map encompass those that are operational, under construction, or in the preparatory stages and larger than 4,000 tonnes/year.