



2024 State of the European Hydrogen Market Report

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1. Background

The State of the EU Hydrogen Market Report is meant to be a “**snapshot**”

- Provides policymakers and stakeholders with an overview of how the EU Hydrogen Market is doing by each year, based on previous year data. 2024 State of the EU Hydrogen Market is based on 2023 data.

2. Introduction to hydrogen

- Key driver for low carbon hydrogen is government policy: in the absence of decarbonisation objectives, need for low carbon hydrogen disappears.
- Suitability of hydrogen varies by end-use sector, and will evolve over time depending on hydrogen's competitive position against other decarbonisation alternatives (especially electrification).
- Two key production routes: (a) electrolytic hydrogen from renewable power (“green”) or nuclear, and (b) hydrogen from natural gas with CCS (“blue”).
- Cost and scale challenges for both production routes, but particularly electrolytic hydrogen given need for additional renewable/nuclear power generation. CCS also not proven at sufficient scale.
- Mid-stream infrastructure (pipelines, storage, terminals) will be an important component in overall value chain (but will have a very different role to existing natural gas infrastructure: balancing supply and demand over space and time rather than long distance transmission from large scale demand centres)
- All of consumption, production and infrastructure have challenges, particularly around business case to justify investment. This report will track progress on addressing these challenges

3. EU Regulatory Developments

- In 2023, important progresses have been made in completing the EU regulatory framework on the low-carbon hydrogen market
- The EU Hydrogen regulatory approach is mainly focused on developing and supporting renewable technologies : new set of criteria and targets in the RED which has to be transposed and implemented by the Member States.
- At the same time, the EU carbon market has been reinforced (extended ETS) and will be applied to imports (indirectly via CBAM).
- The EU funding mechanism have been also improved with the launch of the Hydrogen bank auctions.
- Hydrogen renewable technologies have been included in the nascent EU industrial strategy (Net Zero Industry Act)

Hydrogen and Decarbonized Gas Market package <u>revision</u>	(21 May 2023 regulation and directive signed)	
• Delegated Acts H2	• Delegated Acts H2: expected in 2025	
RED II Delegated Acts	20 June 2023	10 July 2023
RED III	31 October 2023	20 November 2023
CBAM	16 May 2023	1 October 2023
EU ETS (Revision)	16 May 2023	5 June 2023
Alternative fuels infrastructure regulation (AFIR)	22 September 2023	12 October 2023 BUT the new rules will enter into force six months after the date of entry into force of the regulation (12 April 2024)
FuelEU maritime	22 September 2023	12 October 2023. BUT The regulation will apply from 1 January 2025, apart from articles 8 and 9 which will apply from 31 August 2024
RefuelEU aviation	31 October 2023	20 November 2023. BUT The new regulation will apply from 1 January 2024. However, Articles 4, 5, 6, 8 and 10 will apply from 1 January 2025
Green Deal Industrial Plan (Communication)	1 February 2023	-
REPowerEU Plan	28 February 2023	29 February 2023
Net Zero Industry Act	(adopted on 27 May 2024)	
Critical Raw Materials Act	3 May 2024	23 May 2024
Hydrogen Bank (Communication)	16 March 2023	-

Policy gaps

- **Implementation gap:** implementation of the directives and subsidy mechanisms is up to the Member States.
- **Low Carbon hydrogen:** a complete definition of low carbon hydrogen and an associated certification method are missing.
- **High entry barriers to the market and lack of investment security:** Higher production costs, lack of demand (project offtakers), high technical and commercial risks not mitigated by the regulatory framework dampen investment appetite.
- **Competitiveness/demand:** renewable hydrogen prices are currently higher than the ones from traditional fossil fuel option. Support is needed to narrow the gap between the two and making the renewable option more attractive and competitive.
- **Technological neutrality:** the EU hydrogen regulatory framework based only on renewable technologies is a real limitation for a series of industry sectors requiring large volume of hydrogen round the clock.
- **Technology readiness:** the EU framework does not sufficiently consider the development stage of the EU hydrogen technologies. The technology readiness varies across EU sectors.
- **Financing:** The financial support currently available needs to be strengthened and reinforced, as larger funds are needed to meet the 2030 REPowerEU target of 20 Mt renewable hydrogen produced and imported.

3. UK Regulatory Developments

- Energy Act passed in 2023 which creates legal framework enabling hydrogen:
 - Government support mechanisms for hydrogen production and Carbon Capture Use and Storage (CCUS).
 - A levy on natural gas network users to finance the subsidy of hydrogen production.
 - Regulatory framework for hydrogen and CO2 transport and storage.
 - Strategic planning for energy infrastructure, including hydrogen, by the Future System Operator.
 - Trial of hydrogen in home heating.

UK support for hydrogen

- Production - Support for electrolytic and CCS enabled hydrogen production via the Hydrogen Production Business Model (HPBM)– first projects awarded support in December 2023
- Infrastructure - Hydrogen Transport and Storage Networks (December 2023) pathway sets out proposed regulatory and support framework
- Demand – HPBM recipients must have offtake agreements in place; blending in natural gas distribution networks agreed in principle.
- Standards – Low Carbon Hydrogen Standard requires HPBM projects to have carbon intensity $\leq 20\text{gCO}_2\text{e/MJ}$.

EU approach vs UK approach

EU	UK
Political and economic union of 27 Member States - aspects determined at the EU level + others determined at the Member State level.	sovereign state - control over all aspects of its hydrogen policy
preferred technology	technology neutral
'well to wheel' approach	'well to production gate' system
Calculation of carbon intensity of electricity used in electrolysis: temporal correlation of one month until 2030, and then hourly thereafter.	Calculation of carbon intensity of electricity used in electrolysis: temporal correlation of 30 minutes

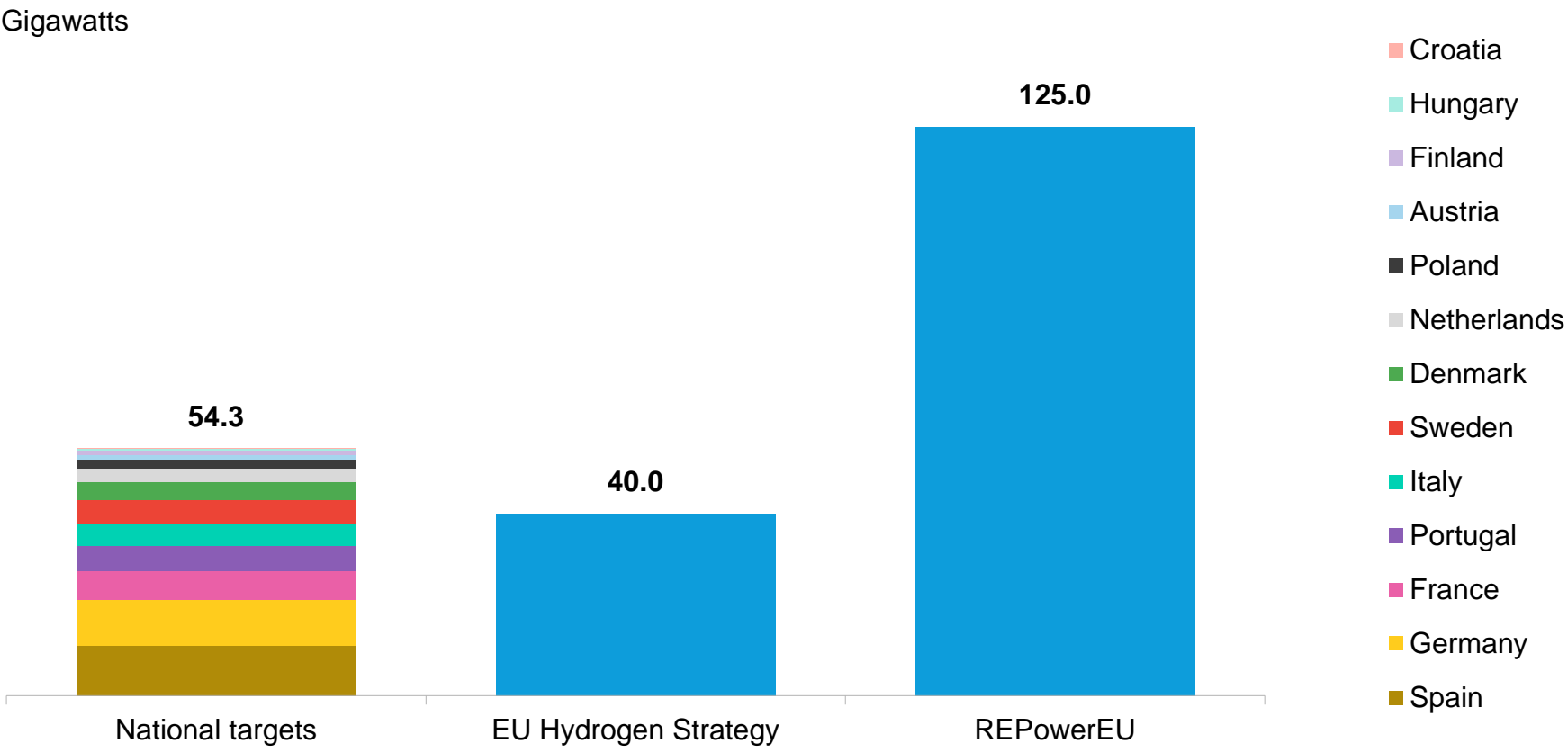
International dimension - Insights

- **The US:** The Inflation Reduction Act (IRA) introduces an attractive framework for hydrogen and fuel cells investments
- **China:** major electrolyser manufacturer

4. Hydrogen Economy KPIs

KPI 1: National electrolyzer targets exceed EU H2 strategy goal but are not enough for REPowerEU

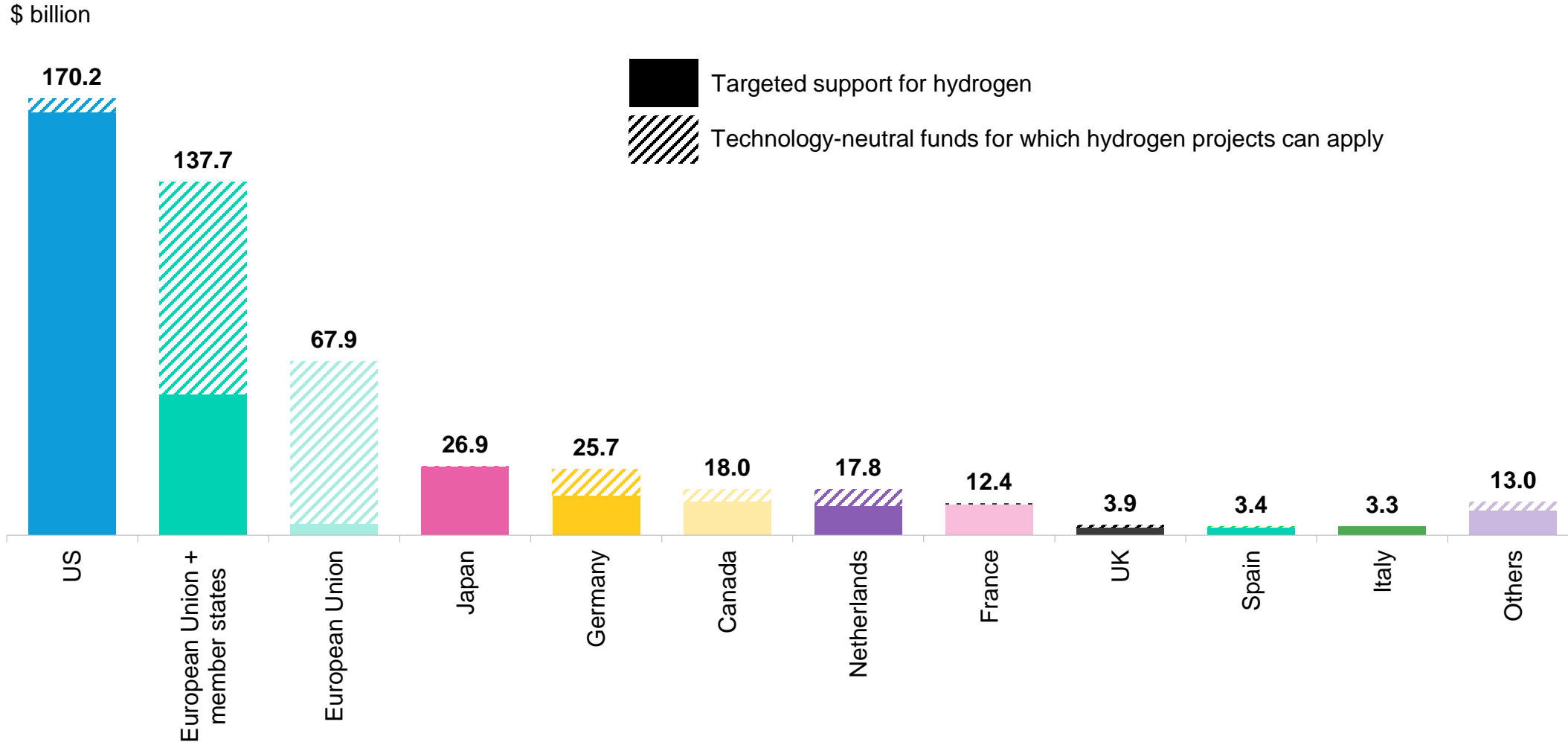
National versus EU electrolyzer targets for 2030



Source: BloombergNEF, National hydrogen strategies, European Commission. Note: REPowerEU target based on estimations.

KPI 2: Europe ranks second in global funding for low-carbon hydrogen

Government funding for hydrogen by market

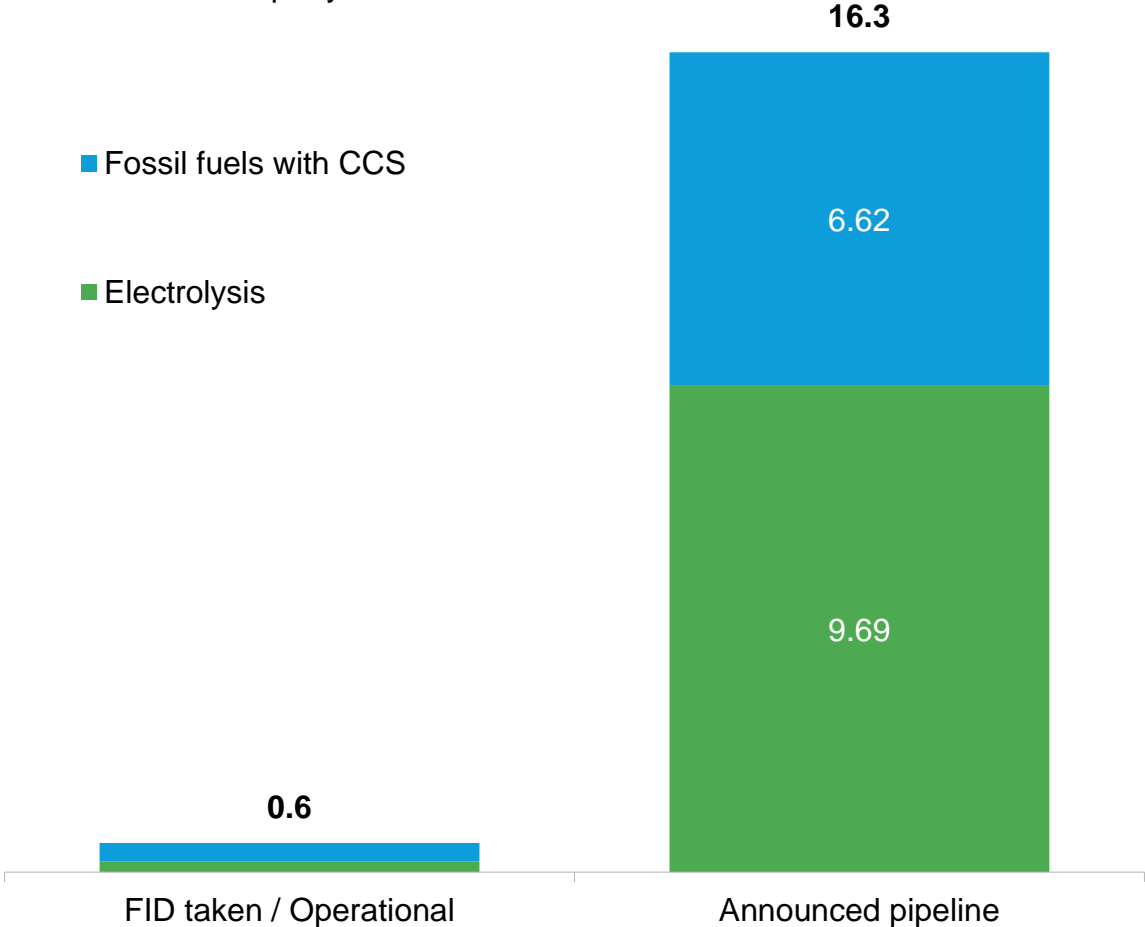


Source: BloombergNEF's Hydrogen Subsidies Tracker. Note: Data as of April 30, 2024

KPI 3: Just 3.6% of the announced pipeline for 2030 are operational or have taken final investment decision

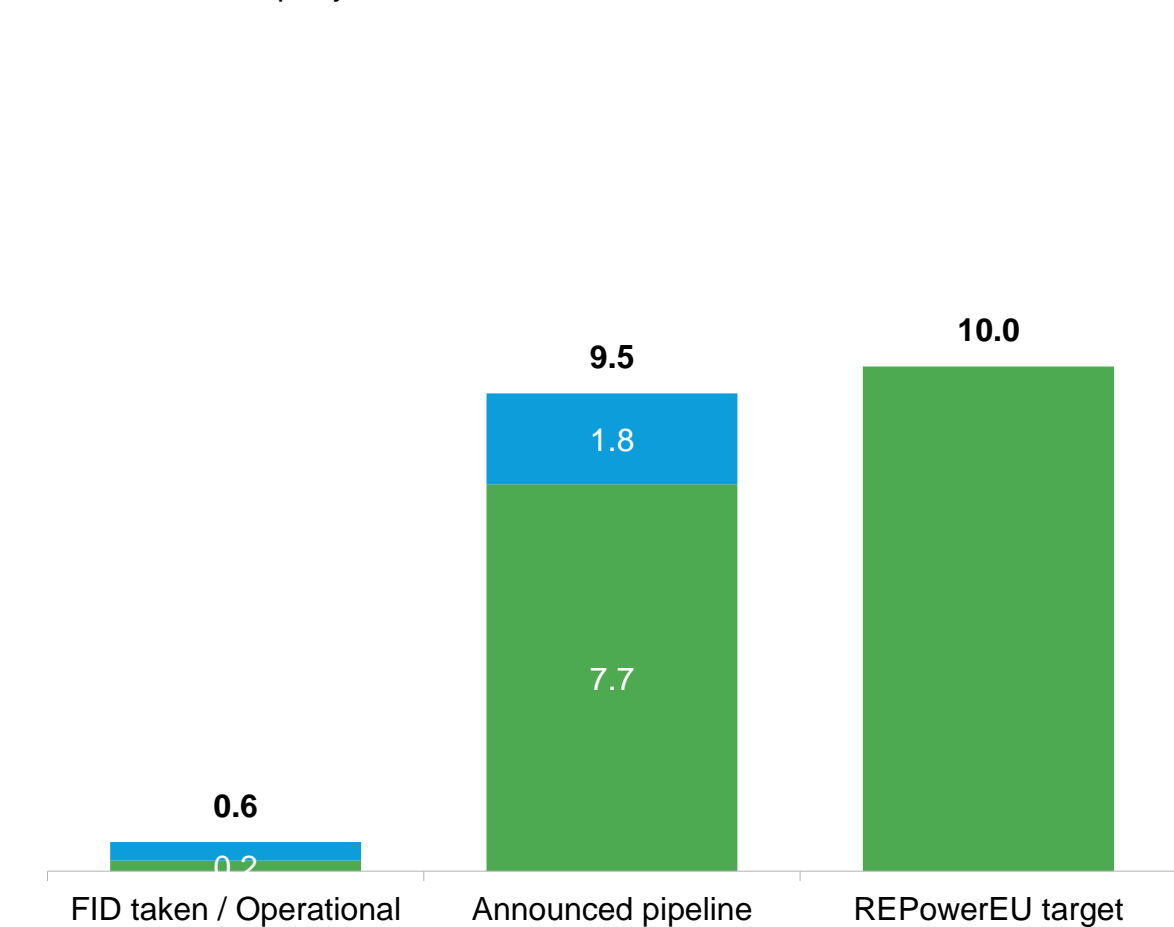
Production in Europe versus announced supply until 2030

Million metric tons per year



Production in the EU versus announced supply and target until 2030

Million metric tons per year

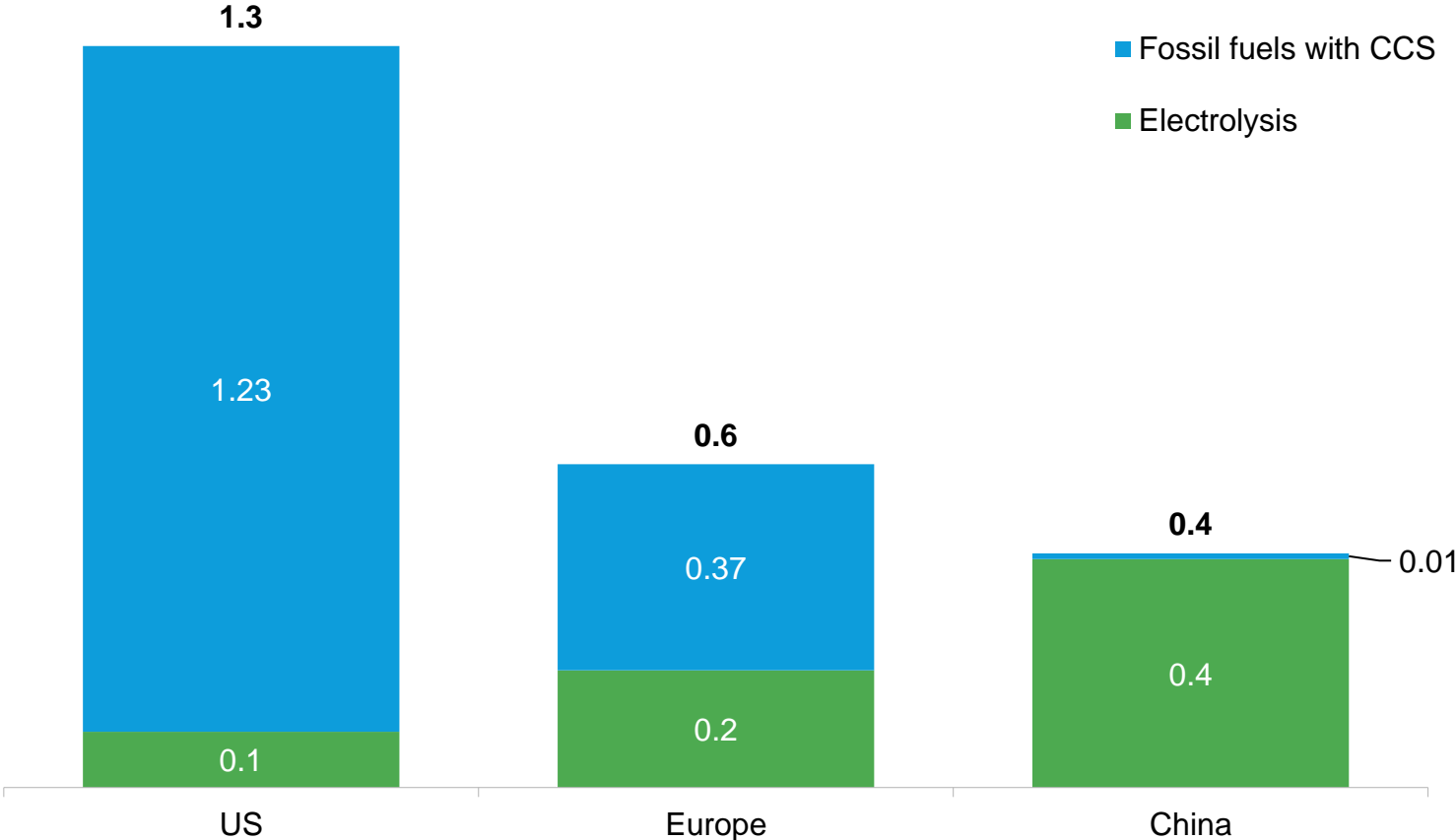


Source: BloombergNEF. Note: Data from BloombergNEF's hydrogen project database as of May 7, 2024. 'CCS' refers to carbon capture and storage.

KPI 4: The US leads Europe on committed low-carbon hydrogen supply but Europe leads China on this metric

Committed low-carbon hydrogen supply across the US, Europe and China

Million metric tons per year

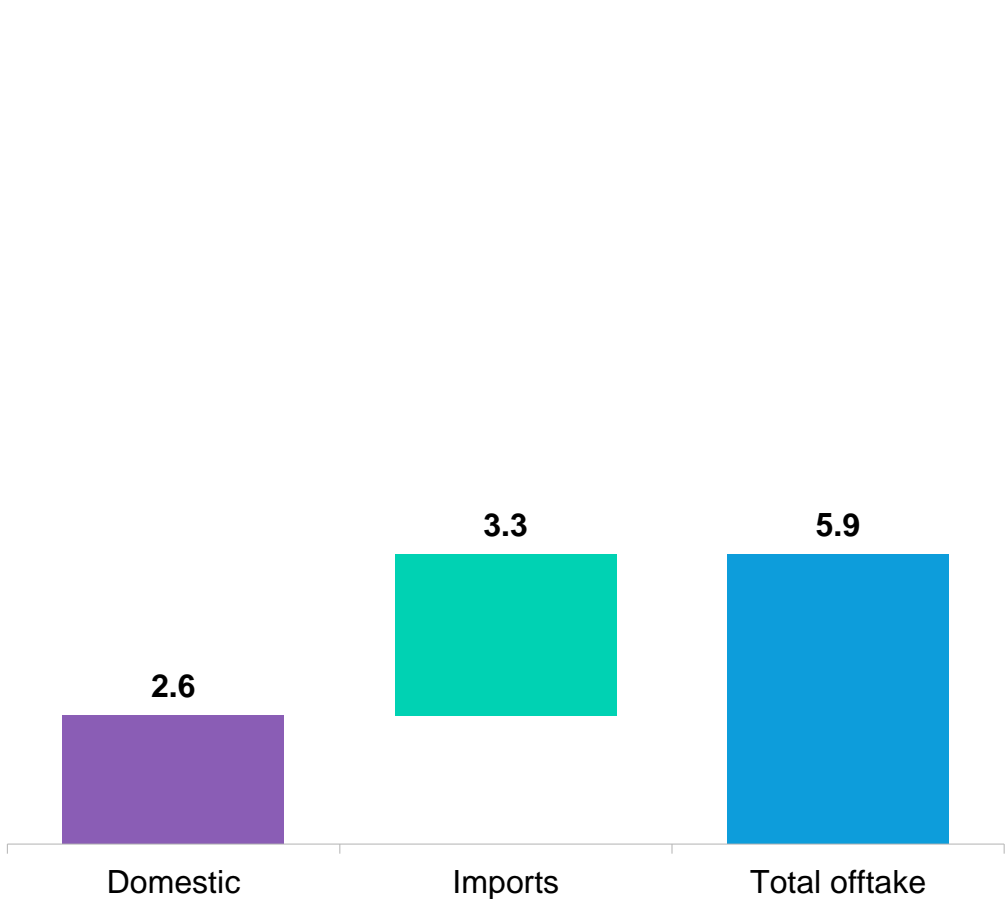


Source: BloombergNEF. Note: Data from BloombergNEF's hydrogen project database as of May 7, 2024. 'Committed' refers to projects that are operational or have taken final investment decision. 'CCS' refers to carbon capture and storage.

KPI 5: 29.5% of the 20 million metric ton REPowerEU 2030 target is in offtake discussions

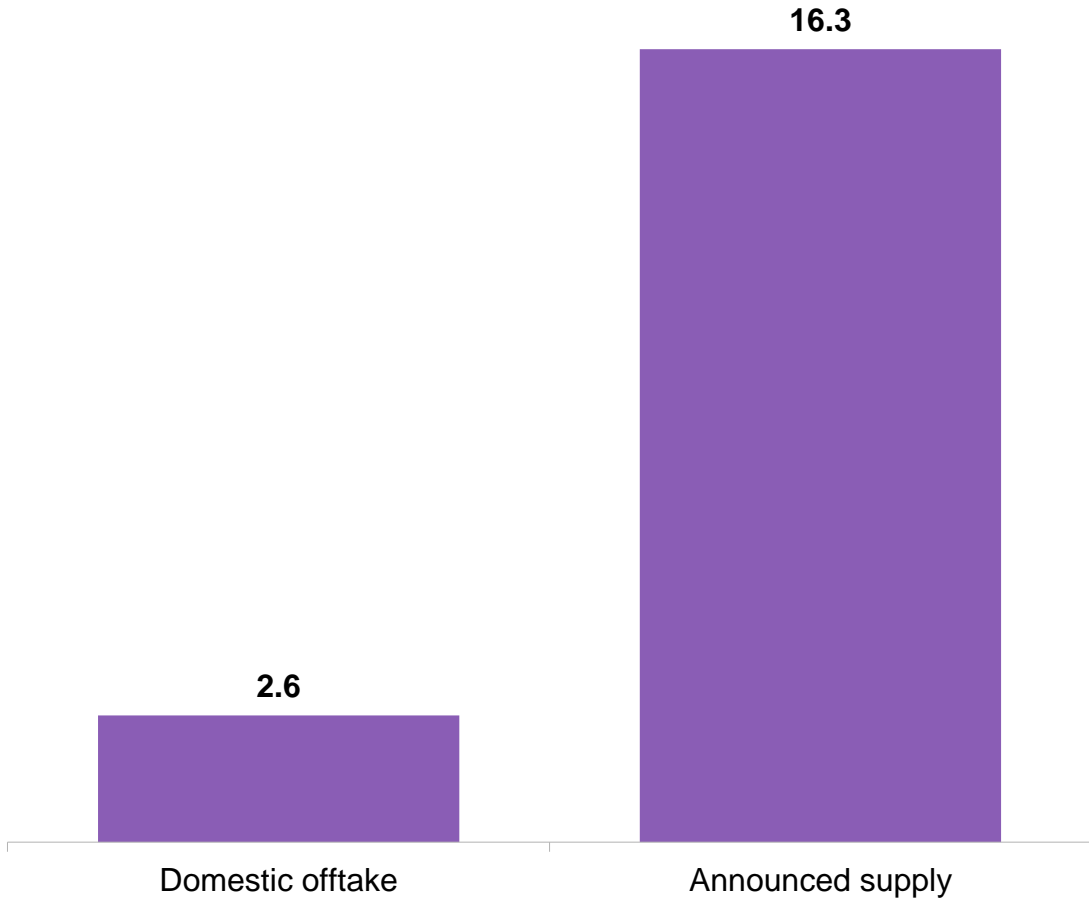
Annual low-carbon hydrogen supply in offtake discussions with European buyers by production origin

Million metric tons per year



Domestic low-carbon hydrogen supply in offtake discussions versus announced supply until 2030

Million metric tons per year

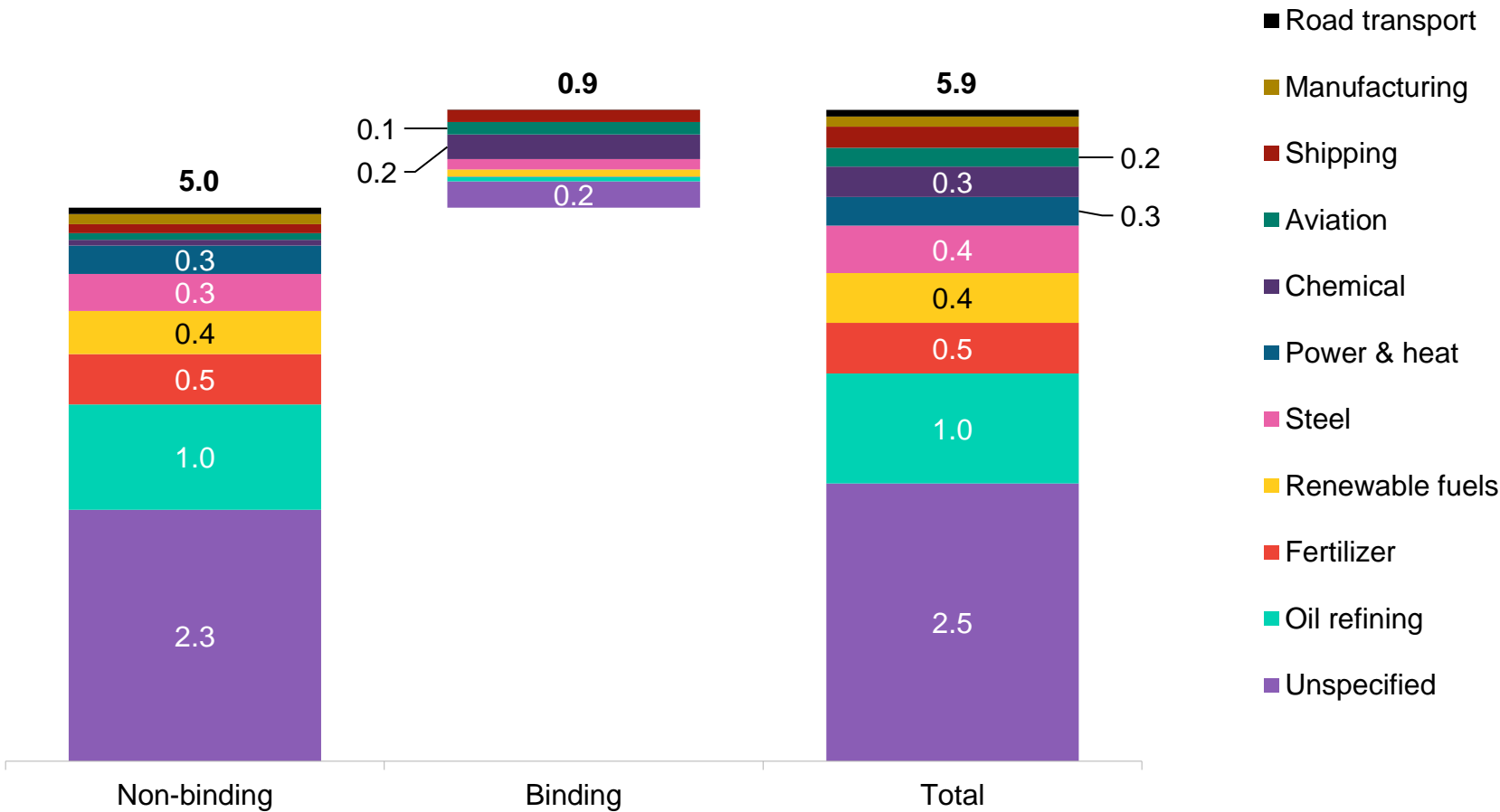


Source: BloombergNEF. Note: Offtake data from BloombergNEF's Hydrogen Offtake Agreement Database as of April 1, 2024. Announced supply from BloombergNEF's hydrogen project database as of May 7, 2024

KPI 6: Just 4.5% of the supply needed to meet REPowerEU has signed a binding offtake agreement

Annual low-carbon hydrogen supply in offtake discussions with European buyers by contract type

Million metric tons per year



Source: BloombergNEF. Note: Data from BloombergNEF's Hydrogen Offtake Agreement Database as of April 1, 2024.

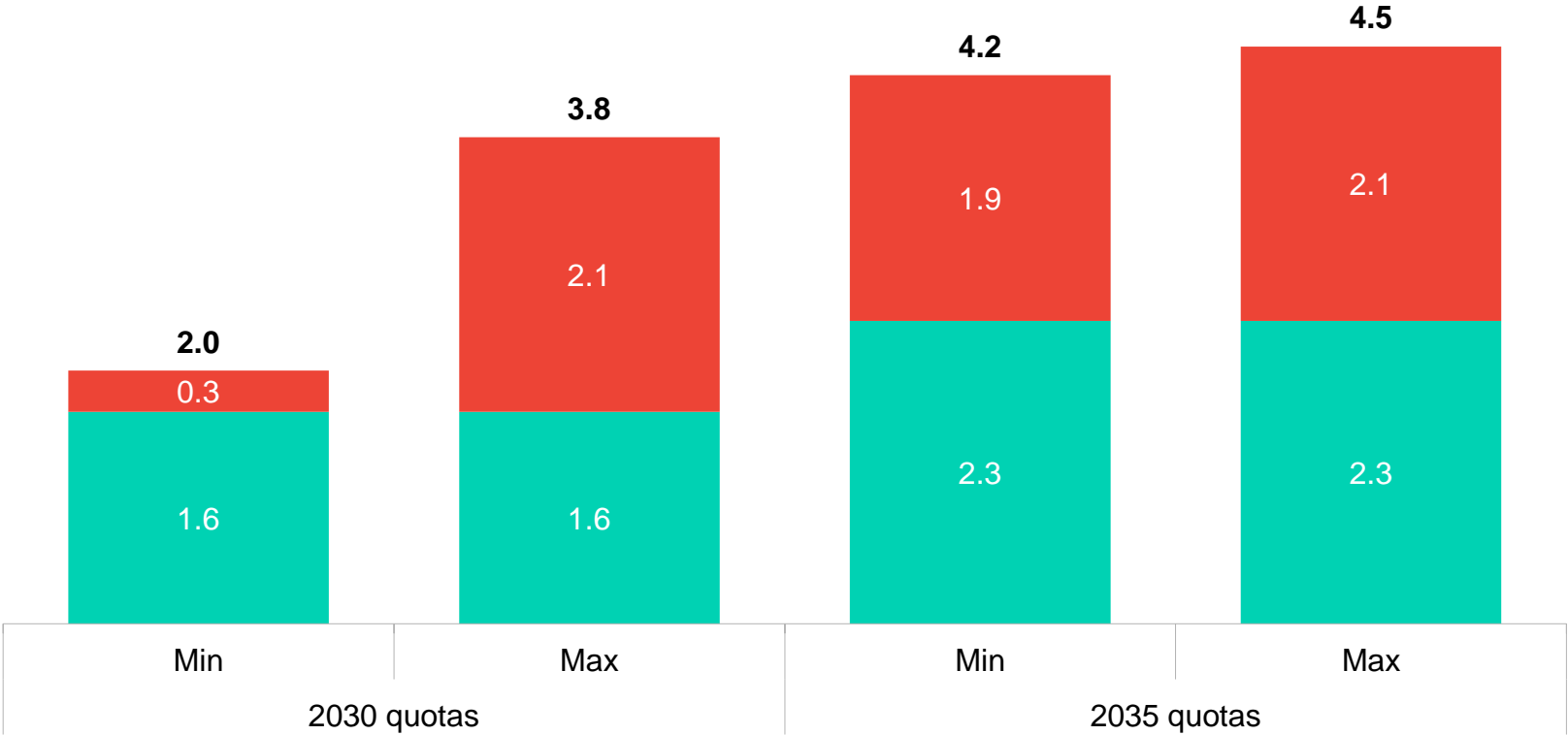
KPI 7: Quotas have been set on an EU level but may not be enough to reach EU targets. Some still need to be transposed into national law

EU quotas for renewable fuels of non-biological origin in industry and transport

Million metric tons per year

Transport quotas

Industry quotas

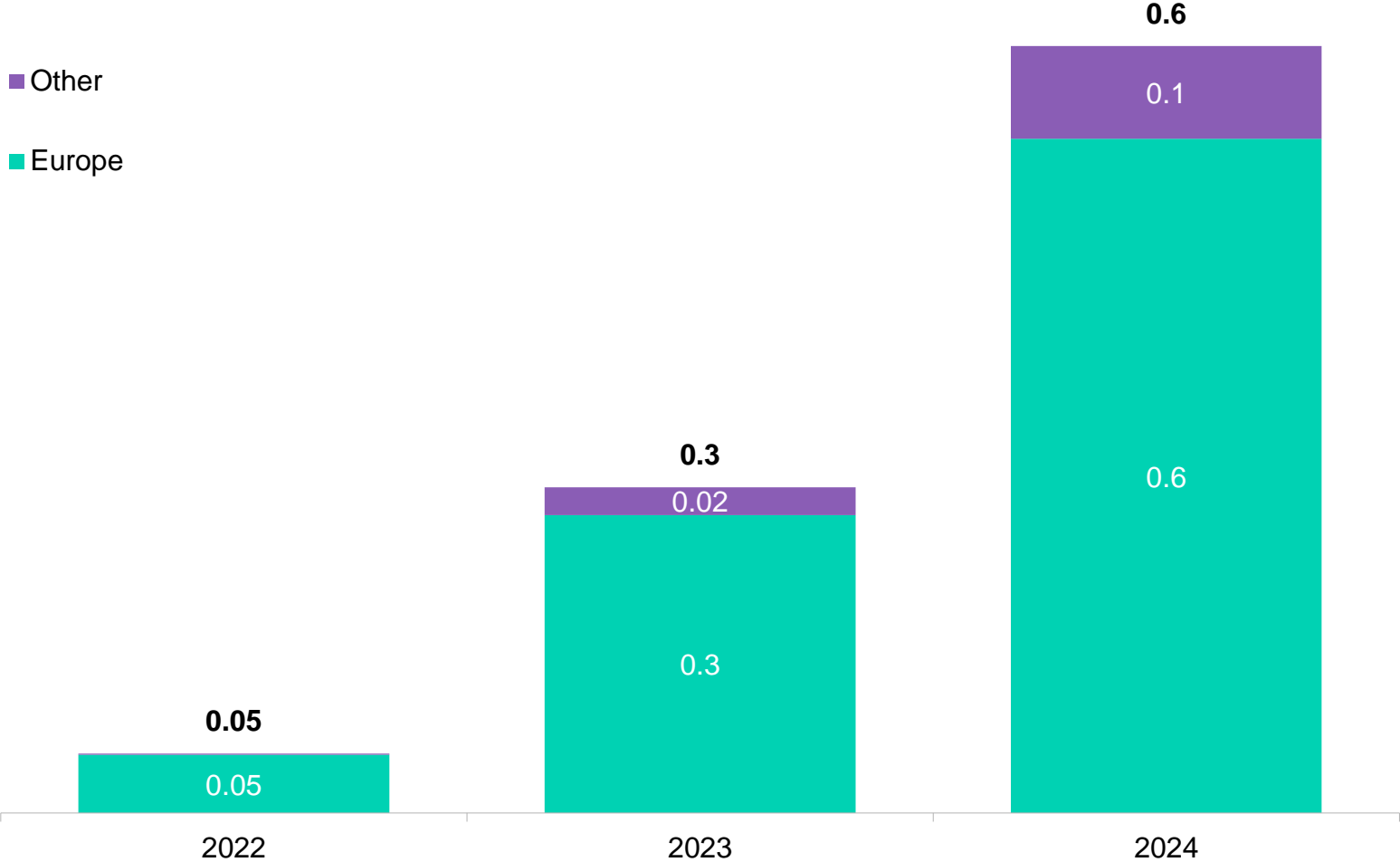


Source: BloombergNEF. Note: Transport quotas consider quotas in the revision of the Renewable Energy Directive, REFuelEU Aviation and FuelEU Maritime.

KPI 8: Domestic manufacturers currently dominate sales to European projects

European electrolyzer shipments by manufacturer origin

Gigawatts

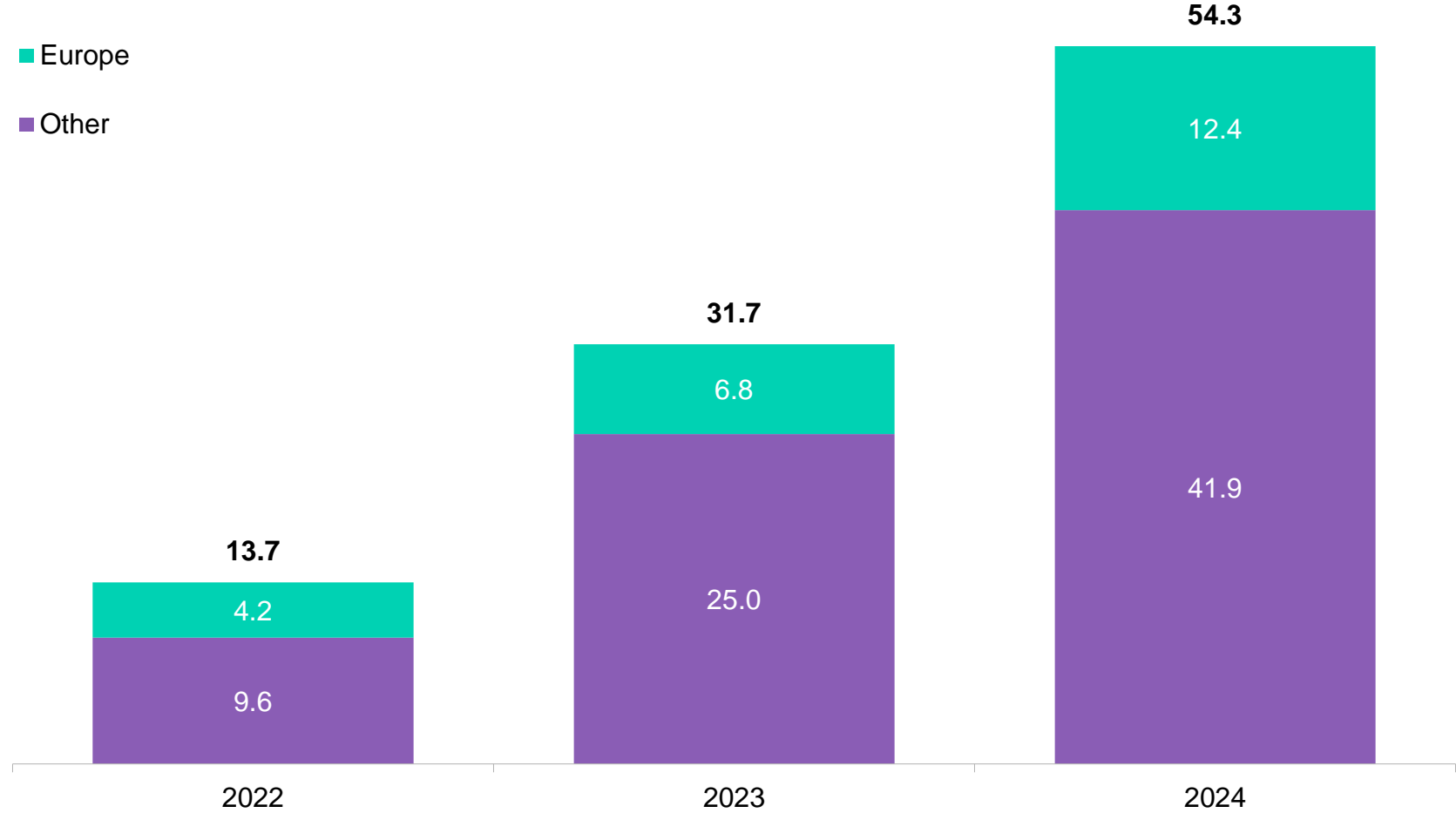


Source: BloombergNEF. Note: Data from BloombergNEF's Hydrogen Supply Outlook as of May 7, 2024. 2024 value is based on BloombergNEF's for 2024.

KPI 9: European electrolyzer manufacturers could account for 23% of global manufacturing capacity by the end of 2024

Global announced electrolyzer manufacturing capacity by manufacturer origin

Gigawatts per year



Source: BloombergNEF. Note: Data from BloombergNEF's Electrolyzer Manufacturing 2024 report as of March 26, 2024.

Europe has made low to moderate progress on nine KPIs for low-carbon hydrogen. More ambitious policy implementation is needed to kickstart a European hydrogen market.

Key performance indicators tracked in this report

Category	KPI	Progress
Targets and incentives	KPI 1: Electrolyzer targets	Moderate. National targets exceed the EU's hydrogen strategy target but make up less than half of the estimated deployment to meet REPowerEU.
	KPI 2: Funding	Good. Europe has committed one of the largest budgets for low-carbon hydrogen projects.
Supply	KPI 3: Committed supply versus pipeline and targets	Low. Just 3.6% of the announced pipeline for 2030 are operational or have taken final investment decision.
	KPI 4: Committed supply versus the US and China	Moderate. The US leads Europe on committed low-carbon hydrogen supply but Europe leads China on this metric.
Offtake and demand	KPI 5: Supply in offtake discussions	Low. 29.5% of the 20 million metric ton REPowerEU 2030 target is in offtake discussions.
	KPI 6: Binding offtake	Low. 4.5% of supply needed to meet REPowerEU has signed a binding offtake.
	KPI 7: Quotas for hydrogen use	Moderate. The world's first binding quotas have been set on an EU level, but not enough to reach EU targets. Some still need to be transposed into national law.
Electrolyzer sales and manufacturing	KPI 8: Share of local content in electrolyzer sales	Good. Domestic manufacturers currently dominate sales to European projects.
	KPI 9: European makers' share of global manufacturing capacity	Moderate. European electrolyzer manufacturers could account for 23% of global manufacturing capacity by the end of 2024.

Source: BloombergNEF

5. Environmental Delivery

- Ensuring that the hydrogen economy delivers on environmental objectives is key for the creation and long-term success of the hydrogen market.
- This chapter assesses the impact of low-carbon hydrogen market deployment amidst European decarbonisation using the most recent and comprehensive data from 2022 (European Hydrogen Observatory).

Four KPIs to monitor environmental delivery trends

5.1 Total emissions from H2 production in Europe

5.2 Emissions savings in traditional H2 consuming sectors

5.3 Emissions savings in overall H2 consuming sectors

5.4 Share of RFNBO H2 in industry

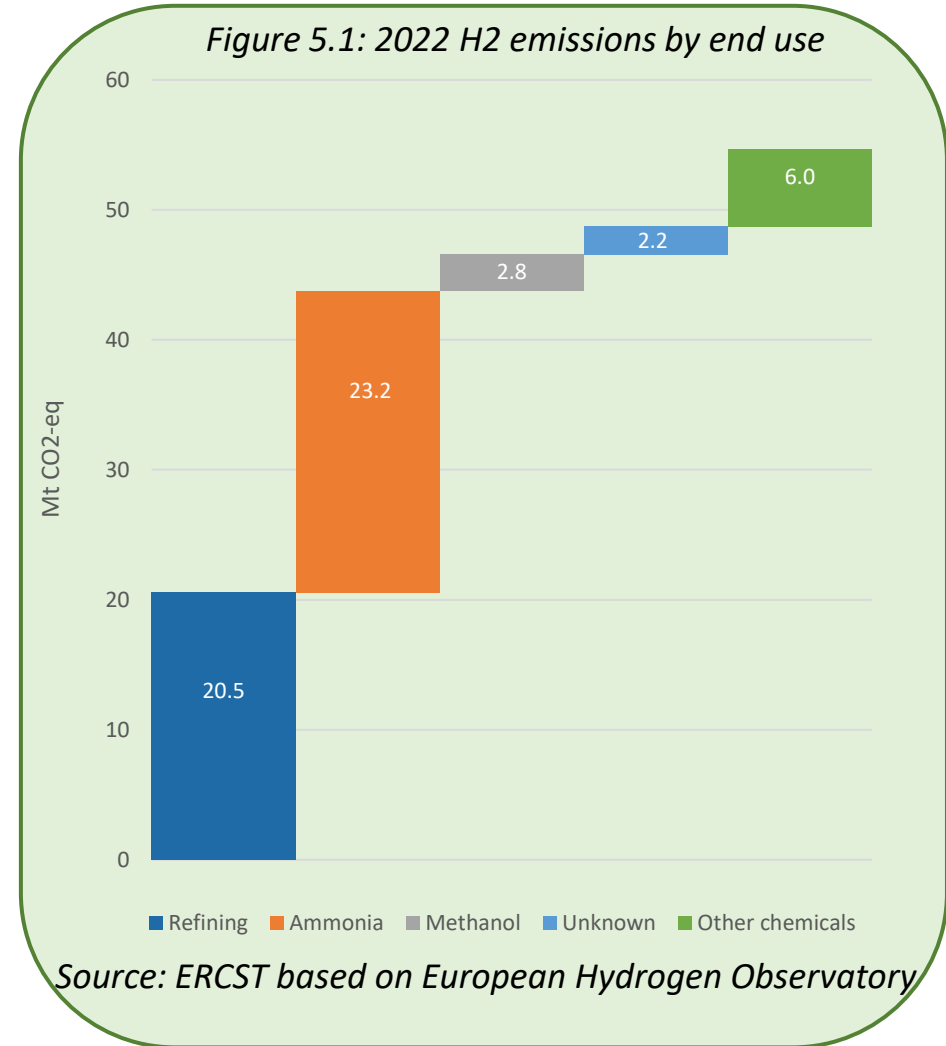
5. Environmental Delivery

KPI 5.1 → Total emissions from H2 production in Europe ¹ **54.7 Mt CO2-e**

- Sectoral shares: ammonia (42%), refining (37%), other chemicals (11%), methanol (5%), unknown (4%).
- Technology shares: unabated SMR production (99.7%), POX and SMR CCS-related emissions only in the kilotonne range.
- Future goal of tracking the year-to-year variation of emissions.

Implied emission intensity of European H2 production, in line with the EU ETS H2 benchmark and the IEA data ²

9.1 t CO2-e / t H2

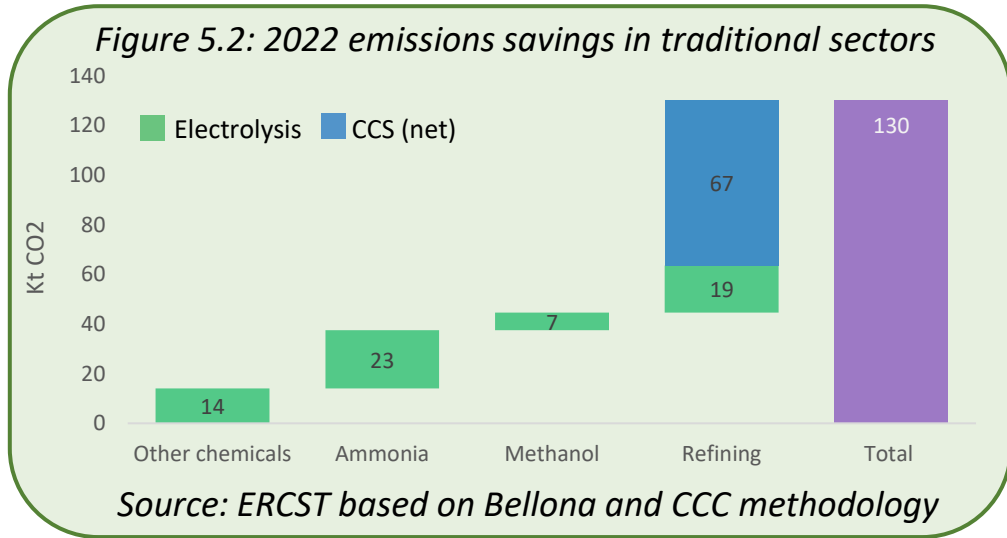


1: Formula: *t H2 by production route * emissions intensities of different production routes*

2: Total emissions / SMR + SMR-CCS + POX + Electrolysis + by-product production

5. Environmental Delivery

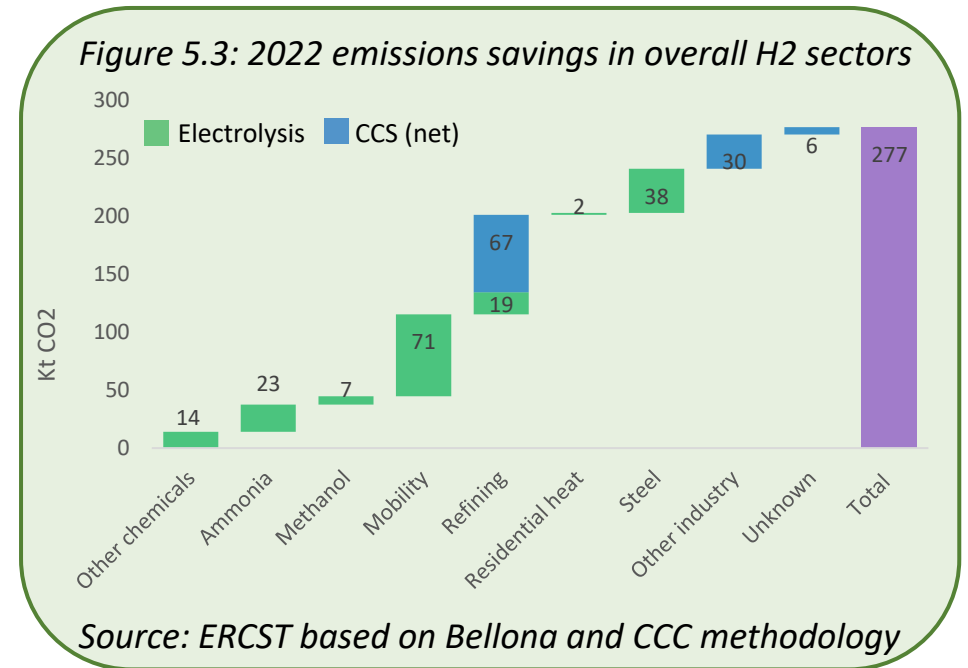
KPI 5.2 → Emissions savings in traditional H2 consuming sectors ¹ **130 Kt CO2**



- Emissions savings defined as retained CO2 due to the deployment low-carbon hydrogen against possible alternative uses.
- Electrolysis-based emissions savings along all the examined industrial processes, with ammonia leading the way.
- This KPI reflects the low penetration of low-carbon H2 in these sectors, which currently equals 0.3% of total production (0.02 Mt).

KPI 5.3 → Emissions savings in overall H2 sectors **277 Kt CO2**

- This KPI extends the previous one by including the amount of CO2 that has not been emitted thanks to the deployment of low-carbon in steelmaking, mobility, residential heat, and “other industry”.
- Considering the direct electrification alternatives in mobility and residential heat, total emissions savings would theoretically increase from 277 to 377 Kt CO2.



1: Renewable H2 production by end use (t) * CO2 emission savings from 55 MWh of renewable electricity used to produce renewable H2 displacing grey H2 (tCO2/MWh) + Theoretical emissions accrued if all SMR-CCS production had been produced with SMR minus emissions from SMR-CCS

5. Environmental Delivery

KPI 5.4 → Share of RFNBO H2 in EU industry **0.2%**

- Official RED III 2030 target for industry (without discounts): 42%
- To meet the target, RFNBO consumption in industry should roughly double every year until 2030, assuming 2030 hydrogen consumption remains at 2022 levels.
- This suggests that meeting the target will likely require not only a significant increase in RFNBO production but also a reduction in the total hydrogen consumption.

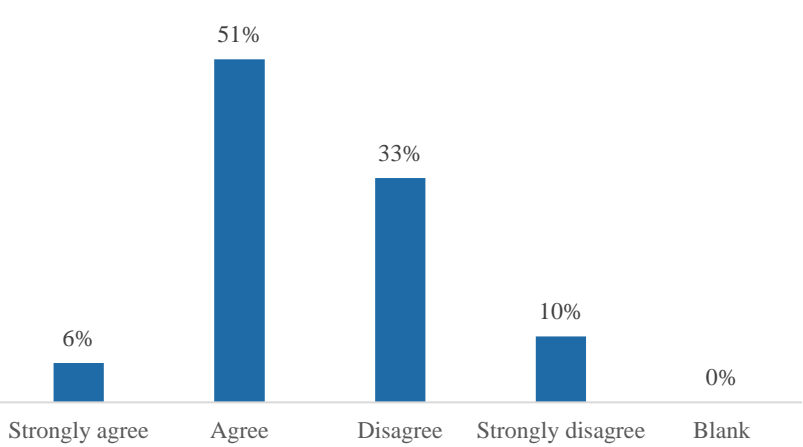
Table 5.1: 2022 EU RFNBO consumption in industry

		Ammonia	Other chemicals	Steel	Total
t H2/Y	SMR	2037199	523268	0	2560467
	SMR CCS	0	0	0	0
	POX	0	0	0	0
	Electrolysis	2248	1343	1542	5133
	Total	2039447	524611	1542	2565600
	% electrolysis	0.110%	0.256%	100.000%	0.200%

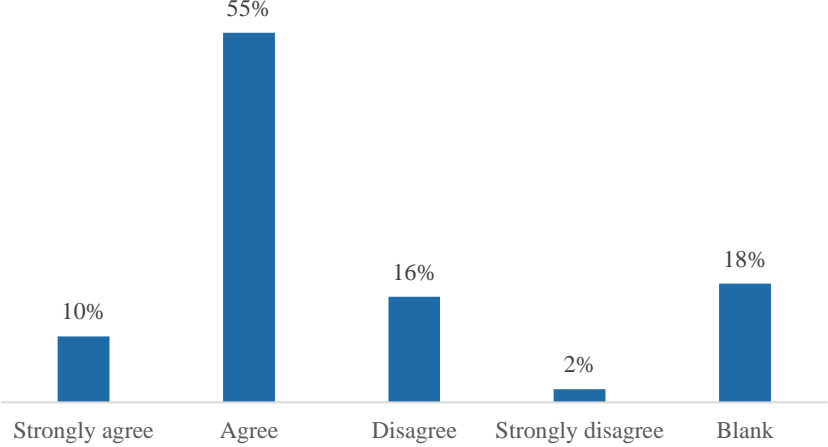
Source: ERCST based on European Hydrogen Observatory

6. Market Sentiment Survey

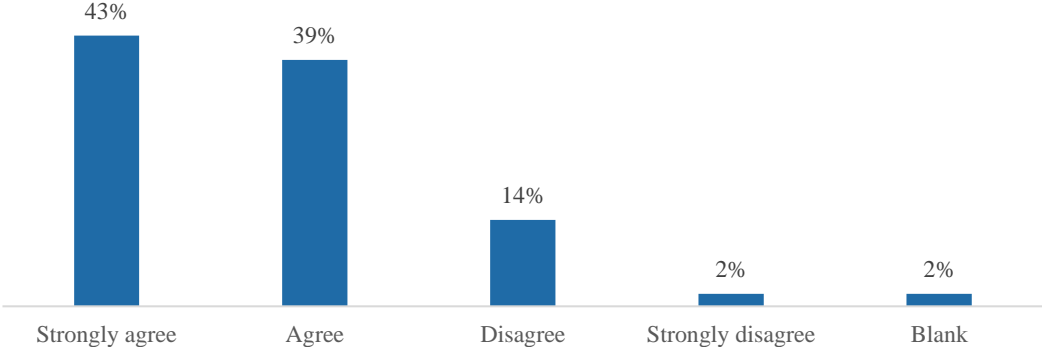
1. The EU Regulations in their current set up are supporting the creation of the EU hydrogen economy.



2. The UK Regulations in their current set up are supporting the creation of the UK hydrogen economy.

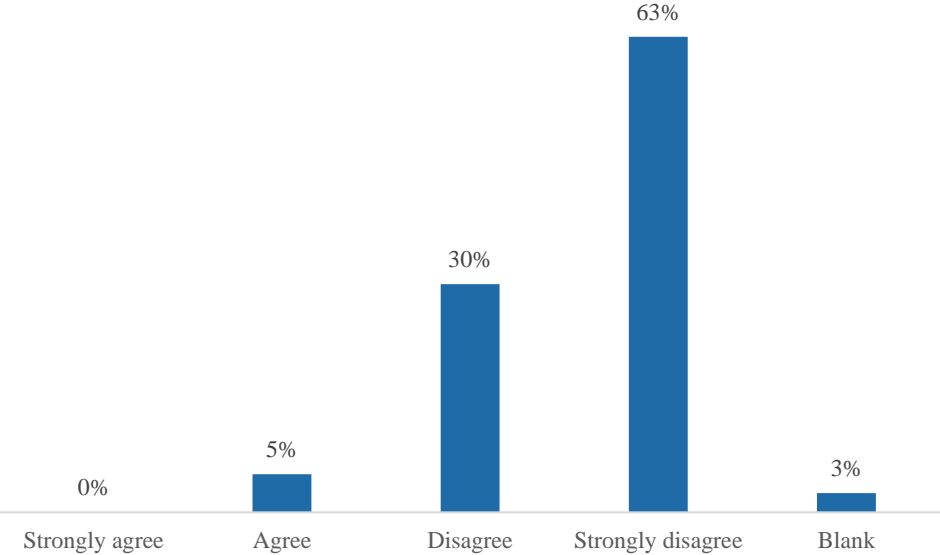


3. The EU Hydrogen Regulatory Framework should be technology neutral as opposed to specific.

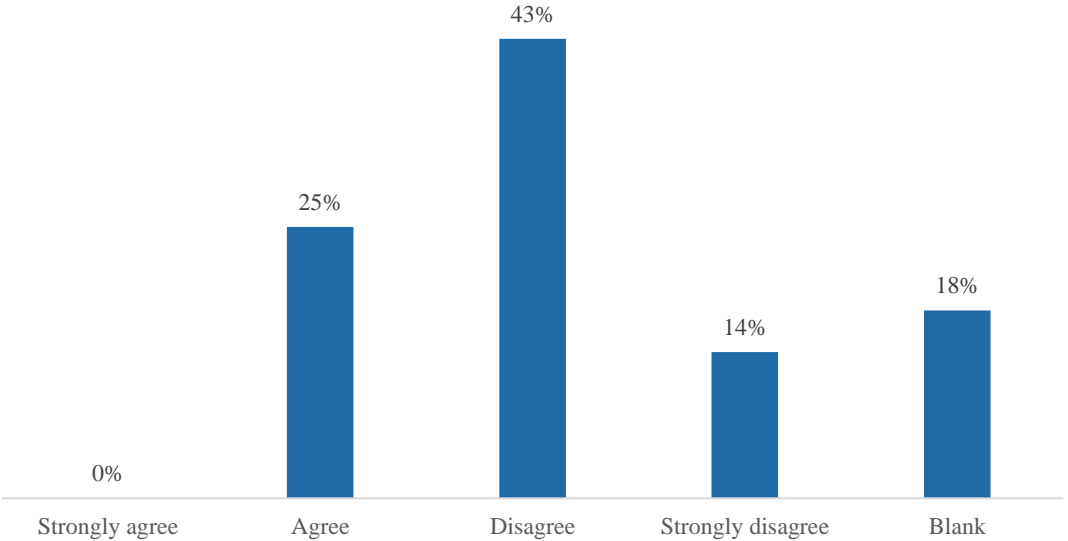


6. Market Sentiment Survey

4. The EU will be able to reach the REPowerEU green hydrogen target of 20 Mt by 2030 (10 Mt domestically produced in addition to 10 Mt imported).

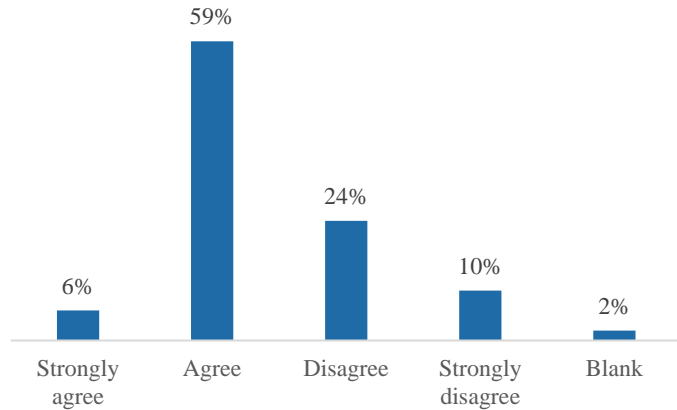


5. The UK will be able to reach the hydrogen ambitions set in the UK Hydrogen Strategy.

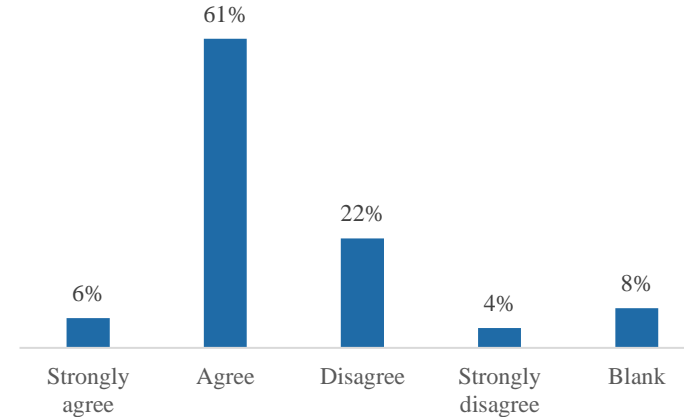


6. Market Sentiment Survey

6. The Renewable Energy Directive III (RED III) is supporting the uptake of hydrogen in industry.



7. The Renewable Energy Directive III (RED III) is supporting the uptake of hydrogen in the transport sector.

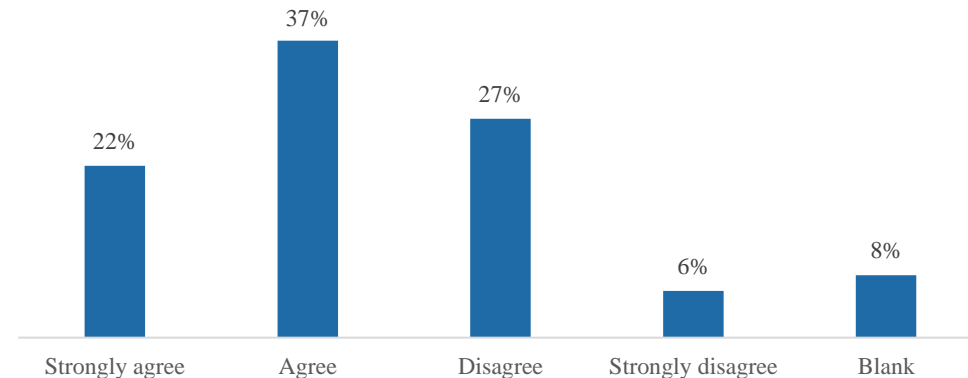


8. Which are the EU Member States (including UK) that have the more conducive public funding framework for the hydrogen sector?

Germany (41%)

UK (18%).

9. The EU should consider a more flexible approach when defining Hydrogen emissions, like the UK (the UK approach is ‘well to gate’ while the EU’s one is ‘well to wheel’).



Key Takeaways

- Developing a hydrogen economy is crucial for achieving the 2050 Net Zero target.
- Hydrogen policy is currently overly regulatory in nature vs market driven approach
- In 2023, significant progress was made in completing the regulatory framework for the low-carbon hydrogen market in the EU and UK – however, some key policy elements are still missing, especially in the EU.
- EU-UK regulatory approach: UK technology neutral vs EU renewable only. For the EU two level approach, leaving implementation to MS.
- The lagging growth of the EU and UK low-carbon hydrogen market negatively impacts the environmental delivery.
- EU governments have made low to moderate progress on 9 KPIs for low-carbon hydrogen. More ambitious policy implementation is needed to kickstart a European hydrogen market.

Key Takeaways

- Europe has announced one of the largest budgets for low-carbon hydrogen after the US, which is set to lead to more FIDs, however, further efforts are needed to translate willingness into actual project commitments and funding remains concentrated in a few EU countries.
- Progress on raising domestic supply and demand is lacking, with most projects stalled in planning stages. Only 3.6% of supply planned for 2030 is past FID or operational, and just 4.5% of necessary supply signed binding offtake agreements, due to insufficient incentives for potential buyers and unclear end use for proposed hydrogen supply.
- Further progress is required on implementing quotas for hydrogen use and expanding domestic electrolyser manufacturing. Slow implementation of quotas on a national level creates uncertainty for project developers and investors.
- Key progress indicators over the next 12 months: (a) how many of the projects which won the first EU H2 Bank auction actually progress to FID (b) if significant FIDs are taken on UK low-carbon hydrogen projects (c) how many firm offtake agreements are signed between customers and suppliers.