Hydrogen market overview

Hydrogen Valley Facility

2026

Roland Berger

The H2V Facility delivers dedicated support to hydrogen practitioners via PDA services, the H2V Knowledge Centre and the H2V Platform

The Hydrogen Valleys Facility

h2v.eu

Dedicated support via the Hydrogen Valleys Facility by

Clean Hydrogen Partnership

1 **Project Development Assistance**

Provision of dedicated Project Development Assistance (PDA) for Hydrogen Valleys projects towards Final Investment Decision

2 **H2V Knowledge Centre**

Sharing & dissemination of knowledge and provision of capacity building for the broader hydrogen community

3 **H2V Platform**

Maintenance & extension of the Hydrogen Valley Platform to enhance its positioning as the global one-stop-shop for hydrogen flagship projects

Delivery partners

Roland Berger · worley · Inycom

Aspirational target 2030

50 Hydrogen Valleys **operational/under construction**

within the EU

Source: Roland Berger

This document is part of the H2V Knowledge Centre that offers hydrogen practitioners knowledge material in written and interactive formats

The H2V Knowledge Centre

Structure and scope of the H2V Knowledge Centre

	Self-service Knowledge Material	Interactive Formats
Commercial	• Knowledge material specifically developed as part of the H2V Facility project • Links and information to other third-party resources and material	• Webinars with content experts (Roland Berger, Worley and external speakers) • Project Development Assistance experience sessions with Hydrogen Valley practitioners
Technical		
Regulatory		
Valley governance		

Target audience

- Hydrogen Valleys
- Project developers
- National, regional and local authorities
- Investors
- Other hydrogen practitioners

Source: Roland Berger

Disclaimer

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Source: Roland Berger

Key objective of this document is to support Hydrogen Valleys with an understanding of the H_2 market dynamics and long-term demand trends

Key objectives and content of this document

Key objectives

Provide H_2 practitioners with an **up-to-date understanding of the hydrogen market** and key trends to inform strategic decision-making

Key content

1. **H_2 demand and supply scenarios**
2. **Political momentum regarding H_2**
3. **Green H_2 project announcements**
4. **Key H_2 project archetypes**
5. **Development of the green H_2 market**

Source: Roland Berger

Understanding current market trends enables Hydrogen Valleys to adapt, position and thrive in a rapidly evolving hydrogen landscape

Relevance of hydrogen market overview for Hydrogen Valley developers

The hydrogen sector is evolving rapidly, creating uncertainty for Hydrogen Valleys …

1. **Swift market developments result in unclear planning and investment strategies but reward agile strategies**
2. **Lack of transparency in regional demand and supply dynamics**
3. **Difficulty in anticipating competitor moves and policy shifts**

… understanding market trends enables a strategic positioning and long-term planning

- Informed **strategic positioning** based on current and emerging trends
- **Improved investment decisions** through data-driven insights
- **Enhanced adaptability** and **resilience** in a shifting hydrogen landscape

Source: Roland Berger

Climate science still clear: no clean H_2, no "net zero" – But: The clean H_2 market uptake in Europe is substantially delayed and faces headwinds

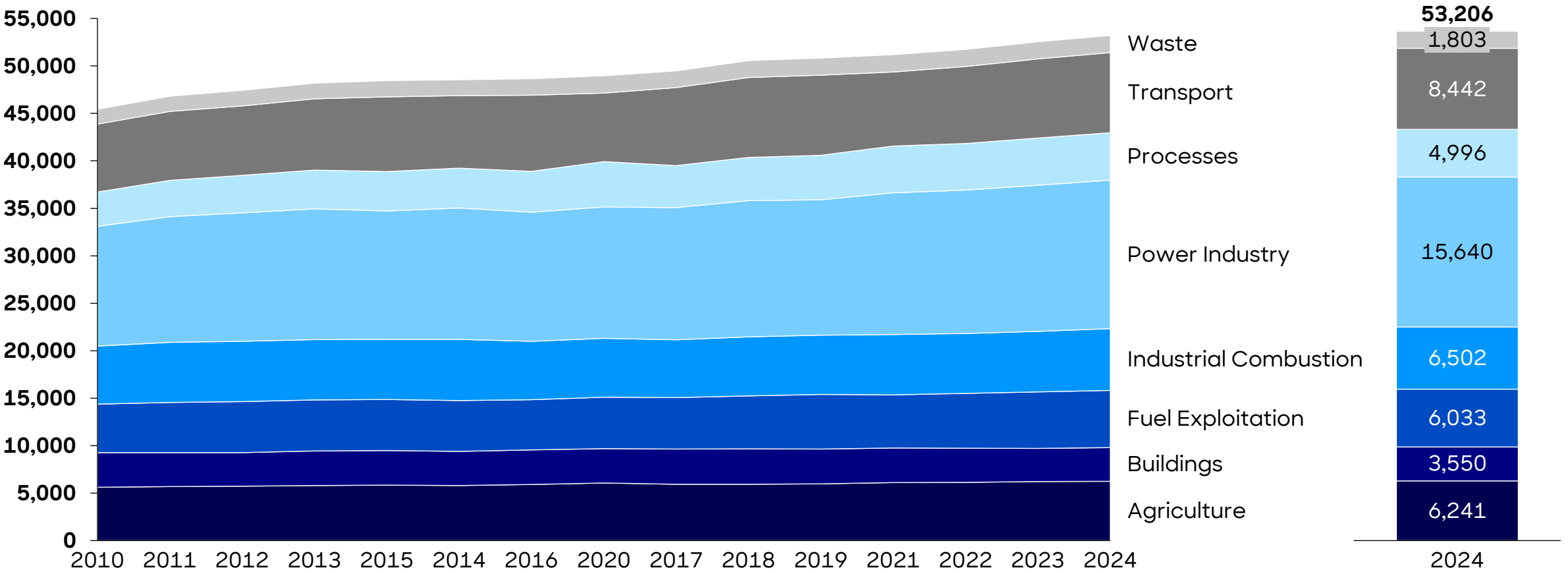
H_2 market fundamentals and developments: Summary

1. **Climate science is as clear as ever:** No clean H_2, no "net zero"; to get there, green hydrogen consumption will have to grow to 376 mt H_2 as per IEA Net Zero Emissions scenario, requiring c. 3 TW of electrolysers by 2050
2. **In principle, strong political support for hydrogen:** to-date, 65 governments have developed national hydrogen strategies and are increasingly adopting demand-side incentives to push clean H_2 use
3. **Still, strong green H_2 project pipeline across the globe:** developers globally have now announced 440 GW electrolyzer production capacity targeting COD by 2030, up from only a few GW 5 years ago
4. **Three key project archetypes can be observed:** Small-scale & mobility-focused H_2 projects (<10 MW), on-site industrial H_2 projects (<300 MW) and centralized large-scale H_2 export "giga-projects"
5. **Green H_2 market will evolve in next 10-15 years with the project development industry professionalizing:** large demand centers in Europe & East Asia will have to source in large volumes from regions where low-cost RES are abundant
6. **The sector is currently in a market consolidation phase with a delayed but steady ramp-up of the clean H_2 sector in Europe:** While the clean H_2 market reached its hype cycle peak in 2022, the market is still growing – 3.2 GW in Europe past-FID

Source: Roland Berger

Global GHG emissions have steadily increased to c. 53.2 bn tons in 2024 – the energy sector is the largest emitter, followed by industry

Global GHG emissions by end-use segments [in m t $CO_{2\,e}$, indicative]



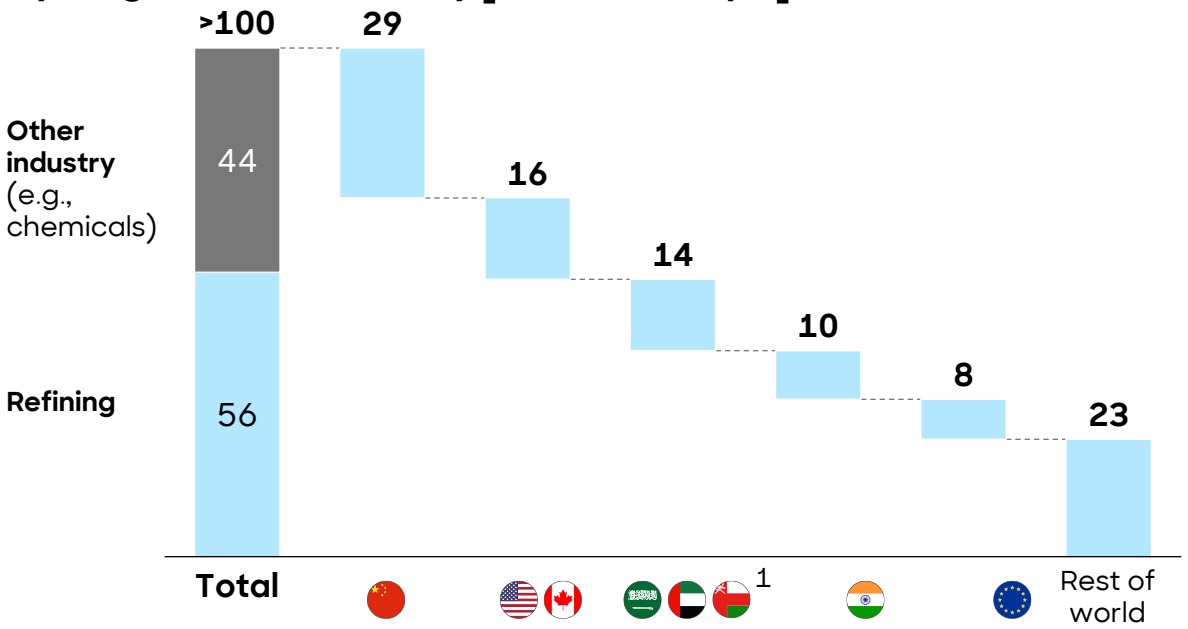
Source: EDGAR/JRC, IEA, Statista, Roland Berger

Illustrative

Today, >100 mtpa of H_2 is used for refining and other industries – >99% from fossil energy, mostly natural gas

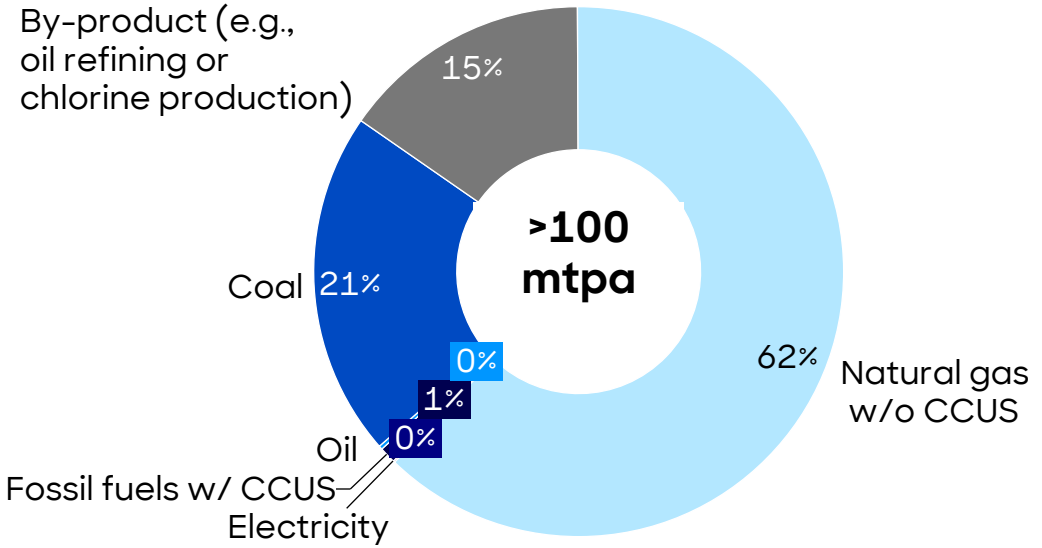
Hydrogen demand and supply by color, 2025

Hydrogen demand today [2025e, in mtpa]



- Today, **a large H_2 market exists, with demand mainly coming from industry**
- **China accounts for c. 30%** of total demand, **followed by North America** (c. 16%), **MENA** (c. 14%) **and Europe** (c. 7%)

Hydrogen supply today [2025e, in mtpa]



- 99% of hydrogen is currently **produced by petrochemical players via fossil routes**, i.e., using coal and natural gas as an input, emitting CO_2
- Going forward, **production needs to be decarbonized**

Source: Market research, Roland Berger

The IEA maps three key scenarios for energy supply and demand – H_2 development highly dependent on assumed scenario

Key IEA energy policy scenarios

Current policies scenario (CPS)

- **Description**: baseline forecast built strictly on policies and regulations that are **already formally adopted in legislation today**
- **Key assumption**: **Cautious perspective –** No change in energy-related policies beyond what is already in place[1]

Fossil-based hydrogen continues to **outweigh** low-emission H_2

Stated policies scenario (STEPS)

- **Description**: forecast built on **policies already in force (CPS) and formally proposed measures** such as official strategy documents that are not yet adopted
- **Key assumption: Dynamic perspective –** Time-bound policies are prolonged at a similar pace of change[2] and proposed measures are officially enacted to law

Low-emission H_2 gains a **relevant share** of total production

Net zero emission scenario (NZE 2050)

- **Description**: **normative forecast** to achieve net zero energy-related CO_2 emissions by 2050
- **Key assumption**: **Aspirational target –** Pathway consistent with 1.5°C-aligned net zero by 2050

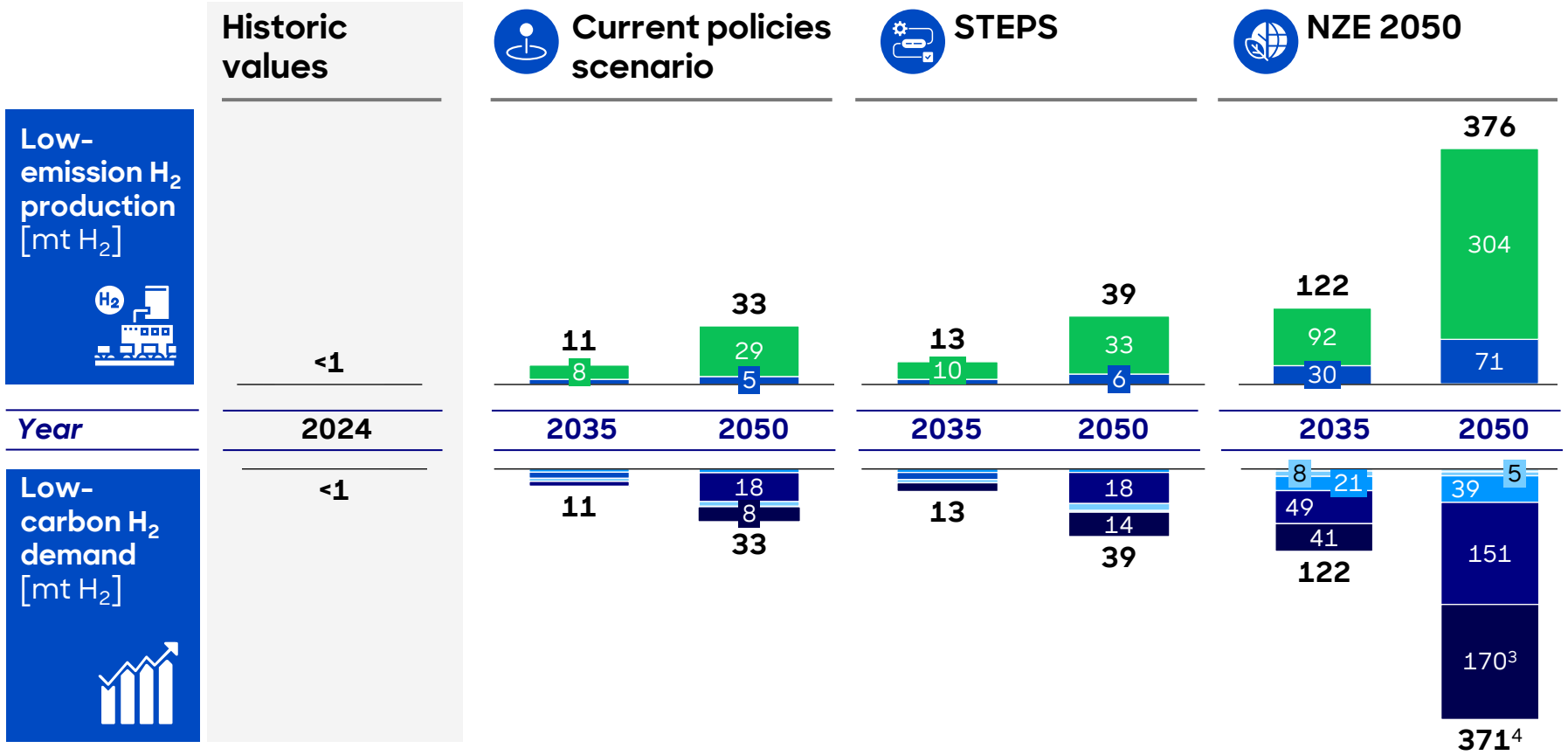
Low-emission H_2 to **largely displace** fossil-based hydrogen production

1) I.e., if policies are time-bound or target specific years, they are assumed to not be reinforced once they expire; 2) I.e., time-bound policies are assumed to be prolonged into the future even after they officially expire, thereby accounting for a more dynamic perspective on energy technology and market trends

Source: IEA, Roland Berger

To reach net zero in 2050, c.376 mt H_2 are needed as per IEA World Energy Outlook – However, current and stated policies only commit to 33 and 39 mt H_2

Low-emissions H_2 supply and demand [mt H_2] (IEA 2025, Q2 2026)[1]



Key observations

- The **gap between policy ambition and net-zero** requirements is still **enormous** – CPS and STEPS project only modest low-emission H_2 production growth, while **NZE demands a roughly 10x larger build-out**
- **Green (electrolytic) H_2** consistently **displaces** blue **H_2 production** in all scenarios
- **Hydrogen-based fuels are the dominant long-term H_2 demand driver** across all scenarios, with power generation contributing significantly to NZE demand

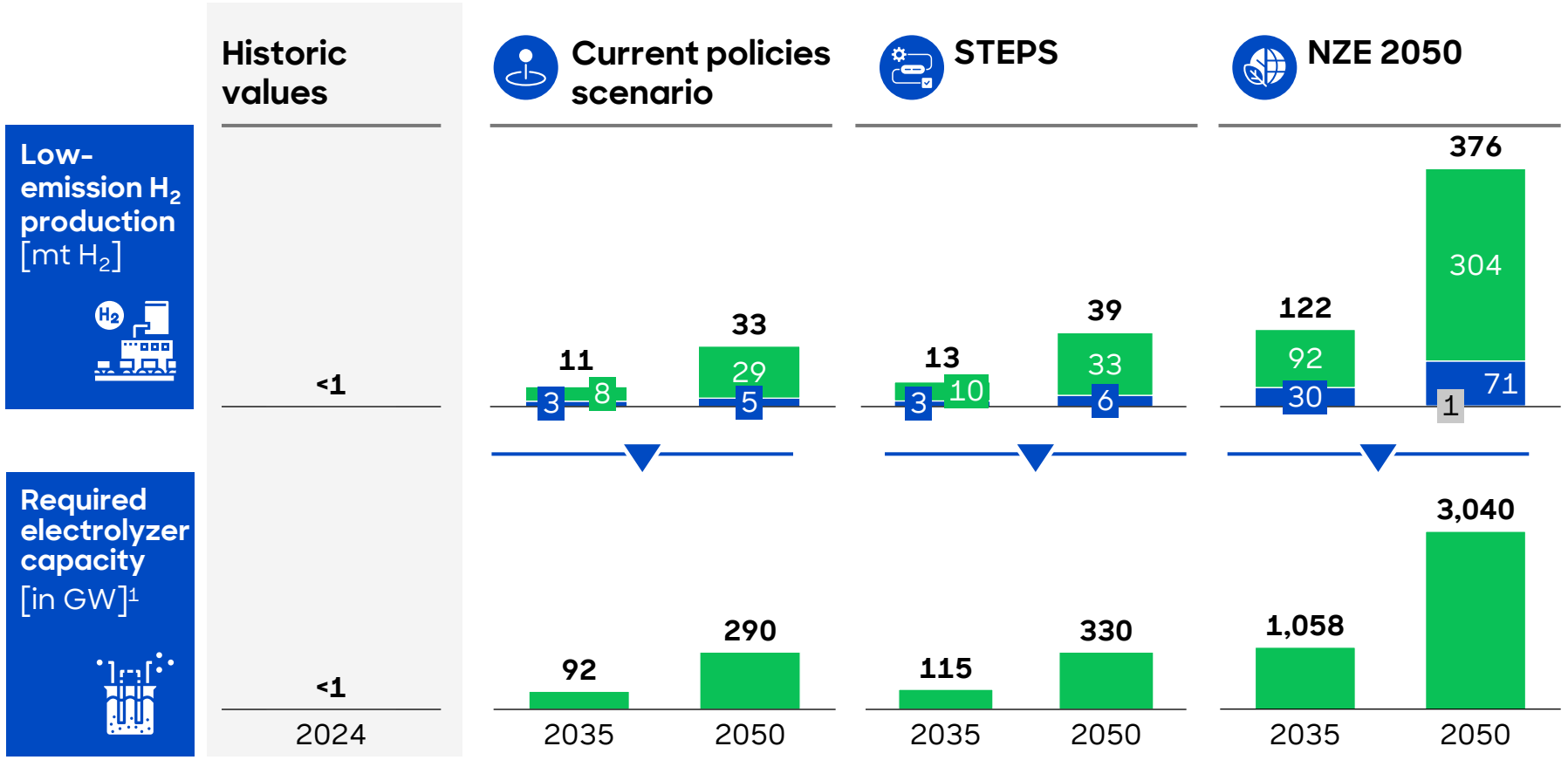
Water electrolysis | Fossil fuels with CCUS | Bioenergy and other | To biofuels | In oil refining | To power generation | To hydrogen-based fuels[2] | End-use sectors[3]

1) Total H_2 demand includes merchant H_2 demand and H_2 demand in industry and refineries covered by onsite production; 2) Hydrogen-based fuels include ammonia and synthetic hydrocarbons (gases & liquids) that derive their energy content from a pure, or nearly pure, hydrogen feedstock; 3) End use sectors include industry, transport, buildings and other, i.e., agriculture and other non-energy use; 4) Differences in production and demand is attributed to rounding differences

Source: IEA, Roland Berger

To reach Net Zero in 2050, c. 3 TW electrolyzer capacity is needed – A 10x difference to the current and stated policies that fall critically short

Low-emission H_2 production [mt H_2] and required electrolyzer capacity [GW] (IEA 2025, Q2 2026)



Key observations

- The **electrolyzer gap** between current policy trajectories and net-zero requirements is stark: CPS and STEPS project only c. 290-330 GW by 2050, a **roughly 10x gap vs. the required c. 3 TW under NZE**
- Even under **CPS and STEPS**, **near-term build-out is highly ambitious**, requiring a **90-100x increase until 2035** compared to today's basis, underlining the importance of clean H_2

Water electrolysis | Fossil fuels with CCUS | Bioenergy and other

1) As the IEA 2025 scenario does not explicitly state required electrolyser capacity, the corresponding figures were derived by applying the same proportionate relationship between low-emission hydrogen production and electrolyser capacity as observed in the IEA 2023 scenario.

Source: IEA World Energy Outlook 2025, Roland Berger

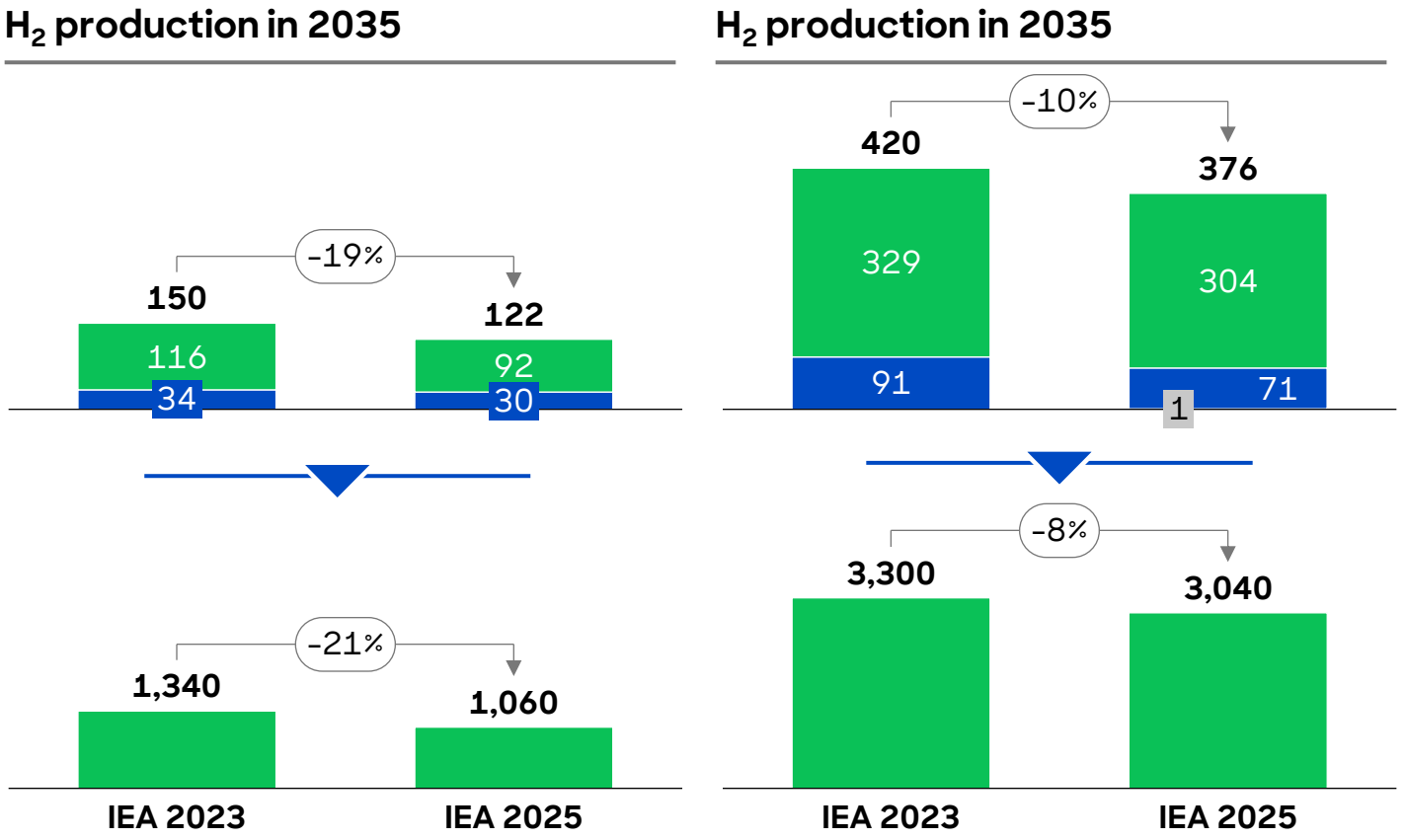
In the IEA's Net Zero Emission Scenario, low-emission H_2 mostly comes from electrolysis, requiring a massive build-out of global electrolyzer capacity to 3 TW

Deep-dive: Hydrogen's role in the IEA's **Net Zero Emission** Scenarios 2023 vs. 2025

NZE 2050

Low-emission H_2 production [mt H_2]

Required electrolyzer capacity [in GW][1]



Key observations

- In the IEA's 2025 NZE scenario, **has materially revised H_2 ambitions downward,** reducing the role of H_2 in achieving net zero as electrification takes on greater weight
- H_2 from fossil fuels with CCUS (c. 20% of low-emission H_2) is a transitional, geographically concentrated pathway (Middle East & North America), set to be displaced by green H_2 and of limited global relevance
- Despite a revised 2050 electrolyzer target of c. 3 TW, the required scale-up remains extraordinary with near-term cuts steeper than long-term, signaling slippage, not structural retreat

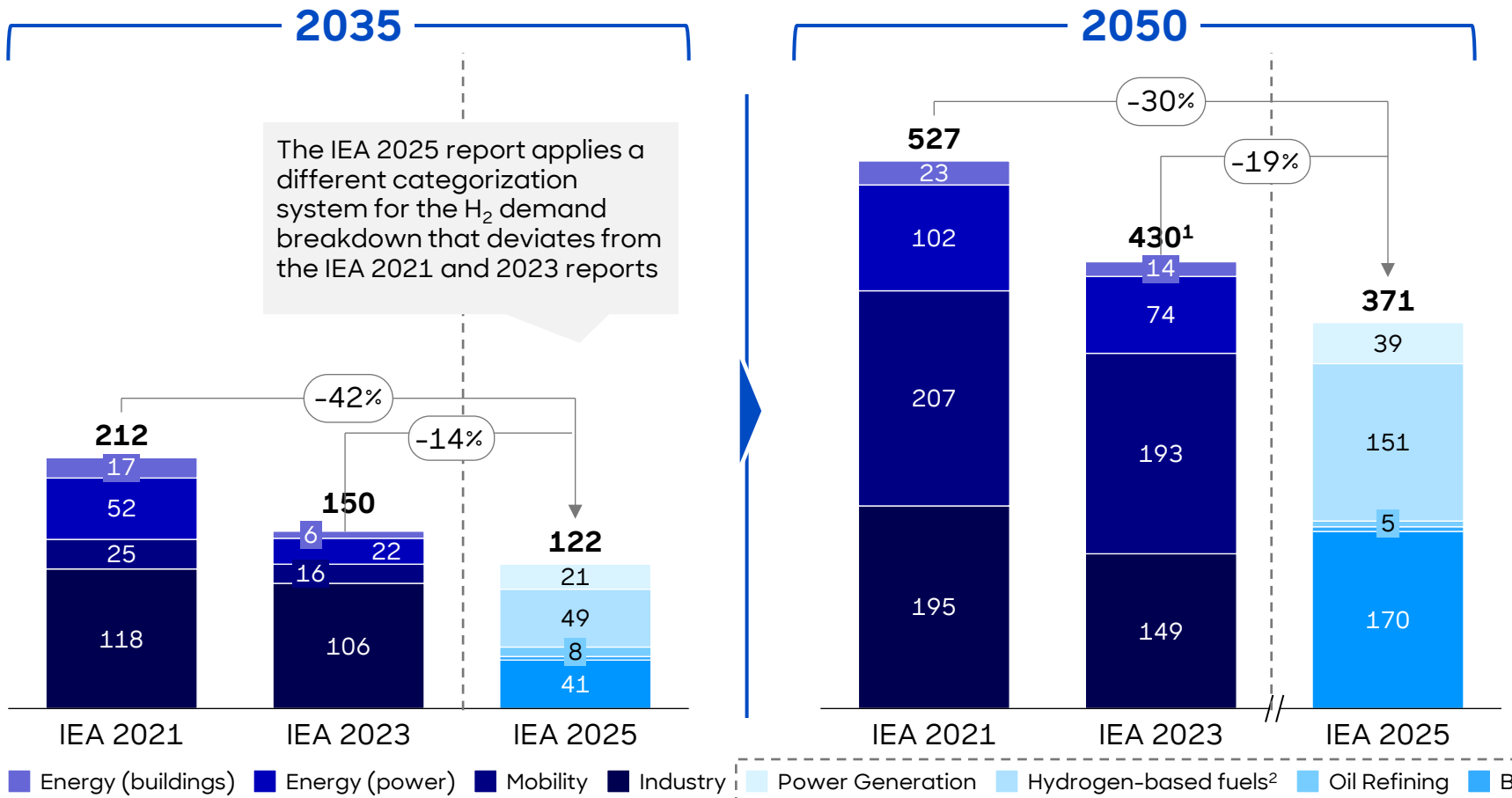
1) As the IEA 2025 scenario does not explicitly state required electrolyser capacity, the corresponding figures were derived by applying the same proportionate relationship between low-emission hydrogen production and electrolyser capacity as observed in the IEA 2023 scenario.

Source: IEA World Energy Outlook 2025, Roland Berger

IEA revised the low-emission H_2 demand in the NZE scenario significantly downward in latest report – H_2 demand shifting towards non-energy uses

Deep dive: Evolution of long-term low-emission H_2 IEA **NZE** demand scenarios [mt H_2]

NZE 2050



Key observations

- IEA Net Zero Emission H_2 demand has been **consistently and materially revised downward since 2021** – The 2035 low-emission H_2 target has been cut by 42% from IEA 2021 (212 mt) to IEA 2025 (122 mt), reflecting, among others, a **stronger than expected role of electrification**
- The overall H_2 demand structure reflects a **steady downward trend of energy (power generation)** as an H_2 end

1) Differences in production and demand is attributed to rounding differences; 2) Hydrogen-based fuels include ammonia and synthetic hydrocarbons (gases & liquids) that derive their energy content from a pure, or nearly pure, hydrogen feedstock; 3) End use sectors include industry, transport, buildings and other, i.e., agriculture and other non-energy use

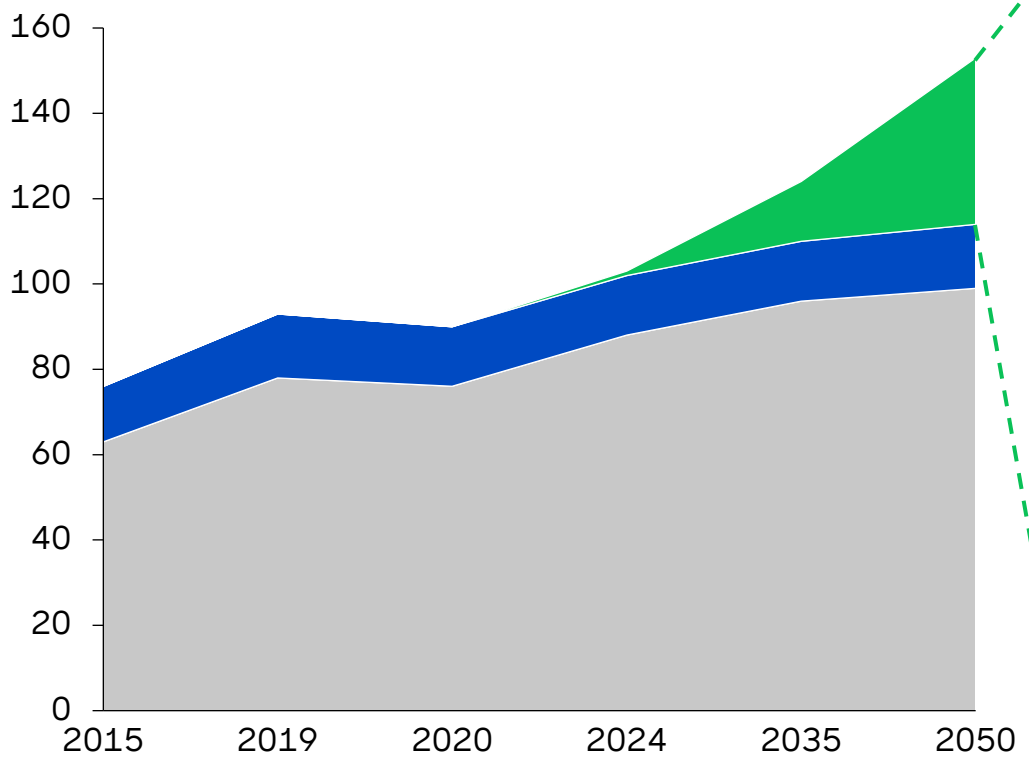
Source: IEA, Roland Berger

In the STEPS scenario, H_2 largely stems from fossil fuels (c.85%), with a ramp-up of low-emission H_2 from <1 mt H_2 (2024) to c. 39 mt in 2050

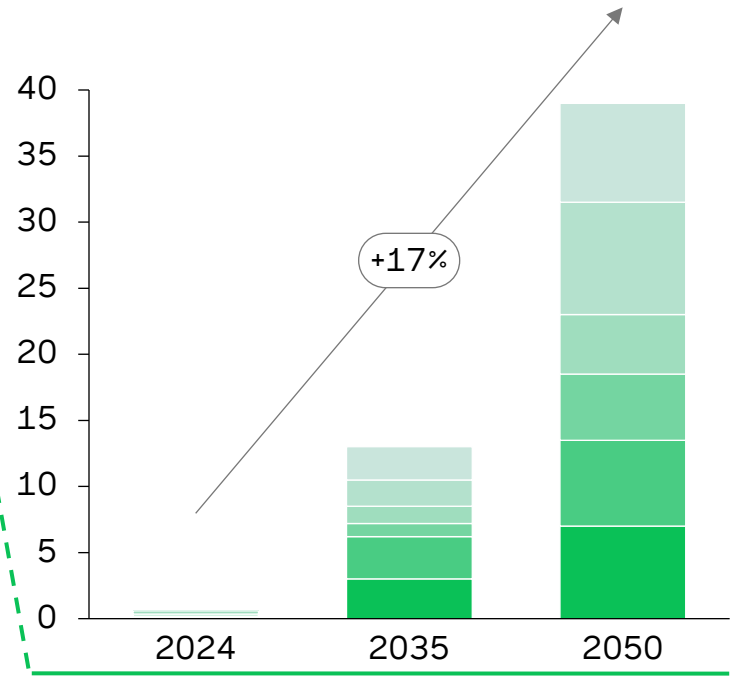
Deep-dive: H_2 production scenario as per **STEPS** [mt H_2] (Q2 2026)

STEPS

Total global H_2 production 2015-2050



.... thereof low-emission H_2 production



Key observations

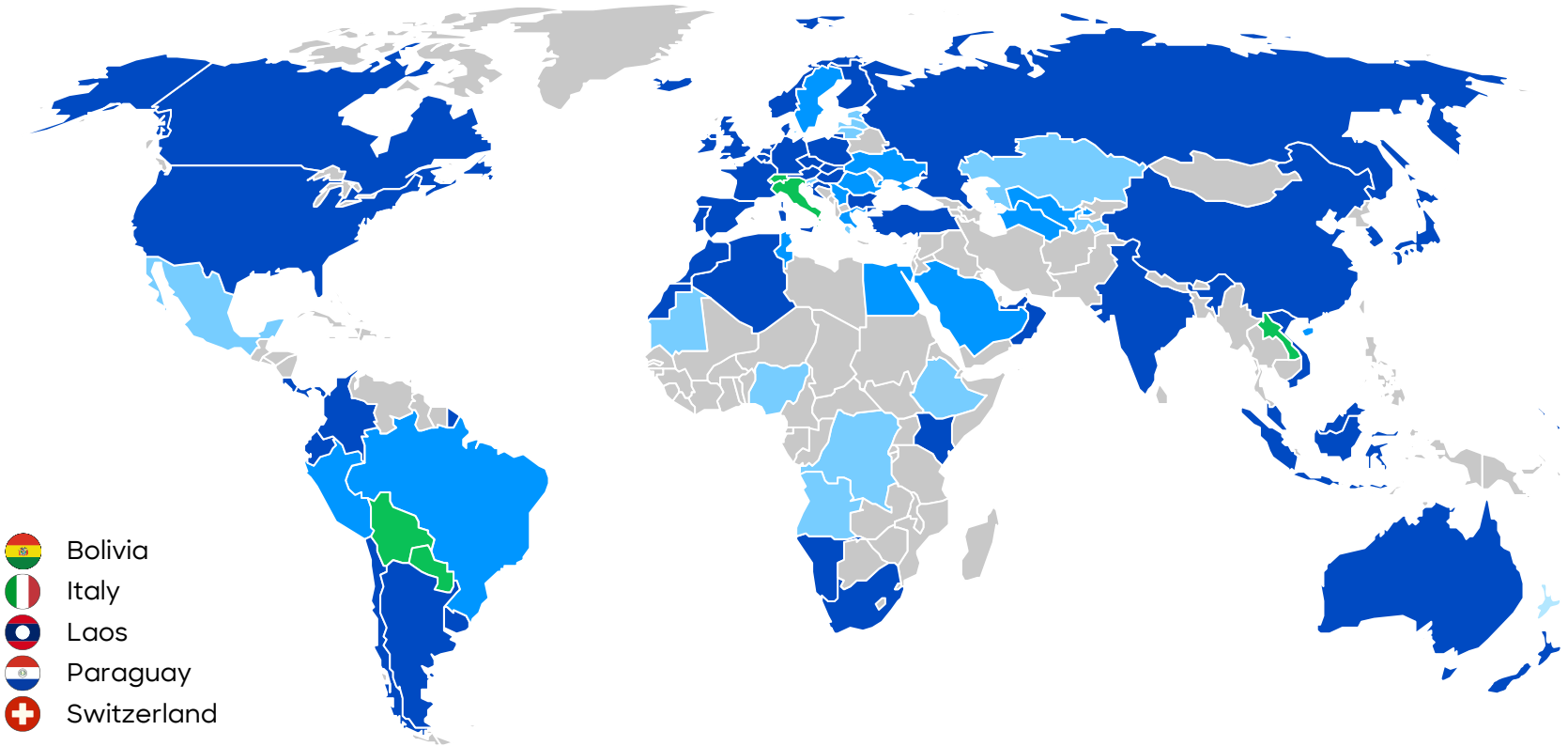
- **As of 2024, low-emission H_2 production** accounts for **>1%, while fossil fuels make up c.85%**
- In STEPS, the relative H_2 production shifts gradually from unabated fossil fuels to low-emission sources
  - **Unabated fossil fuels** will remain a the **largest source** of total H_2 production until 2050, however, their **relative share decreases** from c. 85% (today) to 75% (2050)
  - **Low-emission H_2 production** expected to **increase exponentially**, with a CAGR of 17% across regions until 2050

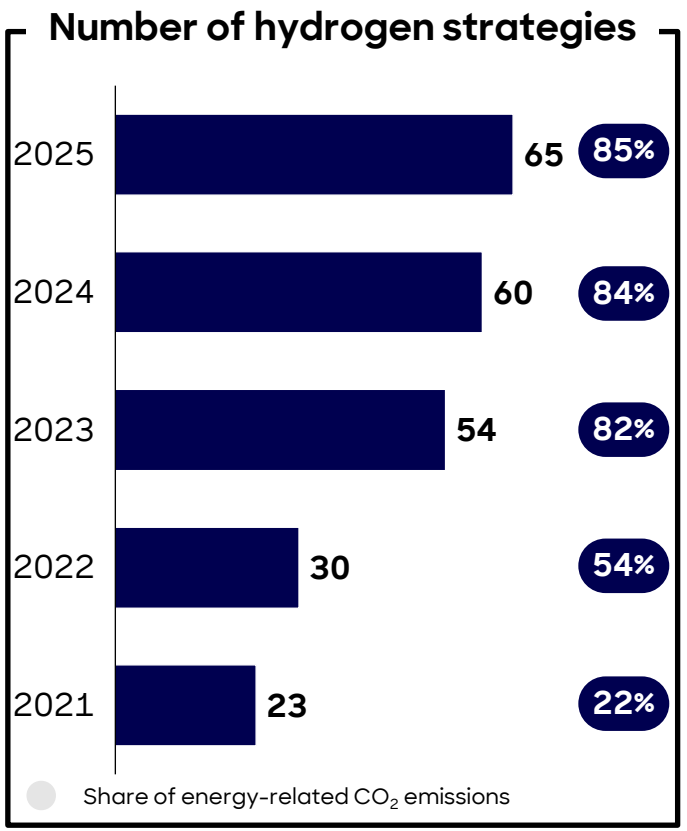
Unabated fossil fuels | By-product | Low-emissions sources | Other advanced economies | Other emerging market & developing economies | North America | European Union | China | Middle East

Source: IEA, Roland Berger

Hydrogen is a political priority, with 65 gov’ts adopting ambitious strategies – However, most from 2022/2023

National hydrogen strategies (as per Q4 2025)





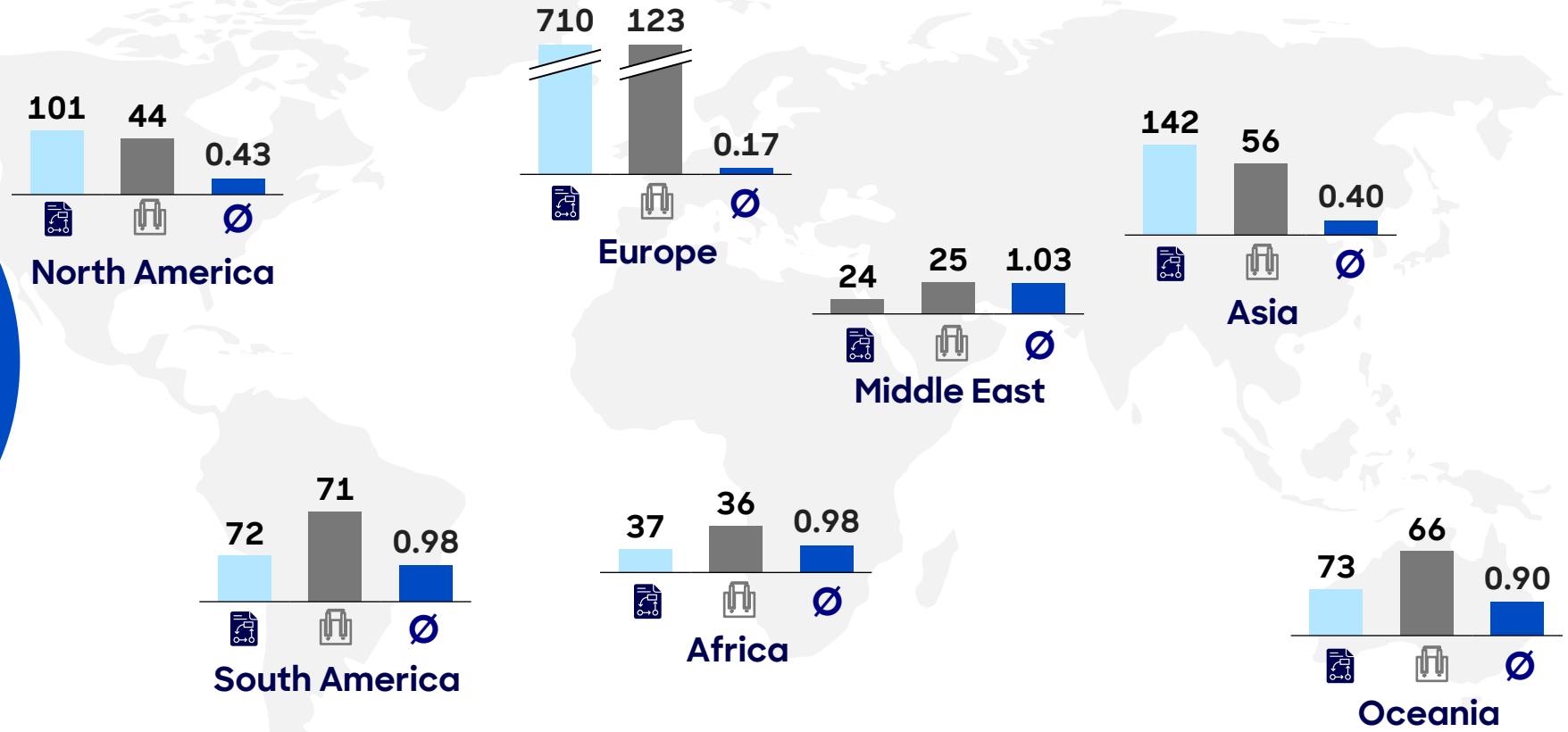
National hydrogen strategy available | National hydrogen strategy in preparation | Initial policy discussions and/or project support | New national hydrogen strategies published in last 12 months

Source: World Energy Council, IRENA, IEA, Roland Berger

Global green hydrogen project announcements add up to approximately 440 GW of electrolyzer capacity by 2030

Global announced green hydrogen projects by 2030 (as of Q3 2025)

- Global project announcements total c. 440 GW[1]
- Around 100 projects exceeding 1 GW each (c. 300 GW total)



Announced projects [#] | Project capacity [GW electrolysis] | Ø Avg. project capacity [GW]

1) As of September 2025, c. 20 GW of projects not included on the map due to unclear or yet undecided project location, only projects with a disclosed start date are included

Source: IEA, Roland Berger

Three project archetypes are emerging: small-scale local mobility pro-jects, mid-scale industrial decarbonization projects and export-oriented "giga-projects"

Green hydrogen project archetypes

Archetype 1

Small-scale, mobility-driven

- **Rationale:** pooling demand from mobility applications (truck fleets, bus fleets, etc.), shared use of refueling infrastructure, scaling supply
- **Capacity:** 5-20 MW ELY (typically grid power, w/ green PPA)
- **Regional focus:** EU, Asia
- **Key challenges:** many stakeholders involved (high complexity against comparatively low H_2 volumes)

Archetype 2

Medium-scale, industry-driven

- **Rationale:** decarbonizing grey industrial feedstock with green H_2; anchor offtake from petro-chemicals, steel, etc.; mobility off-take as add-on
- **Capacity:** 20-300 MW ELY (often grid power, w/ green PPA)
- **Regional focus:** EU, US, China
- **Key challenges:** regulation and power sourcing (e.g., EU RED II DA), seamless integration with ind. processes, expansion limits

Archetype 3

Large-scale, supra-regional

- **Rationale:** Building a local valley with the ultimate ambition to export green molecules, connecting supply and demand across regions
- **Capacity:** 500+ MW ELY (typically dedicated add. renewables)
- **Regional focus:** MENA, AU, LA, NA
- **Key challenges:** regulatory and other enablers for long-term offtake contracts, technology at scale, transportation

Source: Roland Berger

Within 10+ years, clean H_2 will become a globally traded commodity, with the upstream project development industry already maturing

H_2 market development phases

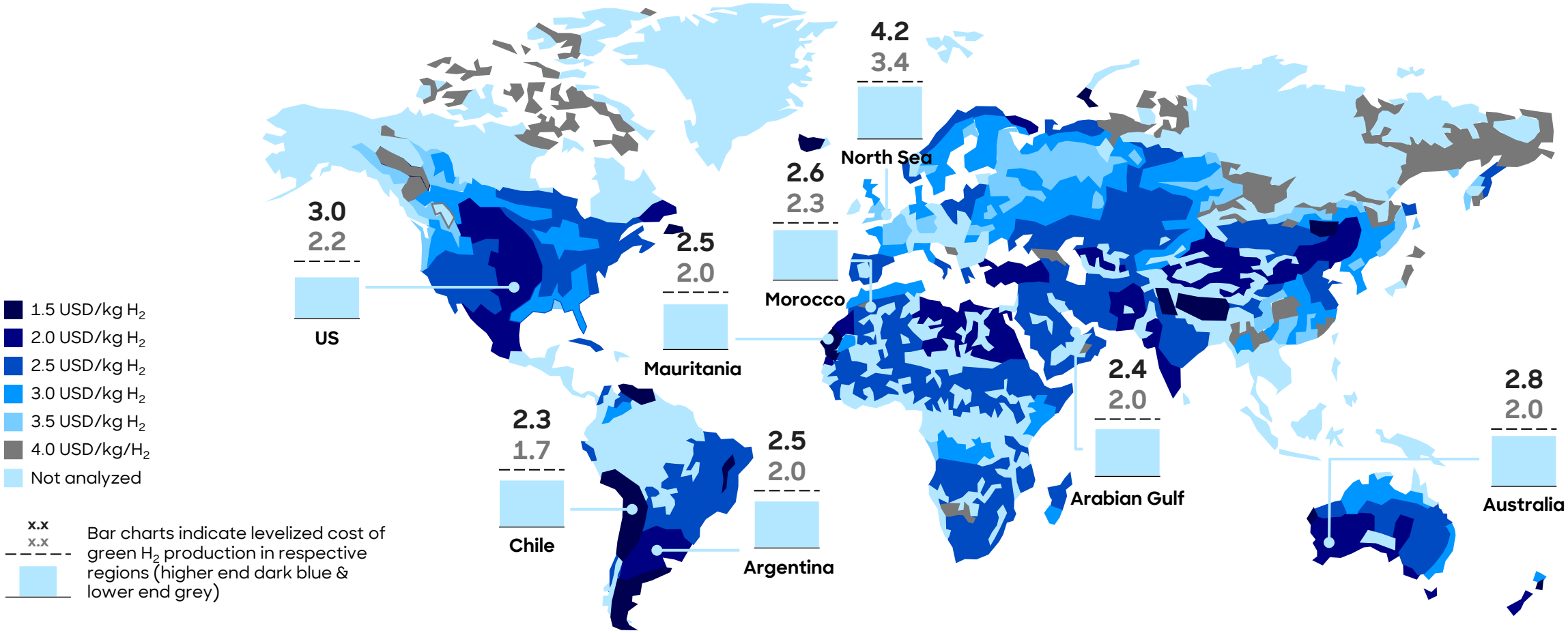
	Phase 1 – Commercialization phase	Phase 2 – Emerging market	Phase 3 – Commodity market
Project landscape	• Focus on **single early adopters** of green H_2 in industry & mobility • **Captive, regional projects** with limited role of H_2 transportation • **Strong role of public support:** regulation (e.g., quotas) & esp. direct funding	• **New H_2 uses** with large volumes enter the picture (e.g., steel, NH_3 for shipping) • Projects **get bigger** and **more int'l, H_2 transp. grows,** incl. flexible carriers • **Continued role of public support**, e.g., quotas, CCfDs, carbon pricing	• **Global connection of supply & demand** centers connected by pipeline network and flexible carriers • **Phase-out of public support schemes,** except for fundamental regulation (e.g., quotas, carbon pricing)
Market dynamics	• **Access to H_2 mainly to project partners** of first-of-kind pilot & lighthouse project • **Captive or project-based OTC market** to minimize sales risk (no brokers) • **Preparation of "Guarantees of Origin"** (GO) framework for green H_2	• **Formation of H_2 demand nests** driven by industrial decarbonization and declining transportation costs • **Only project-based OTC market** to minimize sales risk; need for brokers • Possible **use of green derivatives** for ammonia, methanol, or e-fuels sooner	• **Fixed hydrogen supply chains** with corresponding infrastructure • **Liquid commodity market for hydrogen** with high demand for brokers / trading • **Emerging trading of GOs**

Development of low-/zero-carbon H_2 demand over time [indicative]

Source: Roland Berger

With the most abundant solar and wind density, the global south can produce the most cost-efficient green H_2

Indicative LCOH in different world regions, excl. transport costs [2035+, USD/kg H_2][1]

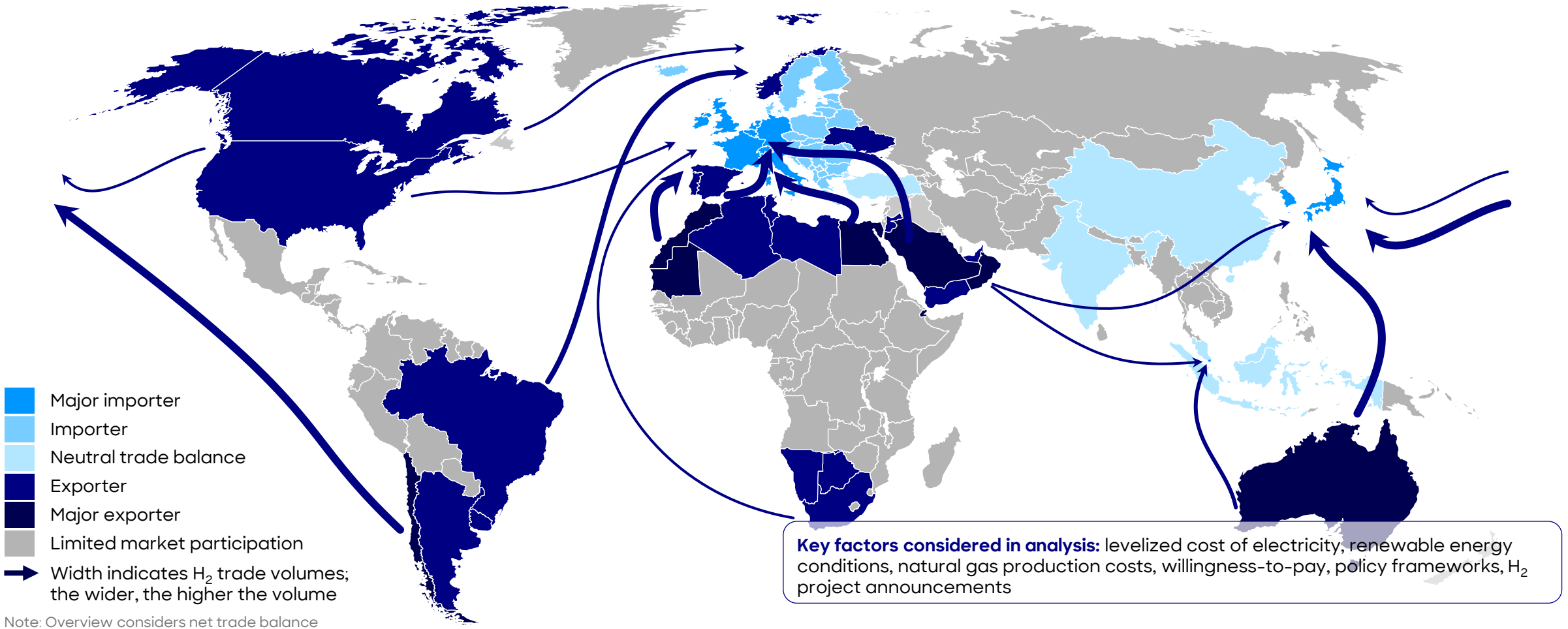


1) As per latest IEA report with following key assumptions: 6% WACC, c. 600 USD / kW ELY Capex, regional solar and wind Capex, optimized mix of wind and solar power depending on region

Source: IEA, Roland Berger

In the long-run, Africa, Australia, Latin America and the Middle East will export H_2 to key demand centers in Europe and East Asia

Expected global clean H_2 export and import centers [2035+]



Key factors considered in analysis: levelized cost of electricity, renewable energy conditions, natural gas production costs, willingness-to-pay, policy frameworks, H_2 project announcements

Note: Overview considers net trade balance

Source: IEA, World Energy Council, Roland Berger

The clean hydrogen hype cycle reached its peak in 2022; since then, market reality hit – We are currently in a market consolidation phase

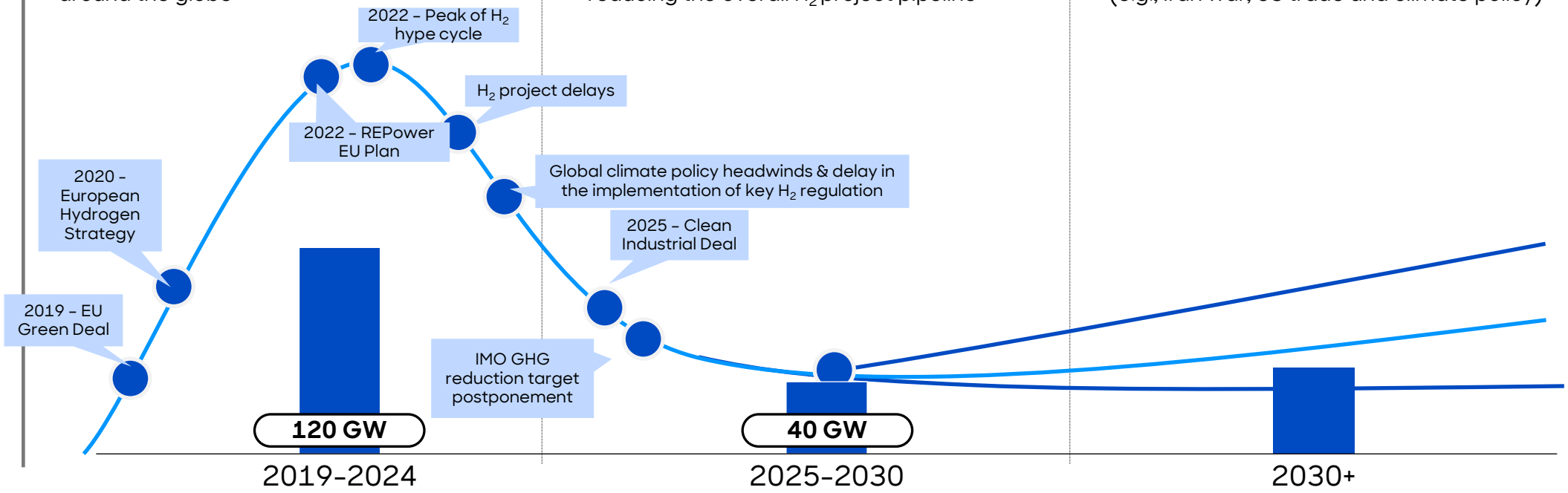
From hype to reality

H_2 market sentiment and landscape

- Establishment of a **comprehensive hydrogen policy framework**, incl. EU Hydrogen Strategy, REPowerEU Plan, RED III and delegated acts on H_2
- Skyrocketing **H_2 project announcements** around the globe

- **Delayed or incomplete implementation of H_2 regulation** that would unlock large-scale H_2 demand
- First announcements of **downsizing**, **delays** or **cancellations** of H_2 projects significantly reducing the overall H_2 project pipeline

- Ongoing wave of **project consolidation** expected due to market headwinds
- **High uncertainty** regarding global **climate policies and implementation of H_2-specific regulation** and **geopolitical developments** (e.g., Iran war, US trade and climate policy)



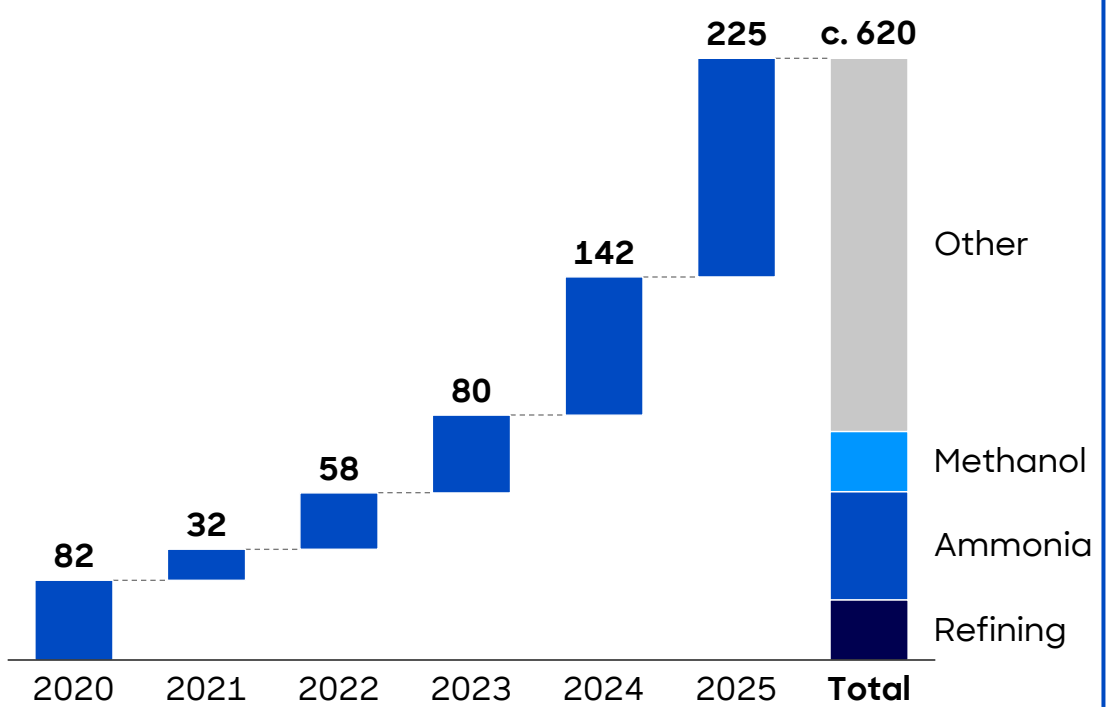
Cumulative RB electrolzyer forecast for 2030 [GW]

Source: Market research, Roland Berger

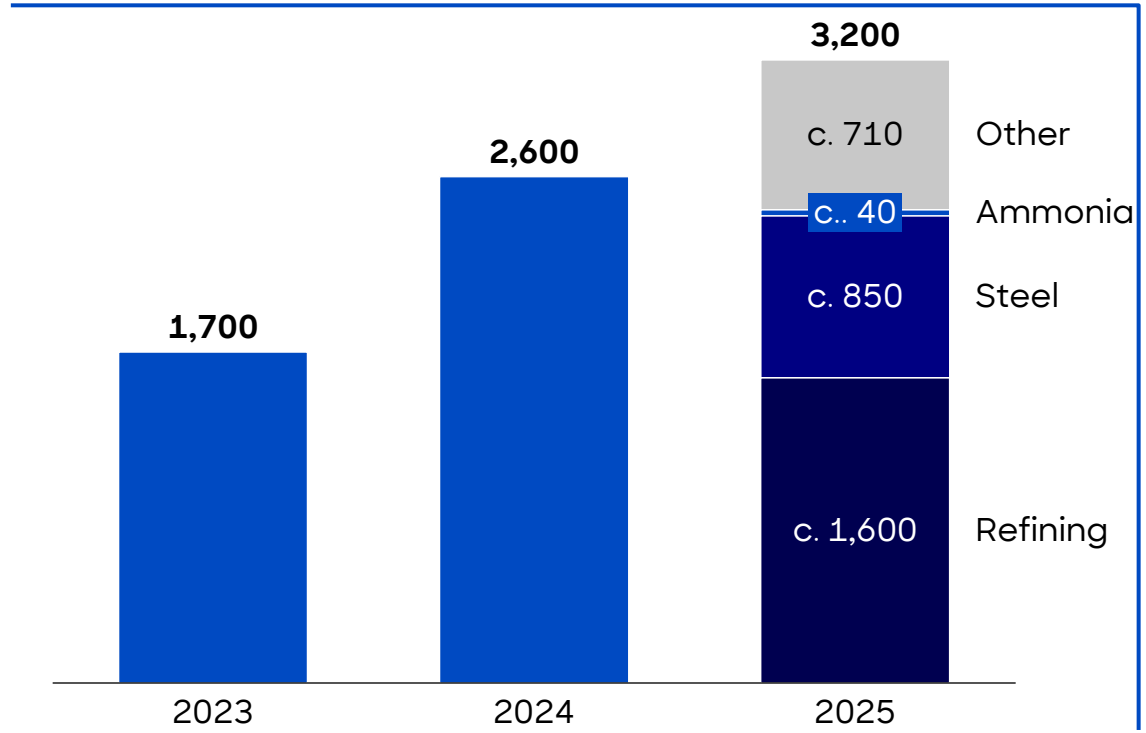
Nevertheless, the H_2 sector is ramping up – operational electrolyzer capacity in Europe is currently c. 620 MW, with another 3.2 GW past-FID

Operational & FID hydrogen projects in Europe [MW]

Operational electrolyser capacity in Europe [MW]



Electrolyser capacity under construction/past-FID in Europe [MW]



Source: Roland Berger, Hydrogen Europe (2025)

Roland Berger