Hydrogen: Maturity Stage and Progress in Key Elements

RePowerEU
Consumption Target 2030: 20 Mt

EU Hydrogen Strategy
Production Target 2030: 10 Mt

Demand 2023: 7.3 Mt

Green H2 2030: 2.5 - 4.4 Mt

Electrolysers:
560 MW vs. 6 GW

- 220 clean H2 projects in operation or under construction in Europe - 4500 MW
- Cost Inflation, Permitting Delays
- Demand - Infrastructure: Vicious Cycle
- RFNBO: Additionality, Correlation Conditions
- Low carbon H2: Recently defined
- 20% H2 in grids - EU Industrial costs up by 24%

- Focus: Industry, Transportation, Energy Storage, Power Generation
- New Dimension: Clean tech Manufacturing
- Initiatives: Legislation, Policies, Incentives, Funding, De-risking Instruments
- Market growth: 56% to 2030, 127% for 2030 to 2040

European Hydrogen Observatory - Data Transparency

Significant Developments - Policies and Geopolitics

4th Gas Package:

- Adopted in May 2024 - Transposed by mid 2026
- Regulatory framework for H2 infrastructure - Unbundling, repurposing rules
- Creation of ENNOH for co-ordination
- Discounted network tariffs
- Hydrogen blending allowance
- Direct applications prioritized over blending

- China: H2 declared as strategic priority in Oct25
- 60% of global electrolyser capacity
- Current production equal to rest of the world
- EU and US: still tech leaders in PEM
- US Shift - Towards Gas and Nuclear
- Blue Hydrogen gains momentum

- RED III: Binding targets for industry, transport
- Grids Package:
  - Coordinated planning
  - Request for H2 Grid Strategy
  - Funding deployed across corridors
- Hydrogen Mechanism Launched: Connecting producers with off-takers

- Subsidies: 111 bn fossil fuels vs. 20 bn H2
- CISAF: Unlocking H2 potential
- Aid up to 100% for RFNBO production and 60% for industrial use
- Cumulation rules, Accelerated depreciation
- Holistic approach: Production, Storage, Derived Fuels, Infrastructure, Manufacturing.

Concrete Steps Forward
Project-by-project Success

- € 25 bn economic opportunity for manufacturing and suppliers by 2030 (BCG)
- European Competitiveness Fund:

  - H2 as Critical Energy Infrastructure?

  - Role in Defence and Security?
- Blending public and private capital
- Risk-sharing - New comers vs. future players

- Innovation Fund - NetZero Technologies:

  2.9 bn to 61 projects
- 8 H2-solutions projects: aviation, shipping, and heavy-duty transport
- EU granted renewable certification for a massive project in China.
- IMEC: $ 1 bn green fuel corridor

Indicative Milestones

- 1st hydrogen-powered backup fuel cells for data centres (Netherlands, 2023)
- Hydrogen fuel cells will be on the agenda for 19% of operators by 2027
- New York: 1st commercially-deployed, 100% hydrogen-fueled linear generator in the world

Industrial Deployment

- 1st industrial-scale ammonia cracking facility: Launched in Antwerp Port
- Ammonia can be transported via existing infrastructure
- BMW: Switching intra-logistics from electricity to H2
- Thousands of H2 forklifts in US warehouses

Greece: Developments on the Ground

- Legislation in place (Law 5215/2025)
- Producer Certificate + GOs
- Geographically confined networks
- H2 as RES storage: not addressed yet
- Incentives and Support schemes
- Produce e-green, E-fuels, Islands Decarbonisation and Modernisation Funds

Infrastructure

- Transportation: New pipelines are H2-ready

  82 mil € grant for West Macedonia
- Hydrogen Backbone - H2dria PCI
- Non-binding Test: 33 players declared interest
- Distribution: 90% allows H2 up to 5%
- Global Maritime Decarbonisation Center

- Pipeline of projects at different stages
- Refinery Green H2 Project:

  50 MW (4.500 - 7200 tn/year), 114 mil € grants
- Hydrogen Valleys:

  North Project 1 (West Macedonia), Crete
- 1st public hydrogen refueling station -

  100% green H2 for road transportation

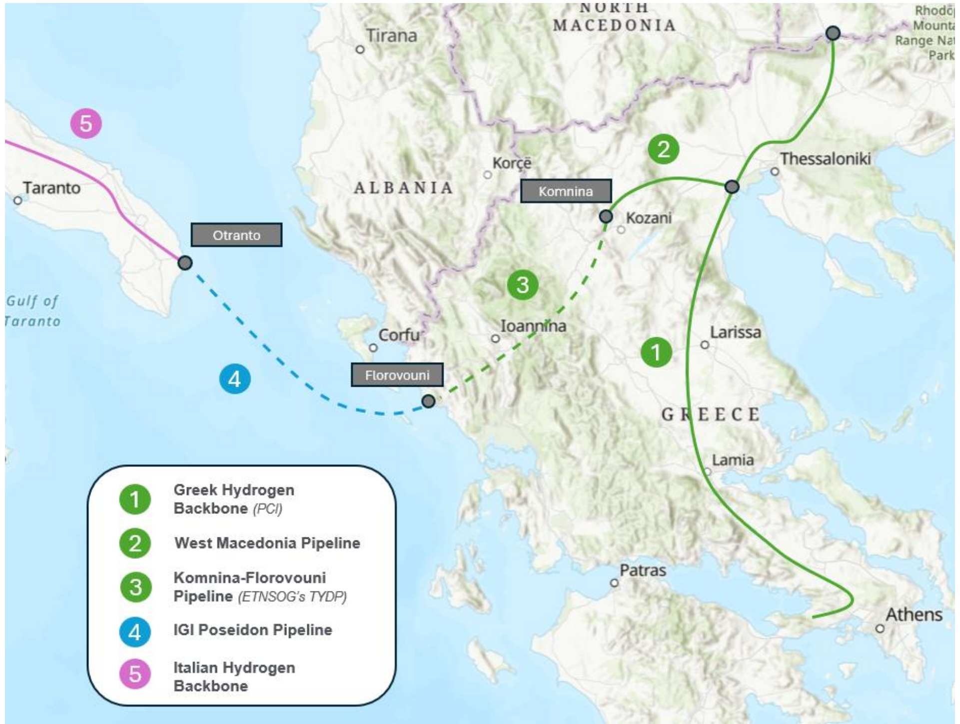
Export Potential

- Greece could deliver 20TWh of H2 to Germany at a cost ranging between 2.9 and 4.5€/kg
- Two alternative routes were assessed, via Italy and Balkans
- Dedicated Production: Metsovo and Komotini
- Among most competitive options for Germany

III To exploit the high green hydrogen production potential of Greece for exports to Germany, 2 transport routes are assessed, one via the Balkan region and one via Italy. Recent analysis by GIZ shows sufficient production for both routes.

Hydrogen transport options considered (from the Greek border to Germany)

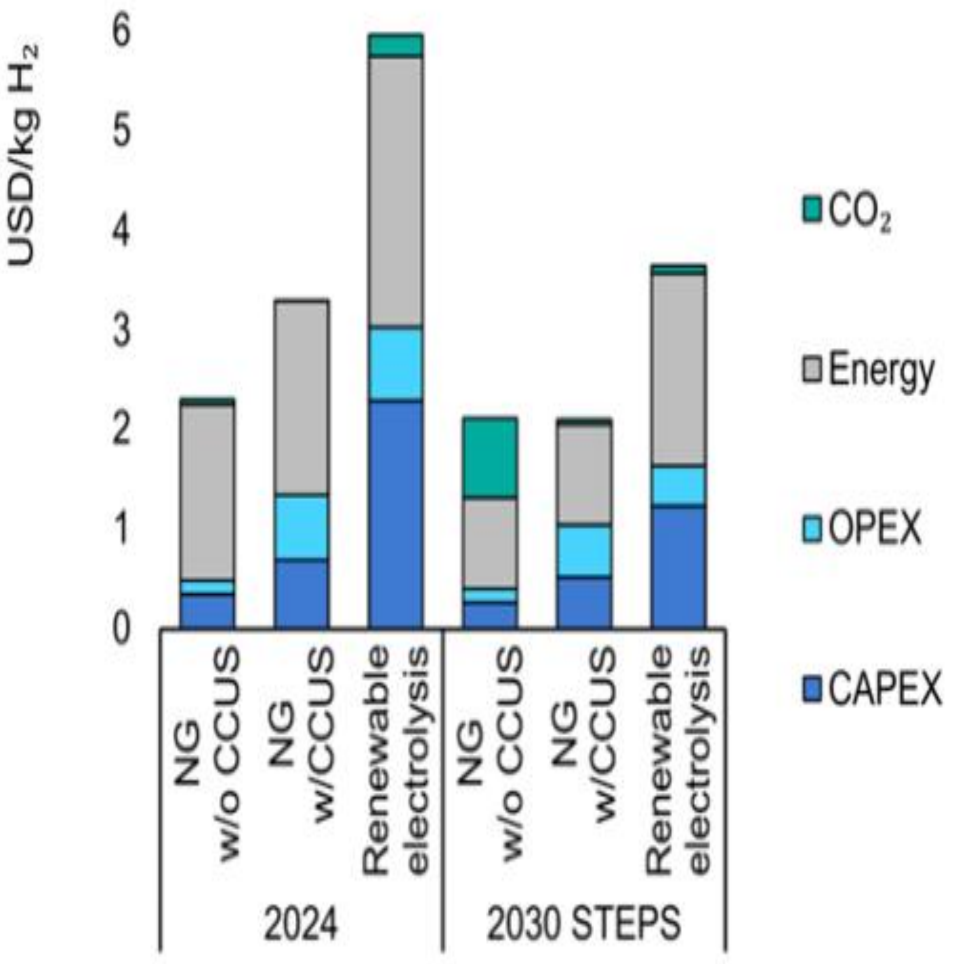
Connection to Italy



Connection to Italy can be realized through the Komnina-Florovouni H2-ready pipeline. This pipeline will connect West Macedonia Pipeline with the IGI Poseidon, which in turn is connected to the Italian Hydrogen Backbone.

The **project routing will cover 262 km.**
Komnina-Florovouni pipeline has been submitted for inclusion in the 2nd PCI/PMI list of the European Commission with an initial capacity of 30GWh/d.

H2 Production: Cost-Component Breakdown
Energy Costs: Key Driver



Source: IEA

- ➢ **North West Europe, 2024:**
- ▪ **Gas-based H2, unabated: EUR 2.9/kg**
- ▪ **Gas-based H2 with CCUS: EUR 3.2/kg**
- ▪ **PV-powered electrolytic H2: EUR 7.5-15/kg**
- ▪ **Wind-powered electrolytic H2: EUR 5.3-7/kg**
- ➢ **2030:**
- ➢ **To achieve cost parity, CO2 price of 140 €/tn !**
- ▪ **Wind-based electrolytic H2: EUR 3.2-4.7/kg**
- ▪ **European- or US-manufactured electrolysers: Costs to decline by 40% : EUR 1200 - 1400/kW**

Innovation Fund - Hydrogen Bank Auctions
3rd Auction: Opening 3.12.2025

- 1st Round (Nov 23 - Feb 24)
- Fixed premium for H2 produced (EUR/kg)
- Certified as RFNBO
- 132 Bids. Over-subscription x15
- Selected range: EUR 0.37-0.48/kg

- 6 projects signed grants in Oct 2024
- 2 in Portugal / Spain, 1 in Finland / Norway.
- 1.4 GWe - EUR 700 mil
- Member states can commit extra funds for their non-selected projects
- Germany: 350 mil, but not awarded

- 2nd Round (Dec 24 - Feb 25)
- 200 mil for maritime, 1 bn other sectors
- 61 Bids. Over-subscription x4
- Selected range: EUR 0.2-0.6/kg
- Resilience: Chinese electrolysers up to 25%

- 12 projects + 3 marine fuel
- New awards: Germany, Netherlands
- Spain, Lithuania, Austria: Extra € 836 mil
- Innovation Fund:
- 4.8 bn €, 24 H2 projects out of 86
- 61 ktpa RFNBO
- 9.3 GW/yr electrolyser manufacturing
- Joint German-Dutch Imports Tender

3rd Auction: New Elements

- Intense competition, but several projects withdrew before or after signing contracts
- 902 mil unutilized, out of the 2 bn offered across both rounds
- Some of these funds could be reallocated to the upcoming auction

Key Challenges:

- Achieving financial close within 2.5 years
- Securing credible infrastructure and off-take agreements
- 3rd auction introduces new requirements: Resilience, sustainability, licensing

Novel elements:

- Supports both RFNBO and low-carbon electrolytic H2 (70% GHG reduction)
- At least 75% of electrolyzer units must originate outside China
- Cybersecurity plan. Inclusion of DNSH: 6 Technical Screening Criteria

Extensive documentation, including:

- 60% of electricity supply secured
- 60% of output
- Electrolyser procurement
- Environmental and grid connection permits
- Equity support - 60% of total financing
- Completion guarantee - 8% of max grant.

National H2 Plans: Under Revision

- Germany: Regulator approved 19 bn € plan for core hydrogen network
- Industrial clusters, ports, storage and XB
- 9040 km: Built or converted by 2032
- Federal Audit Office: Risks and Costs
- 2 GW new gas plants : Early H2-conversion

- France revised H2 strategy, focusing on:
- Entire value chain (manufacturing and exporting electrolysers)
- Grid-based electrolysis
- Entirely domestic production by 2035
- Lowered 2030 target to 4.5 vs 6.5 GW

- Netherlands: 24% binding obligation for RFNBOs in industry, instead of 42%
- Denmark: Halved 2035 expectations
- UK: 22 bn in Carbon Capture over 25 years
- CCUS-enabled H2:

  1 GW in 2025, 4 GW in 2030

- Italy: 3.7 bn € from RRF
- CEF Funding: South H2 Corridor, from Africa to Germany - 40% of EU Imports
- Portugal: Hydrogen Auction at 127€/MWh
- Holistic: From Sines to Rotterdam
- Hydrogen Trade: 50 Terminals globally

Flexibility Potential to be unlocked