Hydrogen Infrastructure for Europe's Data Centres:

A Practical Guide for Operators, Developers and Investors

October 2026



NET ZERO
INNOVATION HUB FOR DATA CENTERS

Hydrogen Europe



About Hydrogen Europe

Hydrogen Europe is the European association representing the interest of the hydrogen industry and its stakeholders and promoting hydrogen as an enabler of a zero-emission society. With 600+ members, including 40+ EU regions and 30+ national associations, we encompass the entire value chain of the European hydrogen and fuel cell ecosystem. Our mission is to unlock the industrial scale deployment of clean hydrogen. For more info, visit www.hydrogeneurope.eu.

About the Net Zero Innovation Hub for Data Centers

The Net Zero Innovation Hub for Data Centers unites leaders across the data centre industry to accelerate the deployment of advanced net zero solutions. Backed by APL, Danfoss, Data4, Engie, Google, Microsoft, Schneider Electric, and Vertiv, the Hub works to identify, test, and de-risk new technologies for the industry, removing the technical, commercial, regulatory, and financial barriers that slow their path to deployment.

Through a structured, collaborative innovation methodology, the Hub accelerates innovation across the data centre value chain. It brings operators and suppliers together to test emerging solutions under real operating conditions and de-risks new technologies by assessing their technical and application readiness. With the Hub, the leaders of the data centre industry select the innovations to deploy in their data centres. The Hub's goal is to support data centre growth while enabling the transition toward a net-zero future.

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01 Executive Summary

1 Executive Summary

Europe's digital competitiveness depends on speed, security, and sovereignty, and all three now hinge on access to power. AI-driven demand and decarbonization targets are converging on the data centre industry just as the electrical grid struggles to deliver capacity at the required pace. Across Europe, installed data centre IT power capacity reached 14.8 GW by the end of 2025, up from 10.5 GW in 2023.[1] Driven heavily by AI workloads, total European data centre power demand is projected to reach about 35 GW by 2030.[2] Within the European Union, data centre capacity is forecast to more than double, from 12 GW in 2025 to 28 GW by 2030.[3] This rapid trajectory, which will only be accelerated by the Cloud and AI Development Act's ambition to triple EU capacity within five to seven years, places immense pressure on existing infrastructure. Connection queues in Frankfurt, London, Amsterdam, Paris, and Dublin already stretch into years, and new projects increasingly face local opposition.

Clean power generation is not the constraint: more than 500 GW of wind capacity alone is waiting in European grid connection queues. The bottleneck is transmission and storage. This publication sets out a practical response: planning hydrogen infrastructure and data centre growth together as a solution to the power access bottleneck, rather than leaving the two to compete for the same grid connections and public consent.

Data centres and hydrogen can be part of the solution. Every large campus already owns dispatchable generation: a fleet of emergency generators, almost all of which are diesel today, sit idle for all but a few hundred hours a year. If converted to hydrogen or another clean fuel, and permitted to operate beyond emergencies, this fleet, together with other energy assets, could become a flexible grid resource. It could earn revenue, free up grid capacity, improve the operator's position in the connection queue, and strengthen its case with regulators and local communities.

This solution is already a reality: in April 2026, the Net Zero Innovation Hub for Data Centers and INNIO demonstrated 3 MW of 100% hydrogen backup power test for selected AI load profiles, with Microsoft, Google, and Data4 as technical observers.

The remaining barriers for the development of hydrogen are infrastructure and policy, not technology. This publication is organized around the three questions every data centre operator, developer, and investor is asking:

When will hydrogen be available in the volumes data centres require?
Europe has 677 MW of electrolyzer capacity in operation today, and supply is expected to reach 1.7 Mt per year by 2030. Supply is to be complemented by imports. Pipeline infrastructure is concentrated in a limited number of markets (Section 3.1)

Where will it be available, relative to where data centres are being built?
Hydrogen supply and data centre growth do not automatically overlap; this publication aims to showcase where data centre development and hydrogen infrastructure can coincide (Sections 3.2 and 4).

At what price can hydrogen realistically be expected?
Production costs vary by more than a factor of five depending on the production pathway. Unlike heavy industry, data centres are not bound by the EU quotas that push other sectors toward the most expensive option, a significant and largely untapped cost advantage for the sector (Sections 3.3 and 6).

Section 3 addresses each question in turn, and Section 4 overlays the answers on Europe's data centre geography. Sections 5 and 6 translate them into potential off-take volumes and a regulatory position that is unusually favorable to the digital sector. Section 7 draws lessons from flagship projects, and Section 8 summarizes key takeaways and conclusions.

1 / European Data Centre Association (EUDCA), State of European Data Centres 2026. Brussels: EUDCA, 2026. Available at: https://www.eudca.org/new-2026-state-of-european-data-centres (figure of 14,784 MW for 2025 and 10,539 MW for 2023, as reported in Enlit and Intelligent CIO coverage of the report). Figures differ between sources because of differences in scope and definitions. ENTSO-E, used in Section 2, reports 12.7 GW for Europe and 9.9 GW for the EU27 (data centres with at least 50 kW of IT power).

2 / McKinsey & Company, "The role of power in unlocking the European AI revolution," October 2024, as cited in Linesight, "Data Centres: The Energy Gap and Power Constraints, Europe," Construction Market Intelligence H1 2025. Available at: https://insights.linesight.com/cmi-2025-h1/the-energy-gap-and-power-constraints-europe/data-centres

3 / European Commission forecast, as reported in Enkiai, "EUDCA Grid Report: 67% Cite Power Challenge, 28 GW EU Demand by 2030, and New ENTSO-E Rules (2025–2026)." Available at: https://enkiai.com/data-center/power-availability-operators-europe/



02 Introduction and context

Europe's digital ambitions hinges on System Integration

In the global race for AI and to build a resilient, competitive and digital Europe, we need a combination of speed, security and sovereignty. The buildup of critical digital infrastructure will require the simultaneous expansion of the electricity grid, batteries, power engines, and gas and hydrogen pipelines. Without energy infrastructure, the digital backbone of Europe cannot be powered and built. Access to power is the main bottleneck of data centre growth, not only in Europe, but in the world, and not only for data centres but in all industries that are seeking to be electrified. Therefore, properly investing in energy infrastructure is an investment in Europe's future.

Access to competitive, reliable, and abundant energy is a major driver for technological competitiveness. As AI systems grow more computationally intensive, the ability to secure, deliver, and manage electricity at scale will shape the global AI race.[4]

The good news is that power **generation is not the bottleneck**[5]. Competitive, clean energy generation projects are available: Over 500 GW of wind capacity alone is trapped in grid connection queues across Europe, with total clean capacity queues in key markets exceeding **800 GW**.

Curtailment of renewables and redispatch are increasing at an unsustainable scale due to the lack of grid capacity, eroding the business case for investment in new clean generation. The International Energy Agency (IEA) highlighted that renewable energy curtailment volumes increased by about 55% in 2024[6]. By 2030, Europe could redispatch volumes equivalent to the 2024 annual electricity consumption of the Iberian Peninsula. **Instead of being wasted, these huge volumes of renewables should be used to produce valuable homegrown energy in the form of electrons and clean molecules to fuel energy's industrial and digital transformation.**

At the same time, while Europe is underutilising parts of its electricity grid, grid expansion delays are also becoming a major bottleneck for the integration of new renewable, hydrogen, data centre, and industrial projects[7]. Connection queues for renewables and industrial consumers can already span between 7 to 10 years. As a result some countries are introducing grid queue management systems where they set a tier system to prioritise some categories of loads over others. This is the case in Denmark and Spain where hydrogen production and electrification is prioritised over data centres for granting grid access. This is why pooling the loads of data centres and hydrogen production facilities behind the meter could help both connect to the grid faster.

More than 10,500 data centre facilities draw around 12.7 GW of IT power, 9.9 GW of it inside the EU27, and sector demand is set to rise from 87 TWh in 2024 to between 134 and 199 TWh by 2035.

Onsite clean power generation could streamline grid connection

The electricity system is undergoing a fundamental transformation. There is not enough grid capacity, and new demand can no longer be inelastic: system operators now require new loads to be flexible so that they can adapt to grid needs. Flexible connection agreements are also becoming the norm for new loads seeking to connect to the grid as electrification and industrialization advance in Europe. To a transmission planner, a data centre today is a large, inflexible load that expects a firm connection. New projects increasingly face local opposition, and a facility that draws power from the system but returns nothing to it is difficult to defend at a planning hearing.

However, data centres are equipped to be capable grid assets: concentrated, digitally controlled, and with on-site generation and storage installations. ENTSO-E estimates the technical flexibility potential of data centres in five European markets at some 16.9 GW by 2030, of which up to 3.8 GW could realistically be made available to the system.[8]

Europe's need for short-duration and ramping flexibility is expected to roughly double by 2030, to between 15 and 30 GW. Moreover, new Demand Connection Codes

4 / IEA, Renewables 2025.

5 / ACER (EU Agency for the Cooperation of Energy Regulators) & WindEurope. Key Finding: Over 500 GW of wind capacity alone is trapped in grid connection queues across Europe, with total clean capacity queues in key markets exceeding 800 GW. Reference: ACER Monitoring Reports on Electricity Infrastructure & WindEurope Position on the EU Action Plan for Grids. Context: ACER and WindEurope emphasize that grid connection queues—rather than supply chains or component manufacturing—have become the primary obstacle to European deployment. In major markets like the UK, Spain, France, and Italy, connection lead times regularly stretch between 5 to 9 years, prompting the European Commission's European Grids Package and regulatory reforms aimed at transitioning to "first-ready, first-served" connection rules.

6 / International Energy Agency (IEA), "Renewables 2025: Analysis and forecast to 2030", accessible here.

7 / EU guidance on ensuring electricity grids are fit for the future, European Commission, accessible here.

8 / ENTSO-E, "From Energy Demand to Grid Support: ENTSO-E Explores Data Centres' Dual Role".

require data centres to deliver dynamic frequency and voltage control, something that until now only Power to Gas, EVs and heat pumps are being designed to deliver with. These capabilities contribute to a more resilient grid and deliver system stability.

Having a more efficient grid also reduces grids costs for consumers, who pay for electricity grid buildout through network charges. Coordinated planning of digital and energy infrastructure can help reduce electricity bill charges for European industries and citizens. The share of household electricity bills that go towards grid charges is expected to increase by 66% by 2050 according to ACER. But in some countries, such as the Netherlands, network charges have more than quadrupled in the last 10 years.

KEY FIGURES

What data centre flexibility is worth, in gigawatts

EU27 data centre IT power is about 9.9 GW today. If it triples to roughly 30 GW in the early 2030s, in line with the aim of the Cloud and AI Development Act, then:

10%

of that load made flexible releases in the order of 3 GW of firm network capacity

20%

made flexible releases in the order of 6 GW*

Flexible connections let a data centre come online with a reduced firm allocation, backed by on-site generation, batteries, or load reduction when the grid is constrained. This avoids network reinforcements that are built too early or too large and makes the capacity available to the next project in the queue (ENTSO-E, 2026).

The evidence from the US points the same way. Duke University's Nicholas Institute finds that the US grid could absorb 76 GW of new load, about 10% of national peak demand, if that load accepts curtailment of just 0.25% of its annual energy. At 1%, the figure rises to 126 GW (Norris et al., 2025). In Belgium, Elia publishes hosting-capacity maps for new large loads at 0%, 5%, 10%, and 20% flexibility. At some substations, the flexible tier decides whether a project can connect now or must wait for a grid upgrade.**

* Assumes each 1 GW of load that can be shed at times of grid stress releases 1 GW of firm capacity.

**Duke's estimate does not account for transmission constraints. Elia's maps are indicative and non-binding.

Sources: ENTSO-E, "Data centres and the power system: expected trends, challenges and opportunities," May 2026. Norris, Profeta, Patino-Echeverri, and Cowie-Haskell, "Rethinking Load Growth," Duke Nicholas Institute, 2025. Elia, Grid Hosting Capacity map and Grid Study Methodology (Dec 2024 version). Capacitypedia, Belgium/Elia (TSO-DSO Cooperation Platform).

Redundancy that enables the data centre to be more flexible, resilient and competitive

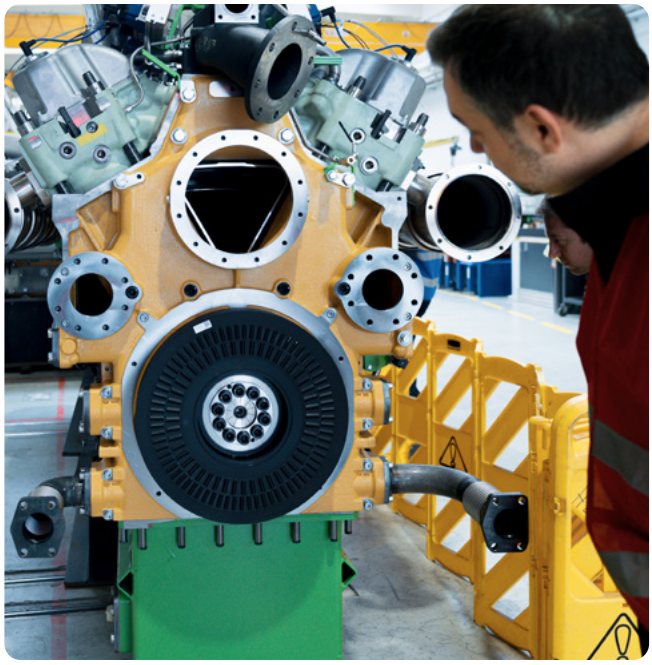
Practically every large data centre already owns dispatchable generation. Redundancy is a core design feature: it provides several layers of protection if one power source fails. The emergency fleet is almost always diesel. It is sized for the redundancy that underpins the availability operators promise their customers, and it sits idle for all but a few hundred hours a year.

Switching that fleet to clean fuels cuts its emissions and diversifies fuel supply. Many operators are choosing hydrogen-ready engines or turbines to keep future options open. The same equipment can also improve the economics and flexibility of the facility. A backup asset that can be dispatched for congestion management, under a flexible connection agreement, or to bridge the wait between an interconnection request and commissioning ceases to be a mere insurance policy. It becomes a revenue-earning resource that can shorten its own payback.

Why Hydrogen?

Several technologies can deliver clean dispatchable power on site — hydrogen engines, PEM fuel cells, aluminium-air generators and long-duration batteries — and the Hub is deliberately validating more than one, applying a TRL and ARL methodology so that operators can judge readiness on evidence rather than on vendor claims.

The technical approach to deliver clean redundancy will likely include a combination of the above mentioned technologies and others. Hydrogen stands out because it has some unique features that can't be easily replicated. It is storable over long durations, dispatchable at the scale a gigawatt campus requires, and — unlike a purely on-site solution — it connects the data centre to an energy system Europe is building anyway. In April 2026 the Hub and INNIO ran a 3 MW demonstration of 100% hydrogen back-up power against data centre load profiles, with Microsoft, Google and Data4 observing, proving that back-up hydrogen technology is ready to scale up and fulfil data centre's challenging requirements.





TRL = Technology Readiness Level, ARL = Adoption Readiness Level

Three Central Strategic Questions

An operator deciding today on a campus that is to be commissioned in 2030 requires certainty about when, where and at what prices will this clean molecule be available:

WHEN

will hydrogen be available, in the volumes a campus requires?

WHERE

will it be available, relative to where data centres are actually being built

WHAT

price can realistically be expected?



03 The Central Strategic Questions

Operators making investment decisions today on data centres scheduled for commissioning in 2030 must have certainty about the availability of the energy infrastructure and fuels that will power their data centre. The good news is hydrogen will be available if project developers are willing to support the sector. For the hydrogen sector, the question is not if we can supply enough hydrogen, but rather if there will be enough offtakers that support investments in the production of hydrogen and its derivatives.

3.1 When Will Hydrogen Be Available?

EXPLAINER

A brief summary of how hydrogen is produced, and what the colours mean

Hydrogen is currently produced mainly from fossil fuels. Most of today's supply comes from natural gas through steam methane reforming (SMR), with smaller volumes from coal gasification; both processes release CO_2 as a by-product. Water electrolysis, which uses electricity to split water into hydrogen and oxygen, still accounts for only a small share of global production, but it is the pathway on which most of Europe's new capacity is being built.

Because the molecule is identical whatever its origin, the industry uses colors to indicate how it was produced and, by extension, its carbon footprint. The three most common are:

- **Grey hydrogen.** Steam methane reforming of natural gas, without carbon capture. **Carbon emissions:** High: the CO_2 is released to the atmosphere (roughly 9 kg CO_2 per kg H_2)
- **Blue hydrogen.** Steam methane reforming of natural gas, with carbon capture and storage (CCS). **Carbon emissions:** Reduced: most of the CO_2 is captured and stored, but residual and upstream methane emissions remain
- **Green hydrogen.** Water electrolysis powered by renewable electricity. **Carbon emissions:** Near zero: no CO_2 is emitted in production

Other colors are also used. **Pink** (sometimes purple or red) denotes electrolysis powered by nuclear energy. **Turquoise** refers to methane pyrolysis, which splits natural gas into hydrogen and solid carbon and has yet to be proven at scale. **Brown** and **black** denote hydrogen made from lignite and bituminous coal respectively. **Yellow** is used for electrolysis powered by grid electricity of mixed origin, or by solar power in some definitions, and **white** for naturally occurring geological hydrogen.

There is no universal convention, and definitions vary between countries and over time. **EU legislation does not use colors at all:** it classifies hydrogen by its lifecycle greenhouse gas emissions, distinguishing renewable fuels of non-biological origin (RFNBOs) from low-carbon hydrogen, both of which must achieve at least a 70% lifecycle GHG saving compared with fossil fuels (see Sections 3.3 and 6). For a detailed assessment of each production route, see Hydrogen Europe, "Clean Hydrogen Production Pathways Report 2024"; for an overview of the color codes, see Harvard Kennedy School Belfer Center, "The Colors of Hydrogen".

Green Hydrogen

As of July 2026, Europe has 677 MW of electrolyser capacity in operation, corresponding to more than 100 kt of hydrogen production capacity per year considering 8760 full-load hours and an efficiency of 53 kWh/kg H_2

According to Hydrogen Europe's Clean Hydrogen Monitor 2025, Europe is expected to reach 1.7 Mt/year of electrolytic hydrogen supply by 2030, corresponding to approximately 15 GW of installed electrolyser capacity if all projects reach completion on schedule.

Thermochemical Hydrogen

An estimated 63 kt of thermochemical hydrogen production capacity is currently operational in Europe. Thermochemical production refers to hydrogen produced through processes such as fossil fuel reforming, gasification or partial oxidation combined with carbon capture, as well as methane splitting, biowaste-to-hydrogen and non-biological waste-to-hydrogen. To qualify as low-carbon hydrogen, production must meet an emissions threshold of 3.38 kgCO_2 per kgH_2.

A further 315 kt of thermochemical hydrogen production capacity is under construction, primarily serving refineries and ammonia production, with most of it located in the Netherlands and France. Around 1.3 Mt of additional capacity has been announced for operation before 2030 and has already progressed beyond the feasibility stage. Many of these projects are now ready to advance and need two things to reach final investment decision (FID): regulatory certainty and secured long-term offtake.

This is where data centres can make a difference. As large, long-term energy buyers, data centre operators could provide the offtake certainty that helps unlock part of this capacity.

Together, this represents production capacity that could, in principle, be contracted in Europe. To turn this capacity into supply for data centres, hydrogen, whether produced in Europe or imported, must reach the sites where it is needed. Pipelines alongside hydrogen storage in geological formations and port terminals, both existing and planned, are the bottleneck for the delivery of the contracted hydrogen. Without them, hydrogen's potential to decarbonise data centres cannot be unlocked.

However, it is worth noting that many hydrogen valleys are already in development, and while widespread hydrogen interconnectors across Europe won't be available in the short term. There are many promising developments happening at local and cluster level, as hydrogen is being already used as feedstock and fuel in many industrial clusters across Europe.

Electrolyser Capacity in Europe: In Operation Today and Announced Pipeline

Status	Electrolyser capacity	Hydrogen output potential	Horizon
In operation today	677 MW	≈112 kt H_2/yr (assuming 8760 full-load hours)	July 2026
Announced total project pipeline IEA*	37.6 GW	≈6 Mt H_2/yr (assuming 8760 full-load hours)[1]	By 2030

* Calculated from 37.6 GW, assuming 52 kWh/kg H_2 and 8760 full-load hours. Sources: Hydrogen Europe and IEA.

The gap between the two rows above represents the current planning potential. It shows that **there is no scarcity of potential hydrogen production**, and what the market needs most is hydrogen infrastructure, an adequate regulatory framework, and offtakers that are ready to support clean alternatives to fossil fuels.

Based on the milestones above, hydrogen adoption in data centres is expected to unfold in three distinct phases:

OUTLOOK

Three phases of hydrogen adoption in data centres

2026 >> 2027
Pilot and test-bed phase

Hydrogen use in data centres is expected to remain limited to demonstration projects (those could include fuel cells and dual-fuel generators for backup power), allowing operators to test hydrogen technologies without requiring large-scale hydrogen supply. Hydrogen would be supplied through existing or newly-repurposed local pipeline segments or be delivered via truck or in tanks.

2027 >> 2030
Early commercial scale-up

As H_2 projects progress towards reaching Final Investment Decision (FID), the first large-scale supply arrangements could become available. Projects reaching FID by 2027 could provide the realistic basis for multi-megawatt commitments from data centres.

2030 >> 2035
Market maturity

As larger hydrogen production projects progress and cross-border infrastructure develops through initiatives such as the European Hydrogen Backbone and Hydrogen Valleys, commercial multi-megawatt hydrogen could become available on a cross-border basis. This would allow data centre operators to move from single-site pilots to portfolio-level procurement.

For projects reaching FID before 2028, hydrogen is likely to be mostly considered as a complementary or backup fuel, supplied via local or regional sources, rather than as a primary source of firm multi-megawatt power. This could change as hydrogen production, transmission, and distribution infrastructure develops and matures towards 2030–2035.



3.2 Where Will Hydrogen Be Available?

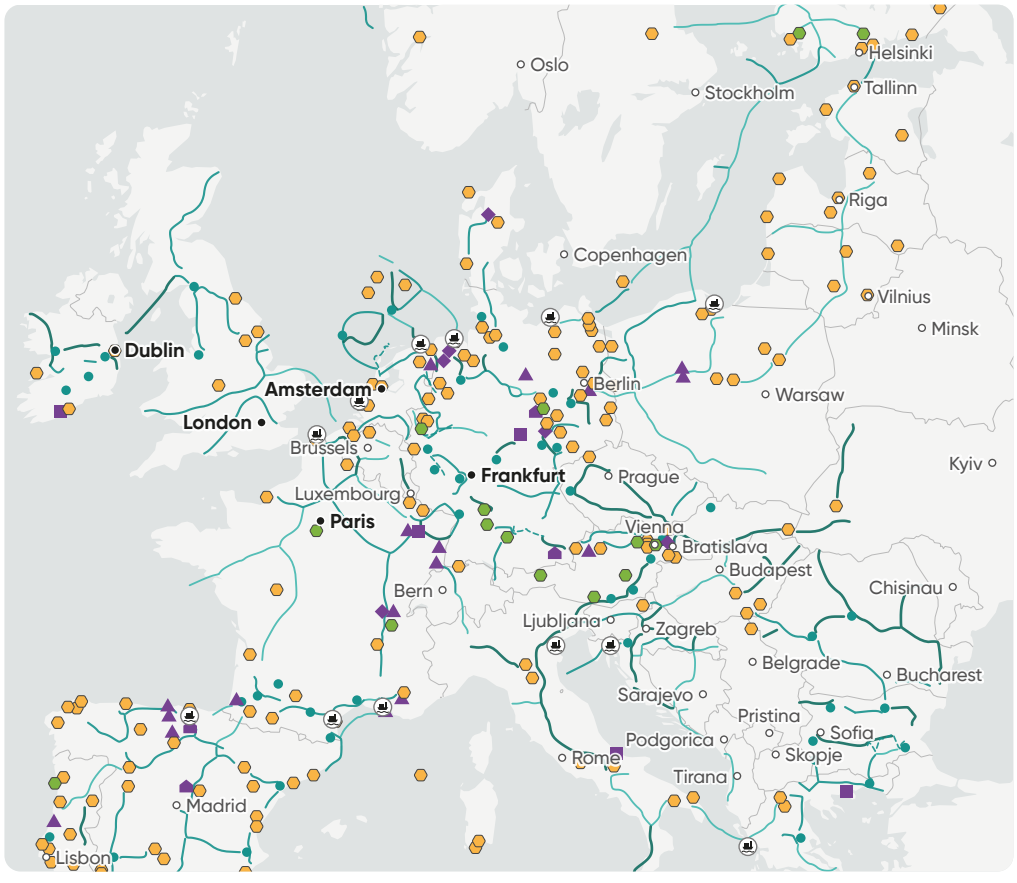
Hydrogen availability will depend not only on the volume of hydrogen produced, but also on the development and availability of the infrastructure.

Across Europe, approximately 550 km of hydrogen pipelines are currently operational, of which 51 km are newly built, and 499 km have been repurposed from existing natural gas infrastructure. Germany currently has the most extensive hydrogen infrastructure, both in terms of operational pipelines and the projects in development (506 km), with most of the remaining operational pipelines located in the Netherlands.

Regarding the European Hydrogen Backbone, the largest developments on its infrastructure are concentrated in Germany, the Netherlands and Belgium, where construction of the backbone has already begun. These countries are therefore also among the locations where hydrogen infrastructure is moving from planning towards deployment.

MAP 1

Hydrogen Infrastructure in Europe: Pipelines, Production, and Storage (existing, planned, and uncertain)



0 250 500 km Scale at 50°N

Source: Hydrogen Infrastructure Map (h2inframap.eu) – ENTSOG, GIE, Eurogas, CEDEC, GD4S and GEODE, in cooperation with the European Hydrogen Backbone. Status Q4 2025. Project locations are indicative. Base map: Natural Earth.

Transmission
- New
- Mix
- Conversion of existing infrastructure

Distribution
- Distribution

High pressure distribution
- New
- Mix

Terminals and ports
- Terminals and ports

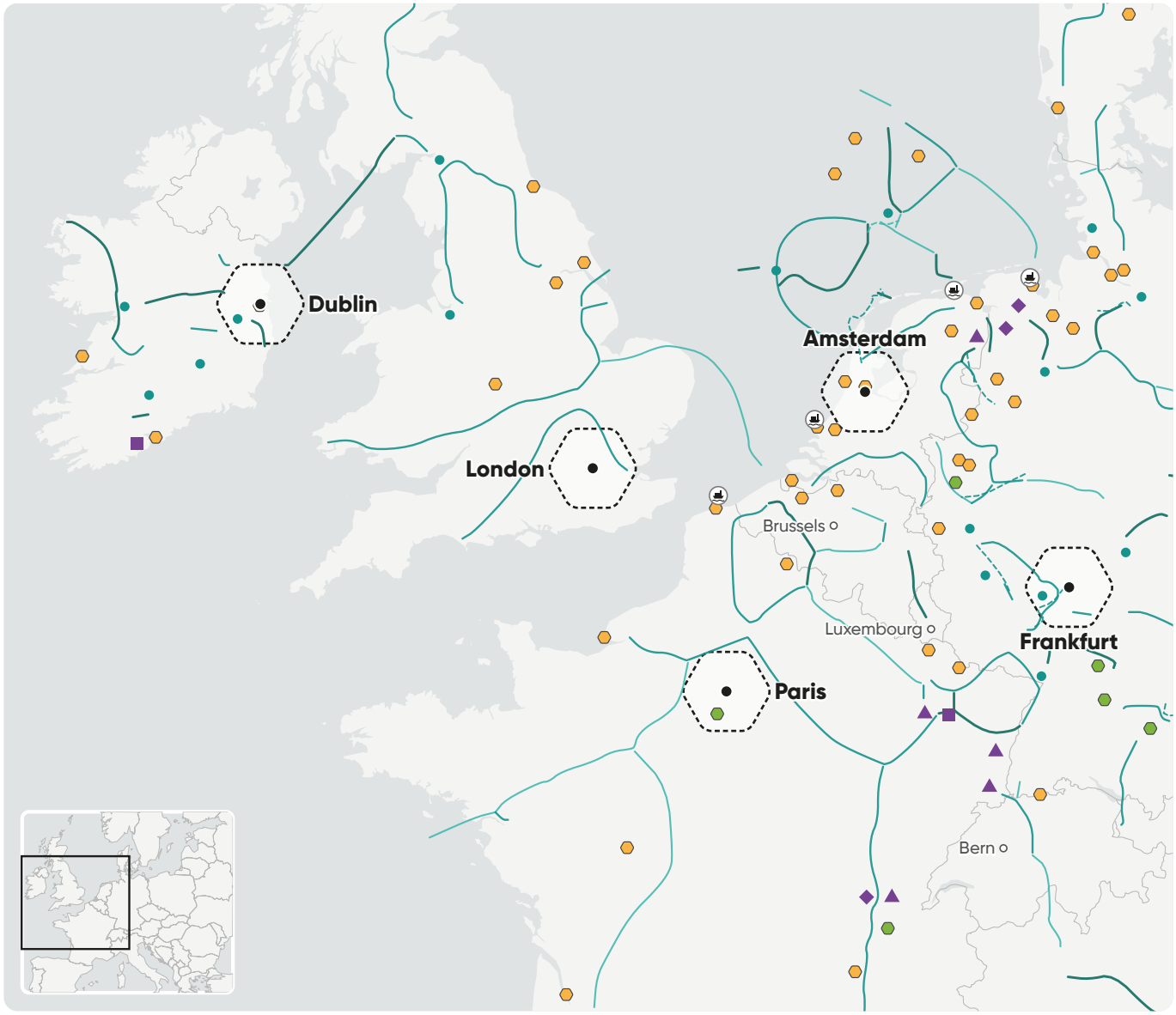
Demand and production
- Demand
- Production

Storage
- Aquifer
- Depleted field
- Salt cavern
- Surface storage & other types
- Underground vertical storage

Cities
- FLAP-D hub
- Capital city

MAP 2

Hydrogen Infrastructure around the FLAP-D Hubs (Frankfurt, London, Amsterdam, Paris, Dublin)



Transmission
- New
- Mix
- Conversion of existing infrastructure

Distribution
- Distribution

High pressure distribution
- New
- Mix

Terminals and ports
- Terminals and ports

Cities
- FLAP-D hub
- Capital city

Demand and production
- Demand
- Production

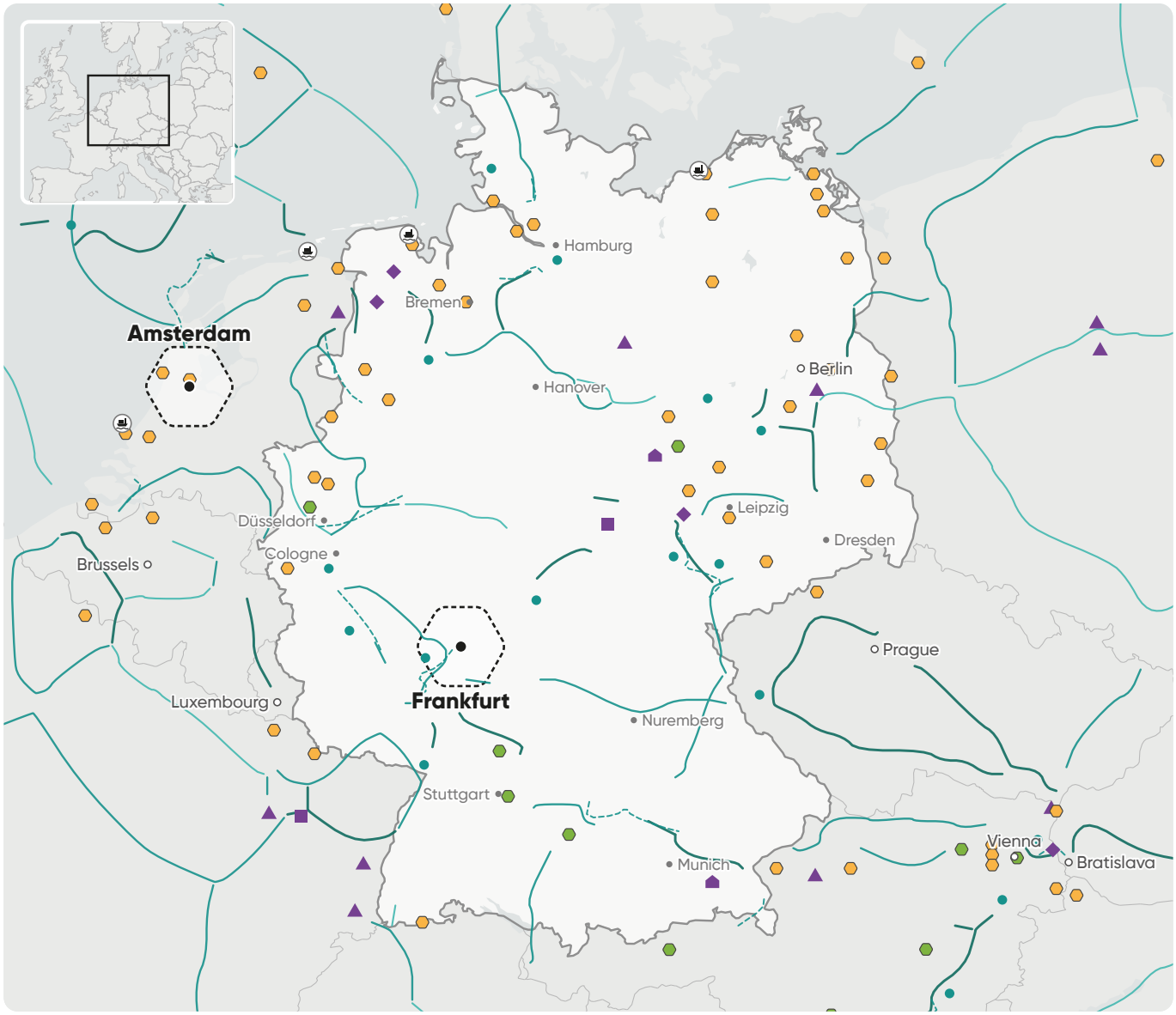
0 100 200 km
Scale at 50°N

Storage
- Aquifer
- Depleted field
- Salt cavern
- Surface storage & other types
- Underground vertical storage

Source: Hydrogen Infrastructure Map (h2inframap.eu) – ENTSOG, GIE, Eurogas, CEDEC, GD4S and GEODE, in cooperation with the European Hydrogen Backbone. Status Q4 2025. Project locations are indicative. Base map: Natural Earth.

MAP 3

Hydrogen Infrastructure in Germany



Transmission
- New
- Mix
- Conversion of existing infrastructure

Distribution
- Distribution

High pressure distribution
- New
- Mix

Terminals and ports
- Terminals and ports

Cities
- FLAP-D hub
- Capital city
- Major city

Demand and production
- Demand
- Production

0 100 200 km
Scale at 50°N

Storage
- Aquifer
- Depleted field
- Salt cavern
- Surface storage & other types
- Underground vertical storage

Sources: Hydrogen Infrastructure Map (h2inframap.eu) – ENTSOG, GIE, Eurogas, CEDEC, GD4S and GEODE, in cooperation with the European Hydrogen Backbone. Status Q4 2025. Project locations are indicative. Base map: Natural Earth.
BMWE – https://www.bundeswirtschaftsministerium.de/Redaktion/EN/Dossier/hydrogen.html

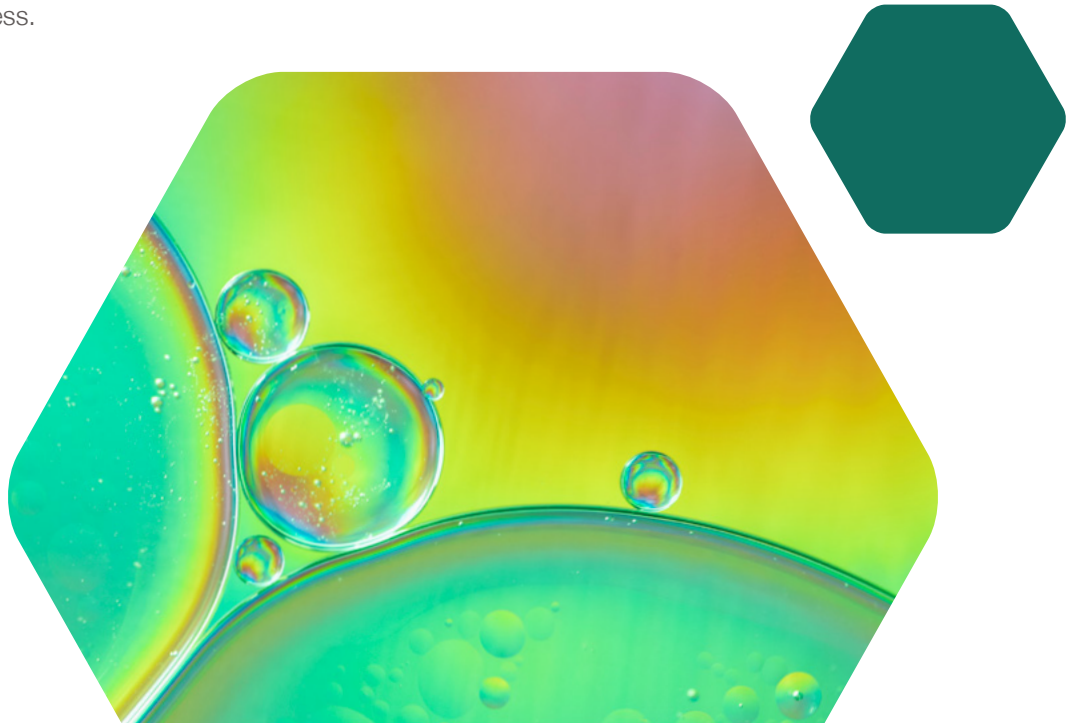
The operational figures above, drawn from the European Hydrogen Backbone (EHB) database, exclude privately-owned pipelines that have historically served refineries. Including these networks the total actual operating pipeline length is closer to 2,000 km (a materially larger existing network than the headline 550 km figure suggests, concentrated around established refining and chemical clusters). For data centres this implies additional opportunities to access hydrogen, particularly where private pipelines and industrial networks are located close to new or planned data centre developments.

Europe's hydrogen pipeline project portfolio totals approximately 38,800 km. This underlines Europe's position as the most active region globally in terms of planned hydrogen transport infrastructure.

Project stage	Length (km)	Share of EU pipeline	FID / operational likelihood by 2030
Operational today	550 (51 new-build + 499 repurposed)	≈1.4%	Already in service
Post-FID / construction	613	≈1.6%	High — on track for 2030
FEED stage	5,272	≈13.6%	Higher likelihood of FID by 2027; those that miss FID by 2027 are unlikely to be operational before 2030
Feasibility study or earlier	≈16,000	≈41%	Significant risk of delay beyond 2030
Total European pipeline project portfolio	**≈38,800 (IEA)**	**100% (≈70% of the global project portfolio)**	—

Note: the FEED and feasibility-stage figures do not sum exactly to the 38,800 km total; the remainder sits across earlier planning or unspecified categories.
Sources: European Hydrogen Backbone (EHB) project database; company/refinery pipeline records not captured in the public EHB dataset and IEA.

As seen by the current developments of the hydrogen pipeline infrastructure, Germany, then the Netherlands and Belgium, offer the most realistic near-term opportunities for access to physical hydrogen pipeline networks and established Hydrogen Valleys clusters. In other parts of Europe, access to hydrogen in the near term is likely to depend more heavily on alternative supply solutions, such as trucked liquid/compressed hydrogen or on-site production, until the European Hydrogen Backbone and other regional networks are sufficiently developed to provide broader cross-border access.



Hydrogen Valleys

Hydrogen Valleys are regional hydrogen ecosystems. A single area, such as an industrial cluster, a port, an airport or a cross-border corridor, brings together hydrogen production (often with dedicated renewable generation), storage, distribution, and several end users who share the same supply infrastructure.[9] Instead of building production, transport, and demand separately, a valley plans them together. This reduces risk for every participant.

Hydrogen Valleys are helping scale up the hydrogen market in Europe. As a reference, the EU Hydrogen Valley Platform lists 83 valleys in 21 European countries. They account for most of Europe's operating electrolyser capacity (over 600 MW) and a significant share of the more than 3.3 GW that has reached final investment decision.[10] The Clean Hydrogen Partnership has supported 27 valleys so far, with around €1.6 billion of project investment from €328 million of public funding, almost five times leverage.[11] Its 2026 call sets aside a further €25 million for valleys.[12] Its Hydrogen Valley Facility selected 13 more valleys for project development assistance in July 2026.[13]

For data centres, valleys are the most practical near-term entry point to hydrogen. They already have the elements a single operator can't easily assemble alone: local production, storage, and distribution, and a mix of offtakers that spread infrastructure costs. A data centre located in or near a valley can source hydrogen for clean backup or flexible on-site power without waiting for the cross-border backbone. In return, its long-term, creditworthy demand can help the valley reach FID. Valleys in or near data centre hubs, such as Rotterdam, Groningen/Eemshaven, Rhine-Ruhr and the Nordics, are natural candidates for net-zero digital energy hubs.

9 / Clean Hydrogen Partnership, "Working with the regions – From Hydrogen Territories to Hydrogen Valleys", https://www.clean-hydrogen.europa.eu/get-involved/working-regions_en

10 / Clean Hydrogen Partnership, "Developing Hydrogen Valleys in a challenging market environment" (H2V sector report, 2026), https://h2v.eu/sites/default/files/2026-07/2026.05883_01_ENN.pdf

11 / Ibid.; see also Clean Hydrogen Partnership, Hydrogen Valleys, https://www.clean-hydrogen.europa.eu/get-involved/hydrogen-valleys_en

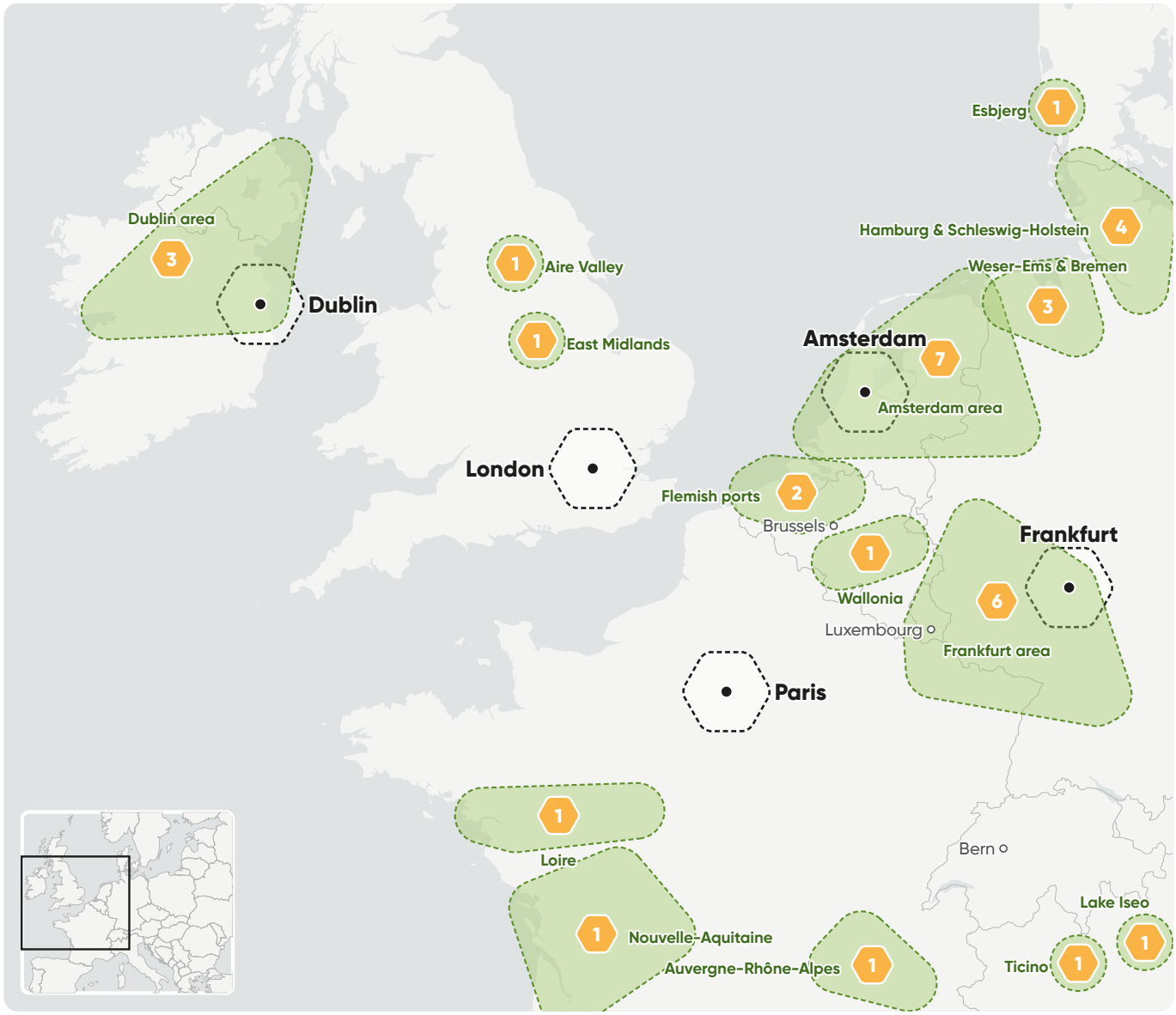
12 / Clean Hydrogen Partnership, "Driving hydrogen innovation in Europe: Clean Hydrogen Partnership opens 2026 call with €105 million", 20 January 2026, https://www.clean-hydrogen.europa.eu/media/news/driving-hydrogen-innovation-europe-clean-hydrogen-partnership-opens-2026-call-eu105-million-2026-01-20_en

13 / Clean Hydrogen Partnership, "Clean Hydrogen Partnership selects 13 Hydrogen Valleys for Project Development Assistance", 20 July 2026, https://www.clean-hydrogen.europa.eu/media/news/clean-hydrogen-partnership-selects-13-hydrogen-valleys-project-development-assistance-2026-07-20_en



MAP 4

Hydrogen Valleys around the FLAP-D Hubs



Hydrogen valleys

- Hydrogen valley area (indicative)
- n — Number of hydrogen projects in the valley

Cities

- FLAP-D hub
- Capital city

0 100 200 km
Scale at 50°N

34 hydrogen projects in 15 valleys shown on the map

Source: H2Valleys – Hydrogen Valley Platform (h2v.eu), Clean Hydrogen Partnership. Status October 2026. Valley areas are drawn around the locations reported in each valley profile and are indicative. Base map: Natural Earth.

3.3 At What Price Can Hydrogen Realistically Be Expected?

IN SHORT

RFNBOs, the European Hydrogen Bank, and what the auctions mean for hydrogen availability and prices

RFNBO: A Renewable Fuel of Non-Biological Origin is hydrogen produced from renewable electricity that meets the EU's strictest rules under RED III and Delegated Regulation (EU) 2023/1184: the electricity must come from additional renewable capacity and be matched in time and location with production. **These rules make RFNBO the most expensive pathway,** at an EU average of €7.1/kg in 2025, from €5.5/kg in Spain to €9.4/kg in higher-cost markets.

European Hydrogen Bank. To bridge the gap between this cost and what buyers are willing to pay, the EU runs competitive auctions in which producers bid for a fixed premium per kilogram, paid for ten years on top of the price they obtain from their customers. The lowest bids win. The premium is a subsidy to the producer, not a market price for hydrogen.

What the auctions show. The third auction (May 2026) selected nine projects with 1,083.5 MW of electrolyser capacity, expected to produce 1.32 million tonnes of hydrogen over ten years, with premiums from €0.44 to €3.49/kg. Demand for support was about seven times the €1.3 billion budget.

What it means for data centres:

- **Availability:** auction support is moving new renewable capacity towards final investment decision, with the most competitive projects in Finland, Greece, Spain, Denmark, and Austria. These are the regions where bankable supply is likely to emerge first.
- **Price:** the premium lowers the producer's effective cost, and therefore the price it can offer, but the support stays with the producer, not the off-taker. Large projects need the least support (€0.44–0.98/kg); small, dedicated supply arrangements, the profile closest to a single data centre, need up to about €3.5/kg.
- **Choice:** because data centres are not required to buy RFNBO (Section 6), certified low-carbon hydrogen, indicatively at €3–5/kg, can offer a more cost-effective route to clean backup power. Moreover, in some projects, not all the hydrogen produced will be certified as RFNBO (they seek to maximise hydrogen production and not all hydrogen produced will be able to meet the hourly correlation and additionality criteria). Therefore, hydrogen producers are seeking offtakers for electrolytic low-carbon hydrogen that are not mandated to fulfill REDIII obligations.

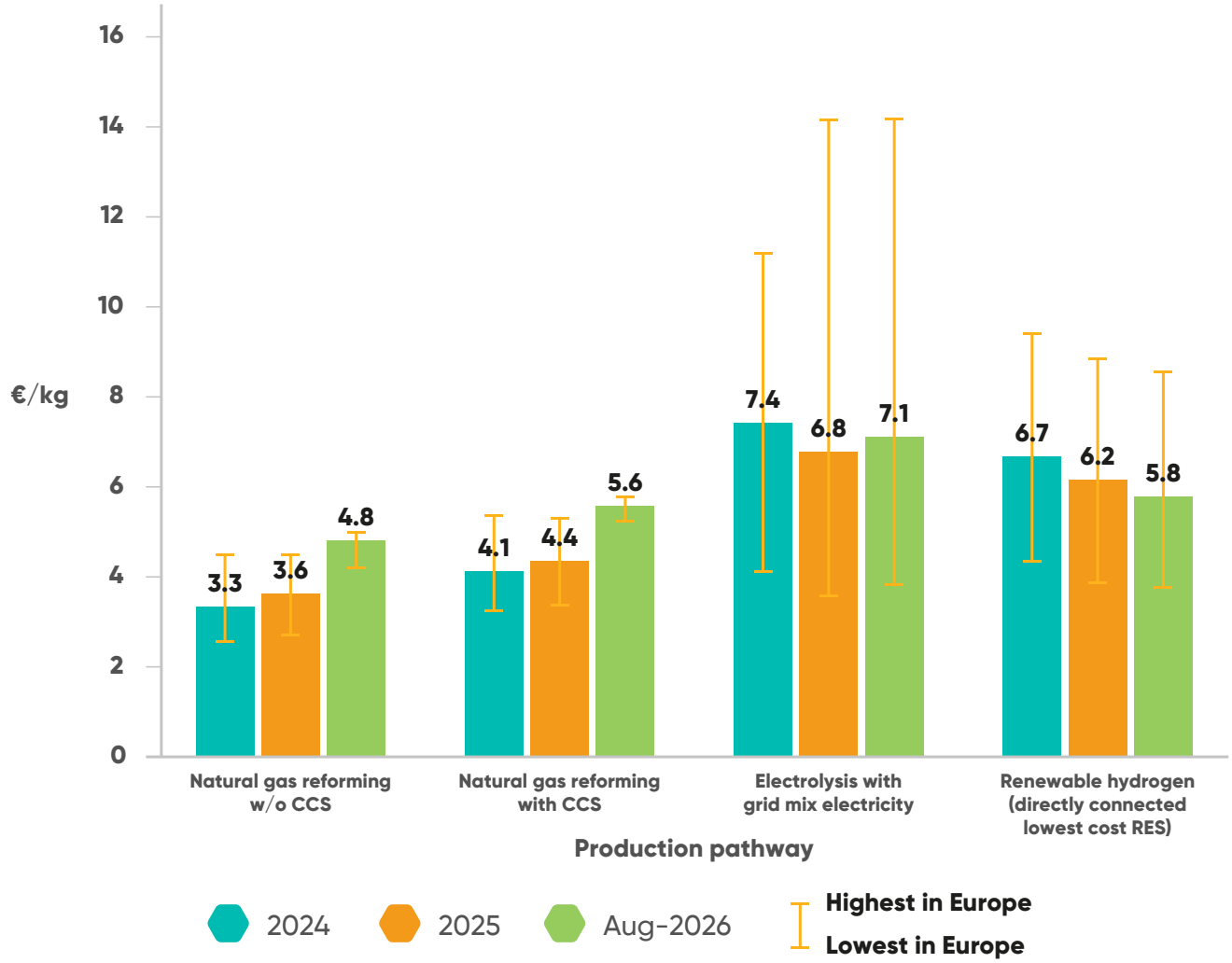
Hydrogen prices can vary significantly across Europe and depending on the source of hydrogen. For green hydrogen, produced from renewable enegy, around two-thirds of the production cost is driven by electricity prices, making access to low-cost electricity one of the most important factors in determining whether green hydrogen can be produced competitively. Depending on the project's cost structure as well as the cost and availability of the electricity supply and associated network charges, production costs can range from around €4/kg to €14/kg.

There is therefore no single price for hydrogen in Europe. For an operator assessing the cost of hydrogen for a specific project, the relevant price depends on three factors: the production pathway, the regulatory requirements the molecule must meet, and where in Europe it is produced. The difference between the cheapest and the most expensive combination is greater than a factor of five.

Figure 1 sets out indicative ranges by production pathway. These figures represent production costs at the plant gate; the costs of transporting and storing hydrogen must be added on top to determine the delivered cost. Pipeline transport can add approximately €0.3/kg per 1,000 km although hydrogen network tariffs have yet to be set. Based on ACER's projections, they're likely to increase materially over the lifetime of an asset.

FIGURE 1

Estimated average hydrogen production costs in Europe (€/kg H_2)



Note: these are not full levelised costs of hydrogen, as they do not include any accounting of future changes to ETS prices, natural gas or electricity price forecasts; they are marginal production costs estimated with added annualised cost of capital investments and fixed costs. Source: Hydrogen Europe, Clean Hydrogen Monitor 2026.

Hydrogen Europe's analysis shows that Natural gas-based hydrogen remained significantly cheaper than electrolytic hydrogen in both 2024 and 2025, even when coupled with CCS. However, electrolytic hydrogen became more cost-competitive over the period, particularly in the most favourable locations. In 2026, higher gas and power prices following the Strait of Hormuz crisis increased the cost of natural gas-based hydrogen, narrowing the gap with directly connected renewable hydrogen to around €1/kg.

Certifiable low-carbon hydrogen, including gas-based hydrogen with CCS and grid-connected electrolytic hydrogen, is materially more cost-competitive than renewable hydrogen, making it a practical option for data centre demand.

For hydrogen imports H2Global's first contract implies a production cost of under €4.50 per kg of hydrogen, equivalent to about €1,000 per tonne of delivered ammonia. H2Global is a German-led mechanism that helps create a market for imported green hydrogen and hydrogen derivatives such as ammonia, methanol, and e-fuels. It pays suppliers a fixed price and sells to buyers at whatever price the market will bear, and public money covers the gap.



04 Overlap Analysis of Hydrogen Infrastructure and Data Centre Growth

Two build-outs, different siting logic

Hydrogen infrastructure and data centres have one driver in common: both need to be close to large sources of energy. Beyond that, they are sited following different planning processes. Hydrogen producers and pipelines follow renewable generation, ports, and industrial clusters. Data centres follow customers, which means large cities, fiber routes, and the network nodes and landing sites where cables come ashore.

As operators follow available power, data centre growth is moving toward places where energy infrastructure is being built. That is where an overlap with hydrogen becomes possible.

Colliers EMEA Data Centres Market Report H1 2026 finds delivery constraints worsening in Frankfurt, London, Amsterdam, Paris, and Dublin (FLAP-D), where grid access limits expansion.[14] Those five hubs have more than doubled their combined live capacity since 2019, from 1.8 GW to about 3.8 GW, yet connection queues have made them a slow route to new capacity. New projects are moving outward: capacity in the pipeline for 2026 to 2028 sits on average 175 km from major hub cities, against 46 km for projects delivered between 2022 and 2025. Overall growth remains strong. Operational capacity across Europe, the Middle East, and Africa passed 12.1 GW in the first half of 2026, with 18.3 GW in the development pipeline.

The role of net-zero digital energy hubs

Today, hydrogen electrolysers and data centres are often seen as competitors for the same scarce resource: a connection to the transmission grid. Planned separately, these requests add up. The connection queue grows, and lead times grow for both industries.

Planned in a coordinated way, the two can work in synergy. In a net-zero digital energy hub, data centres and hydrogen infrastructure are operated as a microgrid together with renewables and batteries. Inside a microgrid, multiple power sources can be orchestrated so that the site places less strain on the grid. It can also deliver grid services and flexibility.

Overlaying map to unveil near-term opportunities

The maps in this section show where such hubs are most likely to emerge first. Overlaying planned data centre development on hydrogen production and planned pipelines reveals the sites close to both. The overlay is also a market signal. Credible demand from data centres can help move hydrogen projects from planning to final investment decision (FID) and construction. As Sections 3.1 and 3.2 show, many projects are still waiting for secured offtake. And data centres have the potential to become levers of the hydrogen economy and beyond, by supporting the deployment of new renewable generation, new hydrogen production and imports, and the buildout of energy infrastructure.

Section 3.2 maps hydrogen infrastructure at three scales, from the EU as a whole to Frankfurt and Amsterdam. Section 4.1 maps data centre growth over the same areas. Section 4.2 overlays the two and identifies where they meet.

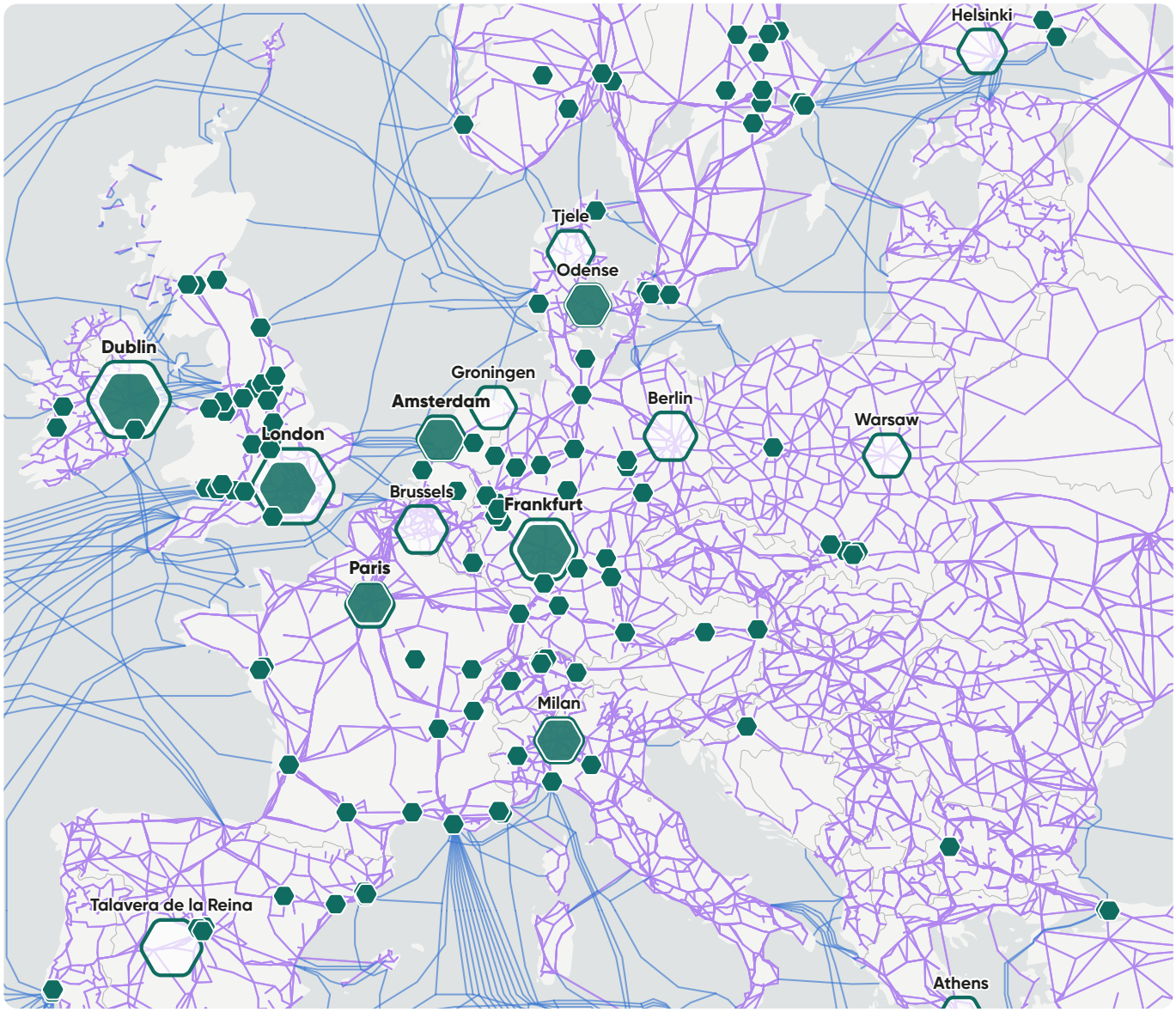




4.1 Data Centre Maps

MAP 5

Data Centres and fiber routes in Europe



Installed data centre clusters

- Planned hubs > 500 MW
- Operating hubs > 500 MW
- Operating hubs < 500 MW

7,000 MW

500

Infrastructure

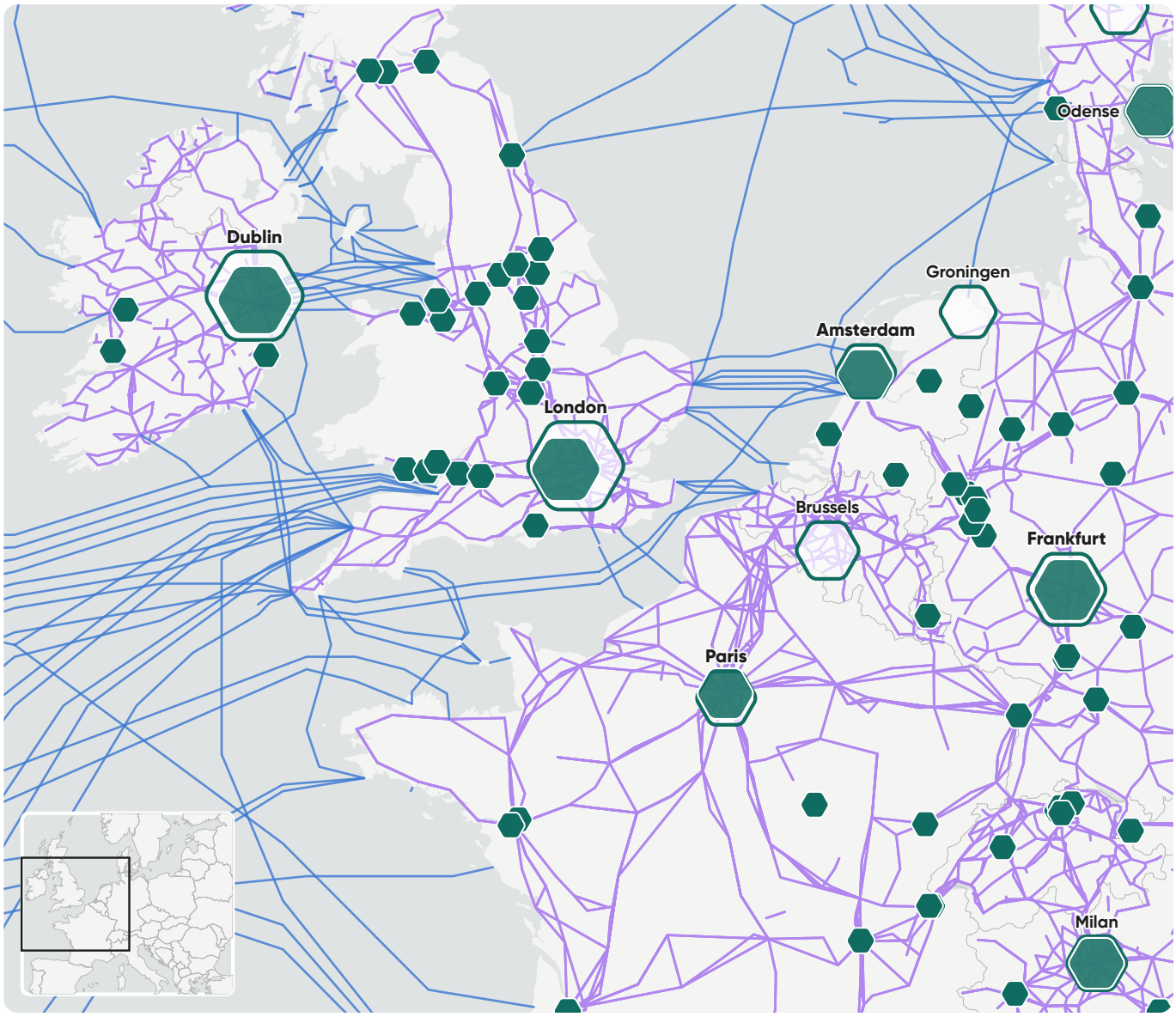
- Submarine fibre
- Terrestrial fibre

0 250 500 km
Scale at 50°N

Source: IEA, Energy and AI Observatory – Energy for AI (installed data centre clusters and infrastructure).
Locations and capacities are indicative. Base map: Natural Earth.

MAP 6

Data Centres around the FLAP-D Hubs



FLAP-D live and pipeline capacity by city (Knight Frank Data Centre Atlas 2026)

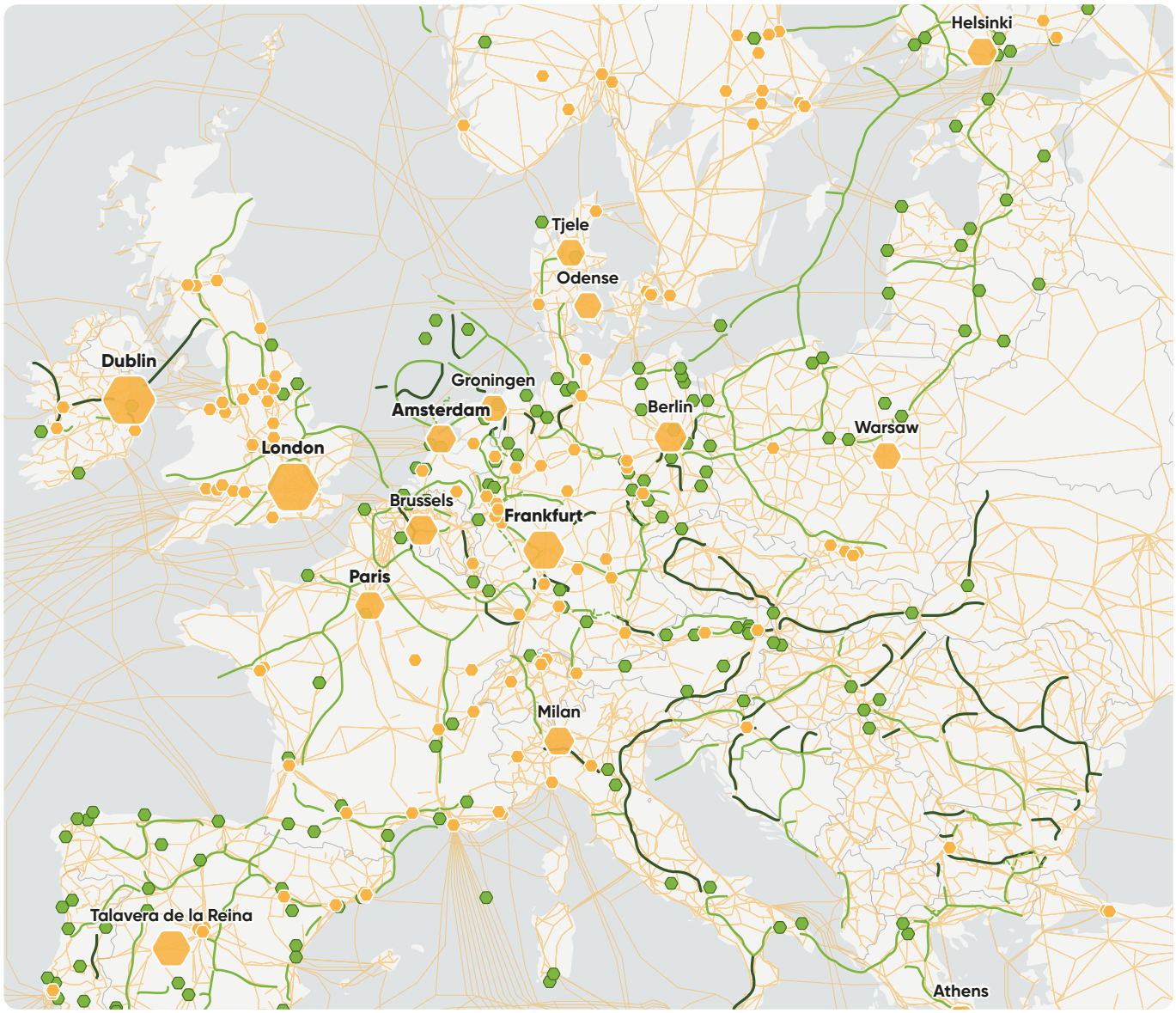
City	Live IT capacity (MW)	Pipeline (under construction + planned) (MW)
London	1,467	5,694
Dublin	1,254	1,649
Frankfurt	980	2,572
Amsterdam	829	722
Paris	696	2,837
FLAP-D total	**5,226**	**13,474**

Source: IEA Energy and AI Observatory.

4.2 Overlap Analysis

MAP 7

Overlap of data centres and hydrogen infrastructure in Europe



Hydrogen

- H_2 pipeline – new / mixed
- H_2 pipeline – repurposed
- H_2 high-pressure distribution
- H_2 production & demand site

Data centres

- Fibre network (terrestrial & submarine)
- Data centre hub > 500 MW, sized by capacity
- Data centre cluster < 500 MW

7,000 MW

500 MW

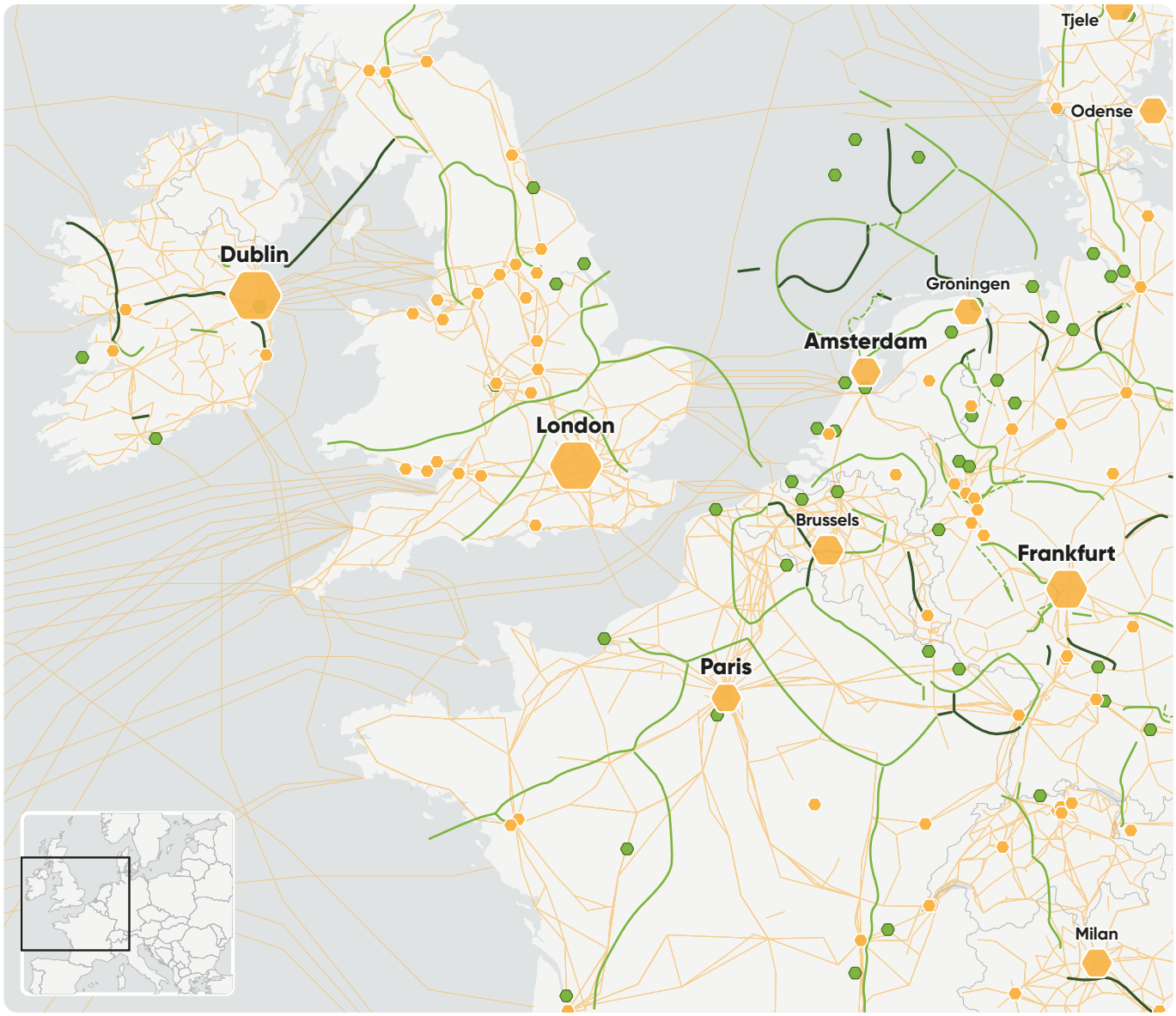
0 250 500 km

Scale at 50°N

Sources: Hydrogen Infrastructure Map (h2inframap.eu) – ENTSOG, GIE, Eurogas, CEDEC, GD4S and GEODE, in cooperation with the European Hydrogen Backbone (status Q4 2025); IEA, Energy and AI Observatory – Energy for AI (data centre clusters and fibre network). Locations are indicative. Base map: Natural Earth.

MAP 8

Overlap of data centres and hydrogen infrastructure around the FLAP-D hubs



Hydrogen

- H_2 pipeline – new / mixed
- H_2 pipeline – repurposed
- H_2 high-pressure distribution
- H_2 production & demand site

Data centres

- Fibre network (terrestrial & submarine)
- Data centre hub > 500 MW, sized by capacity
- Data centre cluster < 500 MW

7,000 MW

500 MW

0 100 200 km
Scale at 50°N

Sources: Hydrogen Infrastructure Map (h2inframap.eu) – ENTSOG, GIE, Eurogas, CEDEC, GD4S and GEODE, in cooperation with the European Hydrogen Backbone (status Q4 2025); IEA, Energy and AI Observatory – Energy for AI (data centre clusters and fibre network). Locations are indicative. Base map: Natural Earth.

Where hydrogen infrastructure and data centres meet?

Read together, the two maps show that Europe's data centre hubs and its emerging hydrogen infrastructure overlap in some areas in Europe. At European scale, the planned hydrogen backbone corridors run through or near most of the FLAP-D hubs and their fast-growing secondary markets. As it can be seen in the picture above, Amsterdam, Frankfurt and the Rhine-Ruhr corridor sit next to the first hydrogen pipelines being built in Europe.

Several of these sites are already being commissioned:

ROTTERDAM

The first section of the Dutch national hydrogen network, a 32 km pipeline from Maasvlakte to Pernis, was inaugurated in May 2026. It will carry hydrogen from Shell's 200 MW Holland Hydrogen 1 electrolyzer and forms the first leg of the Delta Rhine Corridor towards the Ruhr.[15] Rotterdam is within reach of the Amsterdam data centre cluster.

GRONINGEN / EEMSHAVEN

Gasunie is building the northern Dutch network, including the Delfzijl–Eemshaven pipeline, for completion in 2029. RWE plans a 50 MW electrolyzer in the same port.[16] This is the location of one of Google's largest European data centre campuses, and the clearest example on the map of data centres, offshore wind, hydrogen production and pipelines in one place.

GERMANY

The national hydrogen core network is planned to reach about 9,040 km by 2032.[17] Its first 400 km went into operation at the end of 2025. When capacity reservations opened in March 2026, 32 requests totaling 3.5 GW came in, exceeding the operators' expectations.[18] That is early evidence that demand is forming along the corridors that serve Frankfurt and the Rhine-Ruhr region.

Even if the infrastructure is available or will be in the near-term, data centre operators, hydrogen project developers, renewable developers, grid operators and energy companies currently plan on separate timelines, and each one waits for the others to commit first. Turning these overlaps into net-zero digital energy hubs requires joint planning: shared site selection, coordinated grid and pipeline connections, and long-term offtake agreements that give producers the demand certainty they need. Done together, this enables data centre capacity grow sustainably, makes better use of Europe's renewable resources, and strengthens a more resilient European digital and energy system.

15 / Hynetwork (Gasunie), "Rotterdam" project page, https://www.hynetwork.nl/en/region/projects/rotterdam; Hydrogen Council, Global Hydrogen Compass 2026 (Holland Hydrogen 1), https://compass.hydrogencouncil.com/.

16 / Hynetwork (Gasunie), "Hydrogen infrastructure on track to link up supply and demand", https://www.hynetwork.nl/en/knowledge-base/article/hydrogen-infrastructure-on-track-to-link-up-supply-and-demand.

17 / Clean Energy Wire, "Hydrogen to start to flow in pipelines in Germany in 2025", https://www.cleanenergywire.org/news/hydrogen-start-flow-pipelines-germany-2025.

18 / Hydrogen Germany, "GASCADE commissioning 400-kilometer hydrogen core grid" and reservation-phase update, https://hydrogen-germany.de/en/news/gascade-commissioning-400-kilometer-hydrogen-core-grid/.


DATA CENTER



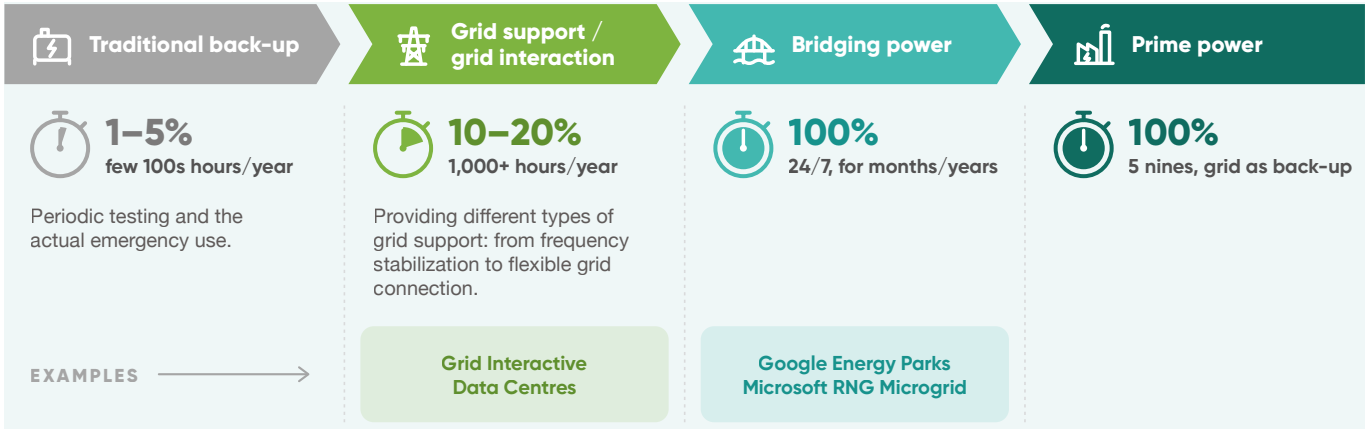
05 Off-take Sizing by Data Centre Operational Use Cases

Hydrogen can power data centres in a wide array of cases beyond back-upL from less than 100 hours per year to continuous supply

What separates the different is not the conversion but the number of hours that the generators are running. Indeed, in most configurations the generation asset is the same - the hydrogen asset can be an internal combustion engine, a fuel cell or a hydrogen turbine. The time variable drives the needs of the infrastructure setup and the fuel requirements such as the fuel volume, the storage size, the revenue available and the value delivered to the grid.

FIGURE 2

The clean on-site power spectrum, from traditional back-up to prime power.



Source: Net Zero Innovation Hub.

Hydrogen consumption: How much hydrogen a data centre needs depending on its size and use case, in tons per year

Hydrogen Europe's September 2025 briefing sized the European opportunity in aggregate, assuming 25 GW of new data centre capacity by 2030 and adoption rates of 25% and 50%. For an operator planning a specific site, the more useful question is what a single facility would consume. The table below expresses how many tonnes per year per MW of data centre installed capacity would be needed for a specific use-case of hydrogen power (from emergency back-up to firm power supply).

Use case	Hydrogen-fuelled operating profile	1 MW	100 MW	1 GW
5.1 Emergency back-up only	1% of annual hours (~88 h/yr), i.e. periodic testing plus real emergency use. The estimated field range is 1-5%.	~5 t/y	~530 t/y	~5,300 t/Y
5.2 Grid support and flexibility	10% of annual load (~880 h/yr, or 2.4 h/day). The estimated field range for grid-interactive operation is 10-20%.	~53 t	~5,300 t	~52,600 t
5.3 Continuous low-carbon power (bridging and prime)	100% of load, 24/7, for months or years	~530 t	~52,600 t	~525,600 t

Basis of calculation: hydrogen lower heating value of 33.3 MWh per tonne; 50% net electrical efficiency for the conversion asset, consistent with the implied efficiency in the Hydrogen Europe briefing; data centre capacity expressed as continuous facility load. On these assumptions one MWh of delivered electricity requires approximately 60 kg of hydrogen. Applying the table to 12.5 GW - the briefing's 25 GW at 50% adoption - reproduces its published results of 0.07 Mt for back-up only and 0.66 Mt for back-up plus grid interaction, which confirms the derivation.



06 Navigating European Regulation: The Unique Data Centre Opportunity

New European legislation is requiring data centres to have a sustainability label

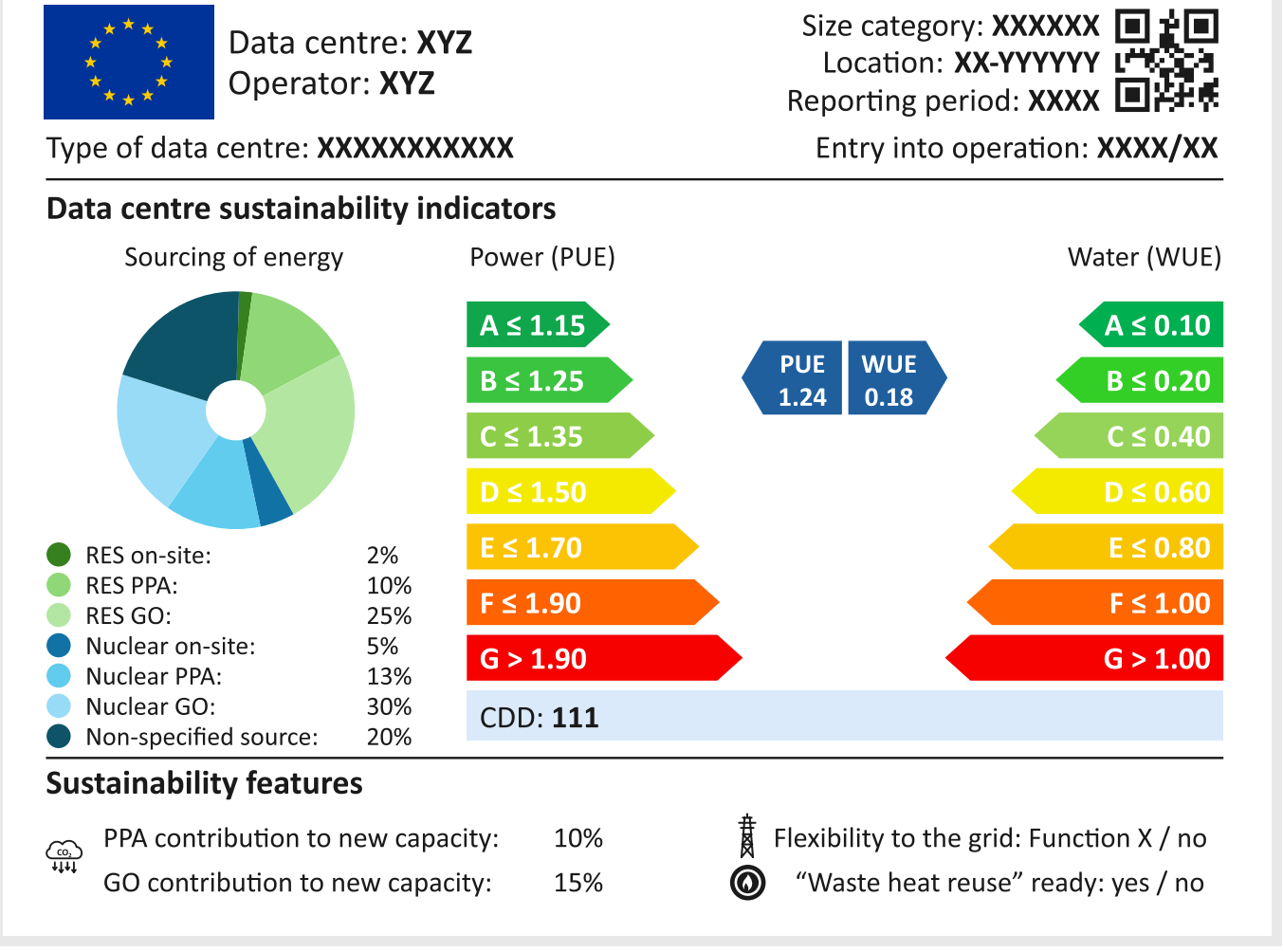
On 21 September 2026, the European Commission proposed a common EU rating scheme for data centres under the recast Energy Efficiency Directive. Every data centre with at least 500 kW of installed IT power would receive an electronic sustainability label. The Delegated Regulation establishing the common rating scheme is now subject to 2-month scrutiny period by the European Parliament and the Council before entering into force. The first sustainability labels for individual data centres are expected to be displayed in 2027. A first review of the scheme is foreseen by end-2028 to assess its effectiveness and possible improvements, if necessary. The European database on data centres generates the label automatically from the indicators operators already report. Labels would show energy and water efficiency, energy sources, contribution to grid flexibility and waste heat reuse. They would be issued every year from August 2027, once the Parliament and Council complete their two-month scrutiny. The Commission is also consulting, until 14 December 2026, on minimum performance standards for data centres. The data from the labels is likely to inform those standards.

Still, this rating scheme doesn't impose any penalisation to data centres, it is very different than those industries that are mandated by REDIII to consume a certain amount of RFNBOs otherwise they would have to pay penalties. This new rating scheme provides transparency and also plays an important role in the public image of data centres to prove they comply with certain sustainability criteria.

FIGURE 3

Proposed EU data centre sustainability label

Source: European Commission, Commission Delegated Regulation C(2026) 3472 final establishing a common Union rating scheme for data centres,



As it can be seen in the label, data centres have onsite RES and RES PPAs, in order to balance onsite generation. Clean molecules will help to provide long-term energy storage beyond batteries. Also, data centres will likely require a certain degree of temporal correlation, and clean molecules can also aid in meeting these temporal correlation criteria (to be defined once the delegated act is approved).

Futhermore, renewable hydrogen could count towards clean generation in the label instead of having non-abated onsite fossil fuels. However, further clarification on exactly how clean molecules would be accounted for by the label should be provided by the European Commission.

The scheme explicitly recognises demand flexibility. Hydrogen-fuelled backup power that can be dispatched for the grid, as Section 2 describes, can serve as an additional on-site asset that adds flexibility without adding emissions.

Hydrogen combustion avoids ETS payments and GHG emissions

Hydrogen combustion is zero-emission at the point of use, regardless of how it was produced. If the hydrogen is green (renewable electrolytic), the emissions saving is roughly 70 gCO_2/MJ of hydrogen used relative to the fossil fuel it displaces. Because point-of-use combustion emissions are zero no matter the colour, using any hydrogen will avoid paying ETS.

To be classified as low-carbon under EU rules, hydrogen must achieve at least a 70% greenhouse gas saving versus the fossil comparator, which translates to a threshold of roughly 3.38 $kgCO_2e/kgH_2$. This can be met either by electrolytic hydrogen using grid electricity (a mix of nuclear, renewables, and some residual fossil generation) or by blue hydrogen from natural gas reforming with a sufficiently high CO_2 capture rate.

A data centre could use grey hydrogen and still not pay any EU ETS carbon cost for it: the ETS counts only direct, point-of-use emissions, and those are zero for hydrogen combustion regardless of colour — the CO_2 associated with producing grey hydrogen has already been priced in (or exempted) at the producer level. In other words, even without access to green hydrogen, burning blue or grey hydrogen on-site would not itself trigger an ETS liability for the data centre. This is not, however, a free pass on lifecycle-emissions: on a full lifecycle basis, burning grey hydrogen is worse than simply burning natural gas, because production losses and upstream methane/CO_2 emissions outweigh the point-of-use benefit. Blue hydrogen only delivers partial lifecycle savings — roughly 30–60 gCO_2/MJ — depending on the capture efficiency of the CCS system used by the producer.

If a data centre wants the hydrogen it uses to count toward its renewable/low-carbon energy integration, it has two compliance routes: buy certified electrolytic low-carbon hydrogen (documented as electrolytic and meeting the 70% GHG-reduction threshold), or produce/convert the hydrogen on-site, in which case third-party certification is not required. Simply buying uncertified grey or blue hydrogen avoids an ETS bill but does not, on its own, support a renewable-integration claim.

Because the digital sector sits outside the EU's heavy-industry decarbonisation mandates but faces growing pressure to demonstrate credible clean-power sourcing (sharpened by the stalled sustainability label), data centres are in an unusually flexible position: rather than waiting for infrastructure and prices to mature on someone else's timeline, they can act as anchor offtakers that help finance new low-carbon electrolytic hydrogen projects directly.

The Renewable Energy Directive in its third revision sets binding quotas for renewable fuels of non-biological origin: 42% of the hydrogen used in industry by 2030, and a minimum 1% RFNBO share in transport fuels by 2030. Those obligations bind two groups - industrial consumers of hydrogen, and suppliers of transport fuels - and member states enforce them with financial penalties. The penalty levels adopted so far range from around €6/kg in Finland and Romania to close to €10/kg in Czechia.

The cost of meeting an RFNBO obligation is not driven by electrolysis. It is driven by Delegated Regulation (EU) 2023/1184, which requires additionality and temporal and geographic correlation between the electricity consumed and the renewable generation that produced it. Those rules are the main reason a renewable hydrogen project in Europe reports a levelised cost between €5.5 and €9.4/kg while conventional hydrogen sits near €2/kg. The premium is, in large part, the price of compliance.

In practice, certified electrolytic low-carbon hydrogen - meeting the 70% lifecycle GHG saving threshold, which permits grid electricity including nuclear, or natural gas with a high capture rate - delivers most of the **environmental benefit at a materially lower cost than RFNBO**. Hydrogen converted on the site where it is produced requires no certification at all.

The other side of the same coin

Because no penalty stands behind a data centre's commitment, there is no regulatory floor under its willingness to pay, so hydrogen producers and network operators are not considering future data centre demand in their planning and hydrogen auctions for booking capacities.

The ability to source certified low-carbon rather than RFNBO hydrogen is worth several euros per kilogram. On the Section 5 volumes, for a 100 MW facility in grid-interactive operation - roughly 5,300 tonnes a year - a €3/kg differential is of the order of €16 million a year.

TAKEAWAY

Data centres face no EU obligation to buy the most expensive hydrogen, and can become supporters of hydrogen production projects for electrolytic and blue low-carbon hydrogen.

Burning any hydrogen on site, grey, blue or green, creates no direct emissions and so no ETS liability. Only the lifecycle footprint differs: grey hydrogen is worse than natural gas, blue offers partial savings, and electrolytic hydrogen offers the most. Operators who want their hydrogen use to count as clean energy have two practical routes, that can be complementary to each other:

- buy certified low-carbon electrolytic hydrogen that meets the 70% GHG saving threshold, or
- produce the hydrogen on site, which needs no certification.

Both routes are materially cheaper than RFNBO. Data centres can also act as anchor offtakers for new low-carbon projects. That way they can lock in certified supply ahead of the wider market.





07 Flagship Projects and Industry Experience

7.1 Case: ENGIE

CASE STUDY

Infrastructure and System Integration for the Hydrogen Economy

Building the Infrastructure Behind a Scalable Hydrogen Market

While hydrogen production technologies are advancing, the successful deployment of hydrogen at scale depends on the development of robust infrastructure capable of producing, transporting, storing, and distributing hydrogen safely and economically. ENGIE is convinced that hydrogen will be a key element in the transition towards carbon neutrality. This is reflected notably in ENGIE's project portfolio, covering both renewable and low carbon hydrogen production projects and infrastructure initiatives at various stages of development (R&I, demonstration, and industrial scale) into existing and future energy systems.

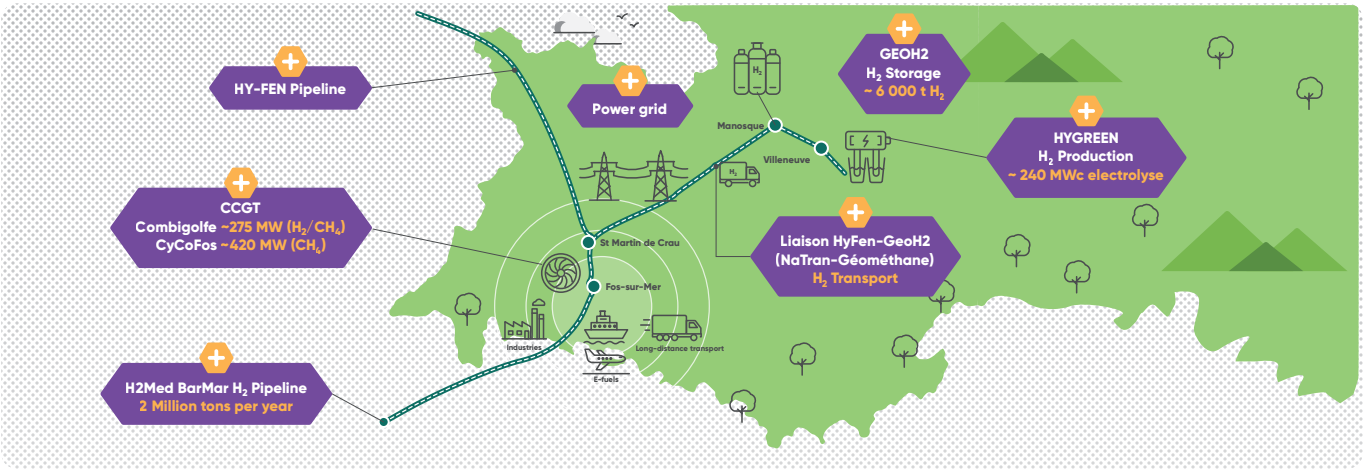
One of the most significant examples of demonstrator project, is HyPSTER (Hydrogen Pilot Storage for large Ecosystem Replication), which is Europe's first real-scale demonstration of underground hydrogen storage in a salt cavern under operational conditions. The project is designed to play a key structuring role in the hydrogen value chain. Its clear ambition is to test industrial-scale, replicable solutions across Europe. Through successful testing, HyPSTER helps establish the foundation for a European renewable hydrogen sector by delivering flexible, robust storage solutions—critical enablers of the energy transition.

HYFLEXPOWER, the world's first integrated power-to-hydrogen-to-power demonstrator using a gas turbine fueled with renewable hydrogen, produces hydrogen on-site with a 1 MW electrolyzer, stores nearly one tonne, and has demonstrated operation of an existing 12 MWe turbine on up to 100% hydrogen. This initiative shows how hydrogen can leverage existing energy infrastructure while creating new pathways for renewable energy integration.

ENGIE is also developing a major renewable hydrogen production and storage project in southern France: HyGreen. This initiative represents a complete industrial ecosystem designed to produce green hydrogen at scale through water electrolysis. With a target production capacity of 240 MW, the project aims to generate approximately 30,000 tonnes of renewable hydrogen annually, stored at large scale in underground salt caverns. The hydrogen produced will decarbonise the regional industrial and port zone while supporting heavy-duty mobility.

Through these projects, ENGIE is demonstrating that the future hydrogen economy is not only about producing clean molecules, but also about creating the interconnected infrastructure systems that enable hydrogen to move efficiently from production sites to end users. To ensure the existence of a strong H_2 ecosystem it is important to:

- Give a strong political signal in favor of greater simplicity, while ensuring a positive and stable regulatory framework and appropriate, long-term economic support across the entire H_2 value chain.
- Reach ambitious objectives for renewable and low carbon H_2
- Recognize H_2 as a key asset and a key player in flexibility.



7.2 Case: European Energy

CASE STUDY

Combining Power-to-X and Data Centres in One Energy Hub

Building a Net-Zero Digital Energy Hub Around Hydrogen at Kassø, Denmark

European Energy develops, builds, and operates renewable energy projects. Founded in 2004, the company holds a pipeline of more than 40 GW spanning wind, solar, BESS and Power-to-X. Its Kassø site in Denmark shows how these technologies can be planned together.

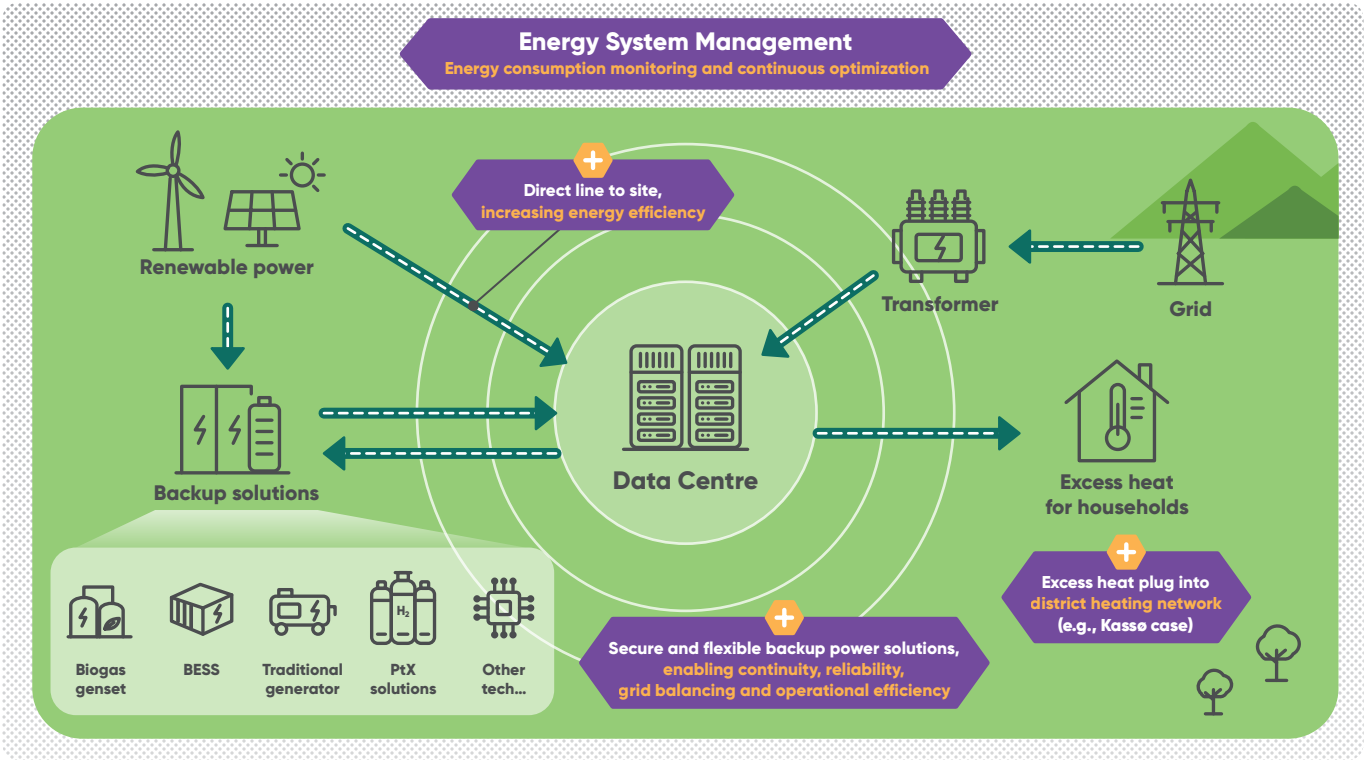
At the center of the Kassø site is the Power-to-X facility in Aabenraa, which turns renewable electricity into e-methanol. It runs on power from the company's own 304 MW solar farm, one of the largest PV parks in Northern Europe, supplemented by grid electricity backed by green certificates. A total of 52.5 MW of PEM electrolysers split water into hydrogen. A methanol reactor then combines the hydrogen with biogenic CO_2 from the ENVO biogas plant in Tønder.

Annual figures for the plant are about 360–380 GWh of electricity, 90,000 tons of water, and 45,000 tons of biogenic CO_2 in, and about 6,300 tons of hydrogen, 32,000 tons of clean methanol (nominal capacity 42,000 tons), and 50 GWh of excess heat out.

The plant couples several sectors. The electrolyser provides grid balancing services, excess heat feeds a district heating network serving about 3,300 households, and the e-methanol goes to shipping, road transport, and industry. Maersk, OMV, LEGO, and Novo Nordisk are among its e-methanol partners.

Building on this site, European Energy presents the Kassø cluster vision as a Net-Zero Digital Energy Hub serving several sections. Renewable generation connects through a private wire, and a thin connection to the public grid covers balancing. The hub combines a data centre, battery energy storage (BESS), Power-to-X, and heat offtake.

In the cluster concept, the existing substation, with import and export capacity of about 238 MW, serves the 76 MW Power-to-X plant, a 24 MW expansion, a 50–100 MW BESS, and a 100 MW data centre. Power-to-X solutions are one of the backup options for the data centre, alongside BESS, biogas gensets.







08 Conclusions & Takeaways

8 Conclusions & Takeaways

Conclusion

Hydrogen-fueled on-site power is moving from concept to proven technology. Generators are available for data centre duty at MW scale, including 100% hydrogen backup test that NZIH and INNIO completed in April 2026 on selected AI load profiles. The remaining barriers are infrastructure, policy, and cost, not generators technologies, which are available and currently in validation .

The strongest benefit of clean onsite power and back-up solutions is speed to power. Clean on-site generation can shorten the path to a grid connection, free up grid capacity, and give projects a stronger case with regulators and local communities, which also helps public acceptance of new data centres.

In the short term, backup and grid-interaction use cases are more achievable than prime power. Backup needs little hydrogen, and the constraints there are on-site storage and reliable delivery. In addition to near-site storage and pipelines, storage can also be addressed with clean molecules such as methanol, ammonia, and e-methane, which are easier to store and handle than gaseous hydrogen. In this report, "hydrogen" includes these molecules. Grid-interactive operation at 10–20% of load is large enough to matter to producers and to make a difference in grid connection time. It is the realistic centre of gravity for the next decade.

The overlay maps show attractive areas where Europe's hydrogen infrastructure and data centre development can be colocated, including around the FLAP-D hubs. Colocation of energy assets and data centres (Digital Energy Hubs) can be affordable for deployment at scale, and data centres' freedom from RED III quotas gives them room to choose the most cost-effective low-carbon hydrogen route. These sites should now be the focus of detailed technical and economic evaluation. Turning them into projects will depend on joint planning, positive economic cases, and firm, bankable offtake commitments.



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Section 2 — Introduction and context

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Our own extrapolation, flagged in the text: the EU27 fleet reaching roughly 30 GW in the early 2030s applies the Cloud and AI Development Act's tripling ambition to the 9.9 GW EU27 base reported by ENTSO-E.

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Section 3.3 — At what price

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Natural gas-based hydrogen remained significantly cheaper than renewable hydrogen in 2024-2025, even when combined with carbon capture and storage (CCS), although recent rising gas prices narrowed the gap, reducing the gap to €1/kg on average and bringing some regions close to cost parity. Renewable hydrogen (direct connection) competitiveness improved in 2025, driven by declining electrolyser CAPEX and lower renewable electricity costs, with production costs in the best locations falling to around €3.9/kg.

Section 5 — Off-take sizing by use case

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