LCPDelta

# *Hydrogen Intelligence Service*

# About LCP Delta

## Our mission is to enable a better, faster energy transition for all

Founded in 2004 and based across the UK, France, Norway, the Netherlands and beyond, LCP Delta provide data-driven research, consultancy, technology products and training services to companies investing in and navigating the energy transition.

We are a diverse team from a variety of backgrounds including engineers, data analysts, environmentalists and more.

LCP Delta is a mission driven organisation - all of us want to make a difference to the energy transition and accelerate the path to a low carbon future.

The energy market is becoming increasingly complex. As consumers become more empowered and as energy systems around the world decarbonise, there is a need to understand both the generation and demand side to effectively navigate the rapid changes occurring.

*We know it's a complicated topic, and we're here to help.*

**Andy Bradly, Partner, LCP Delta**

LCP Delta was formed through the merger of Delta-EE and LCP Energy to bring together deep generation and consumer-side expertise, to provide our clients with a single partner to help them on their journey and provide them with a 360° view across the energy spectrum.

*Andy Bradley*
*Partner*
andy.bradley@lcp.com

*Jon Slowe*
*Partner*
jon.slowe@lcp.com

**200+**
**Global clients**

**6**
**offices**

**110+**
**Colleagues**

# *LCP Delta provides the best advice, support and tools to enable the energy sector to drive the energy transition*

## Subscription research services

Our portfolio of subscription research services offer in-depth insights across the energy transition landscape. We have been undertaking primary research with organisations active in the energy transition since 2004 – we have an unparalleled international network of contacts we can draw on. Each service focuses on a particular aspect of the energy transition.

## Market and strategic advisory consulting

We provide support across the full energy value chain with bespoke research, insight, forecasts and advice tailored to them. Our consultancy offerings draws on expertise and data from across LCP Delta, from strategic market entry analysis through to detailed half-hourly revenue forecasting.

**We support our clients in four ways**

## Technology & data

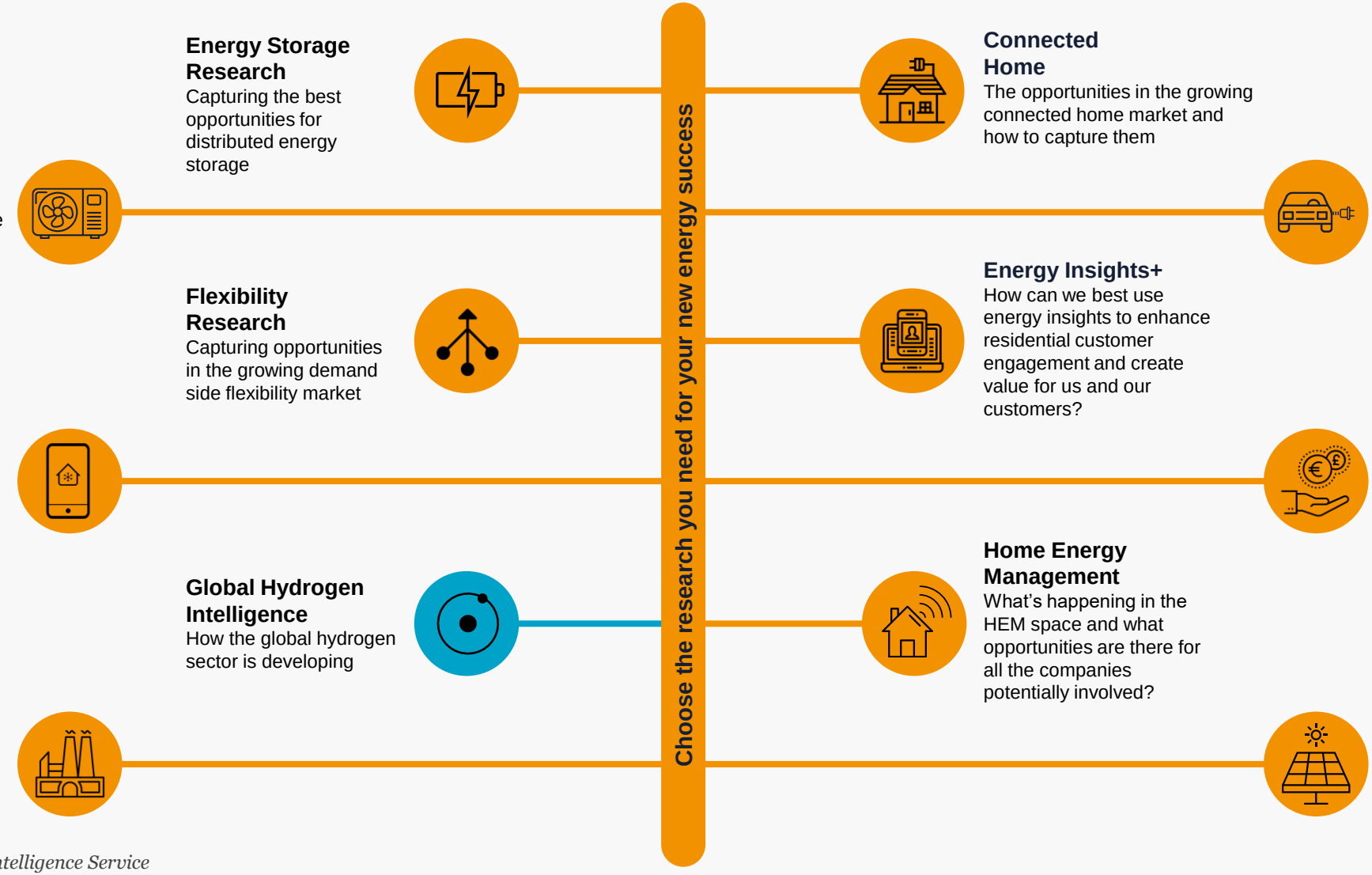
Data integration and analysis is at the heart of the energy transition. However, sourcing and navigating complex, wide-ranging datasets is challenging. At LCP Delta, we combine and curate proprietary and public datasets to provide you with a single source of truth across the energy spectrum and make this data interactive using our cutting-edge technology.

## Training

Our training helps professionals quickly develop their new energy knowledge, accelerating their impact for organisations who want to capture opportunities. We provide meaningful, concise and easy to understand short courses.

# Subscription Research Services

Use a combination of our subscription research services, bespoke consultancy projects and training services to gather the information you need to ensure your business's success in the energy transition.




**Energy Storage Research**
Capturing the best opportunities for distributed energy storage

**Decarbonisation of Heat**
Gain a holistic understanding of the future of the heating sector from a product and policy point-of-view

**Flexibility Research**
Capturing opportunities in the growing demand side flexibility market

**Heating Business**
How to evolve from selling individual products and commodities to become a successful home energy solution provider

**Global Hydrogen Intelligence**
How the global hydrogen sector is developing

**Distributed Power**
How to succeed in the global distributed power market

**Connected Home**
The opportunities in the growing connected home market and how to capture them

**EV Charging**
How to best develop position and activities to succeed in the rapidly growing eMobility market

**Energy Insights+**
How can we best use energy insights to enhance residential customer engagement and create value for us and our customers?

**New Energy Business Model**
Understand, identify and implement the most promising commercial opportunities from the increasing disruption in the energy sector

**Home Energy Management**
What's happening in the HEM space and what opportunities are there for all the companies potentially involved?

**Solar PV**
Understanding the growth of solar PV across Europe

# LCP Delta Hydrogen

*Support for companies to* ***understand****, develop* ***strategy and tactics*** *for, and* ***invest*** *in emerging* ***hydrogen markets*** *in Europe and beyond*

LCP powering possibility

| ***Knowledge and capability building*** | ***Market insight, analysis, and evaluation*** | ***Strategy development*** | ***Market and asset design and forecasting*** |
|---|---|---|---|
| ***Training*** | ***Hydrogen Insight Service*** | ***Bespoke consulting and modelling support*** | |
| | ***HYbase*** | | |
| Hydrogen fundamentals | Subscription research | Strategic insights | |
| Energy market training for the hydrogen sector | Market data and visualisation | Power market analysis, hydrogen cluster modelling, and asset sizing and optimisation | |
| | | Investment decision support | |

*Clients we support*

- ***Govt, Regulators & System Operators***
- ***Oil & Gas Sector***
- ***Utilities***
- ***Energy Networks***
- ***Investors***

# *Hydrogen has become a headliner in the energy transition*

Why is this? Will this last?

## Why has hydrogen become a headliner in the energy transition debate?

| | |
|---|---|
| **Net zero is now the ambition** | This is not possible without hydrogen |
| **Electrification creates network and system operation challenges** | Clean hydrogen can smooth out some of the peaks and troughs in energy networks |
| **Commercial viability** | Falling costs of renewable electricity and electrolysers will combine with new incentives to improve competitiveness |
| **Vested interest** | The only way the gas industry can play a significant long-term role in a net zero future |

## Why will hydrogen continue to play an important role in the energy transition?

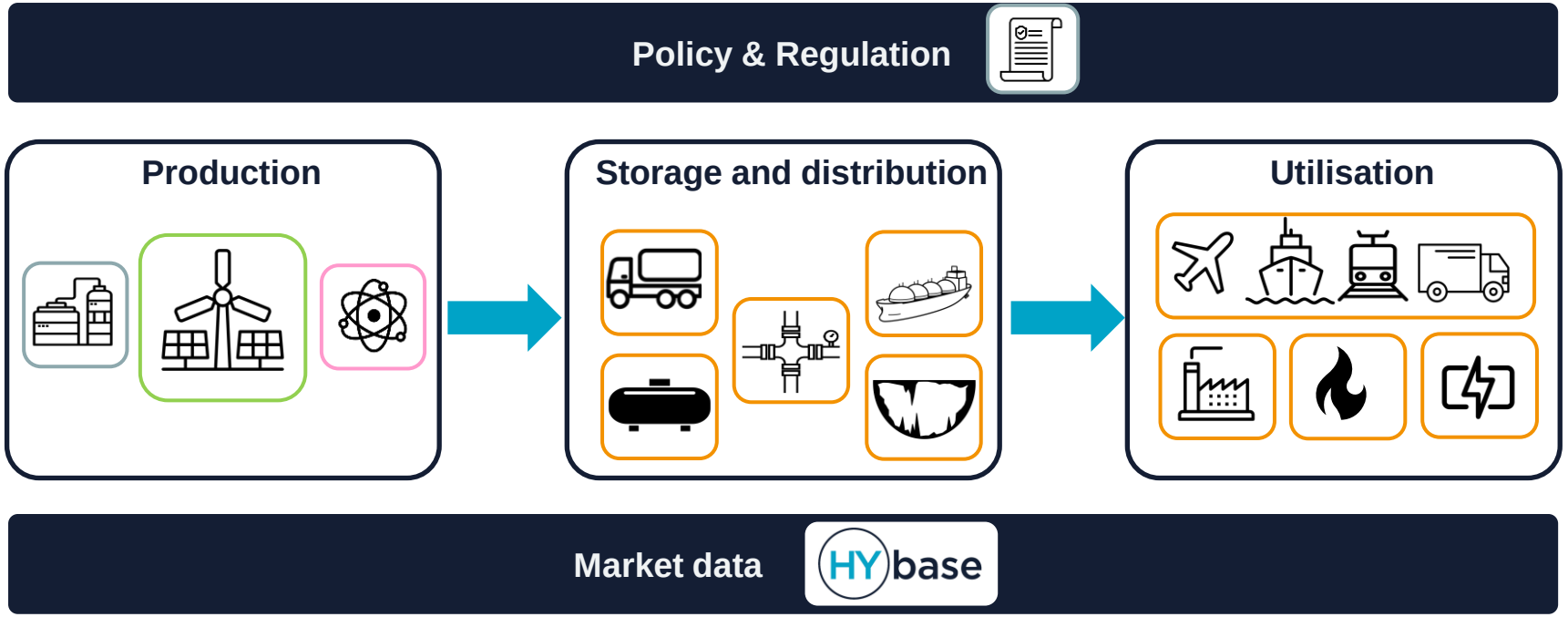
| | |
|---|---|
| **Important role to play** | There are no good alternatives to using clean hydrogen in steel, petrochemical refining, fertiliser manufacturing shipping and aviation |
| **Hydrogen or electrification?** | There is huge uncertainty as to where direct electrification is feasible and desirable – and where hydrogen is a better answer than electrification |

**This is the battlefield which will determine the future role for hydrogen.**

# *We cover the full clean hydrogen value chain*

From production through distribution storage and end-use

**Focussing on green hydrogen, we help you to understand where and when demand for clean hydrogen will develop and identify how value chains will be established.**

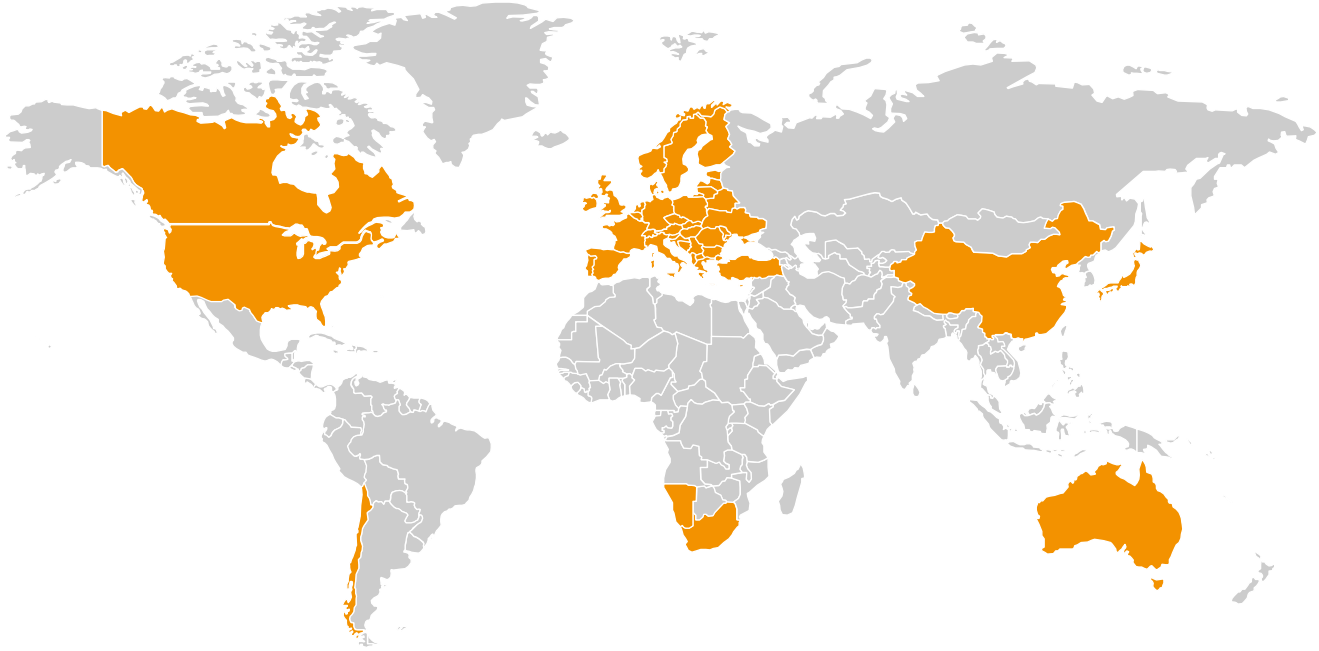


# *Understand the key markets for green hydrogen*

We offer realistic, no-hype analyses and views on the whole of the developing clean hydrogen value chain in Europe and across key global markets.

## We cover Europe and other key global markets in our research

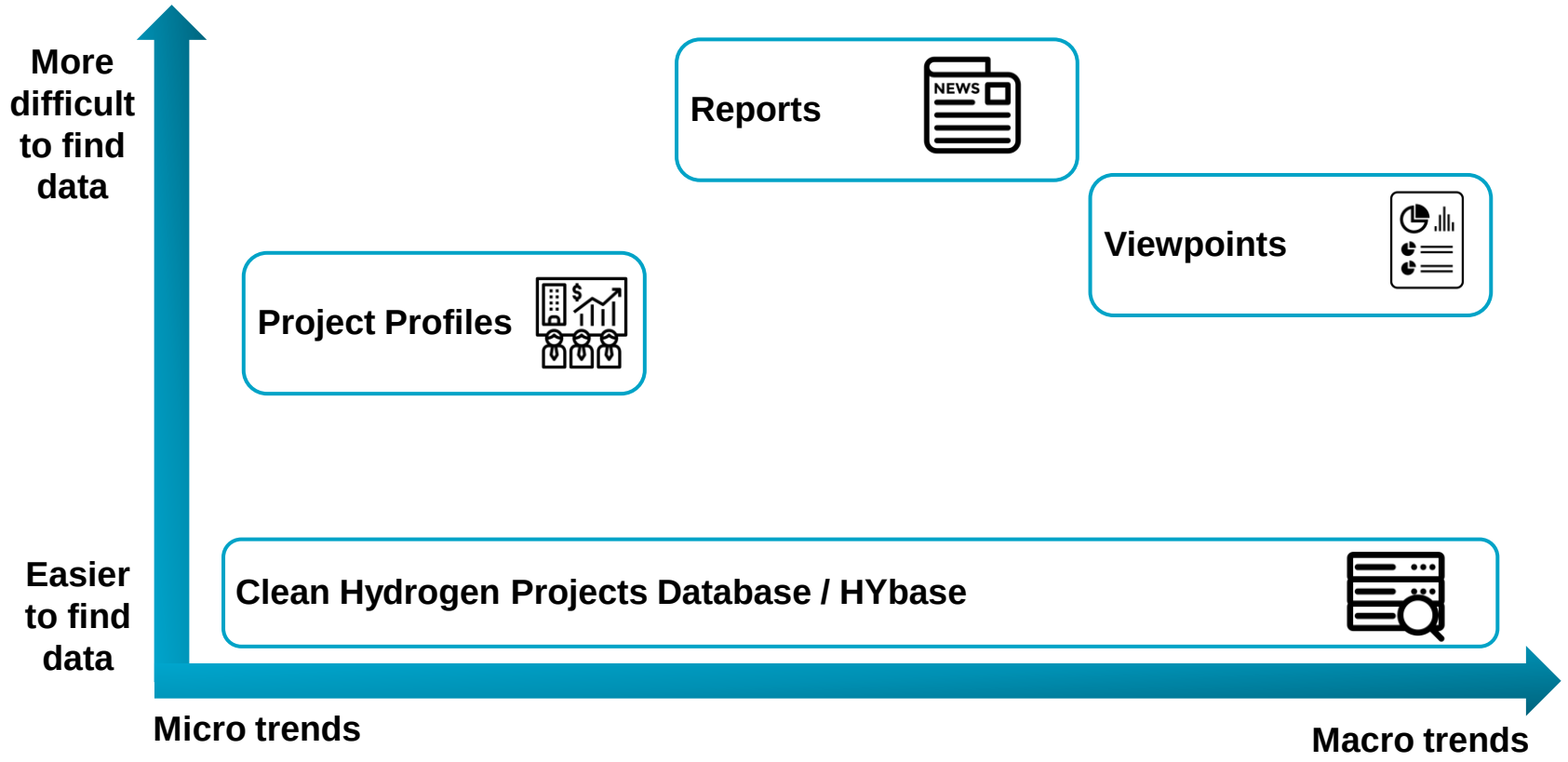
- Understanding and providing depth of knowledge on the demand side of clean hydrogen.
- Providing expertise in market activity around green hydrogen solutions – not just electrolysis.
- We bring clarity to policy and regulatory developments helping you to understand the incentives at play.



# *Data and reports offer breadth and depth of research*

Our projects database underpins our qualitative reports

**Offering breadth of knowledge through our Clean Hydrogen Projects Database, as well as depth on specific topics through viewpoints, reports and profiles.**



# *Immediate access to existing content*

January 2024

LCPDelta

### Levelised Cost of Hydrogen Calculator

Excel model to breakdown hydrogen project cost components with built in multi-year forecast

### National Hydrogen Strategies

Global H2 strategy tracker, with review and summary of H2 policy ambitions. Recurring update.

### Project Profiles

Detailed take-aways from strategic hydrogen projects across the globe, unpicking project investment, stakeholder involvement and key learning for next of a kind projects.

>20 profiles live

### European Green H2 project database

HYbase

Portal includes over 800 up to date projects, with in-depth information on a project level basis to support business development roles (including details on stakeholders, planning stage, and investment).

The tool also provides market trends based on the announced project pipeline, including an offtaker analysis.

## Reports & Viewpoints

**H2 Production**

- The EU Electrolyser Market: What now and what next?
- How will electrolysers secure their green power?

**Storage & Distribution**

- Hydrogen Blending in Natural Gas Networks - How will a market develop?
- How are gas DSOs influencing the transition from natural gas to hydrogen in networks?
- Hydrogen long-duration energy storage: how much capacity will there be across Europe by 2030, and will this be enough?

**Understanding Offtakers**

- Clean Hydrogen Demand in Industry – Fundamentals & Outlook to 2030
- Clean Hydrogen for Power Generation
- Will hydrogen trucks scale in Europe, and to what degree by 2030?
- Near-term opportunities for hydrogen in aviation

**Unlocking Investment**

- What is driving developers of green hydrogen projects?
- What support mechanisms are emerging for hydrogen, and what will their impact be?
- Hydrogen market development: new players on the block

# *How our research helps your business*

The service allows you to make the best-informed decisions by providing data, analysis, insights and realism on how the global clean hydrogen sector is developing.

## Benefits

- Cuts through the hype around hydrogen to give a realistic view of the sector
- A user-friendly, intuitive way to find out who is doing what, where how and why
- A reliable source of up-to-date information on developments in clean hydrogen
- Deep dives into demand for hydrogen across key applications, exploring economics and business cases
- Learn from projects, both existing and planned
- Insights into key aspects of the hydrogen value chain

## Example clients

- Energy suppliers
- Oil majors
- Gas network companies
- Policymakers
- TSOs
- DSOs
- Equipment OEMs

> *LCP Delta provides us with ongoing, first-class insight and advice to support our low carbon investment activities.*
>
> **Leading Investment Company**

# *Research Highlights*

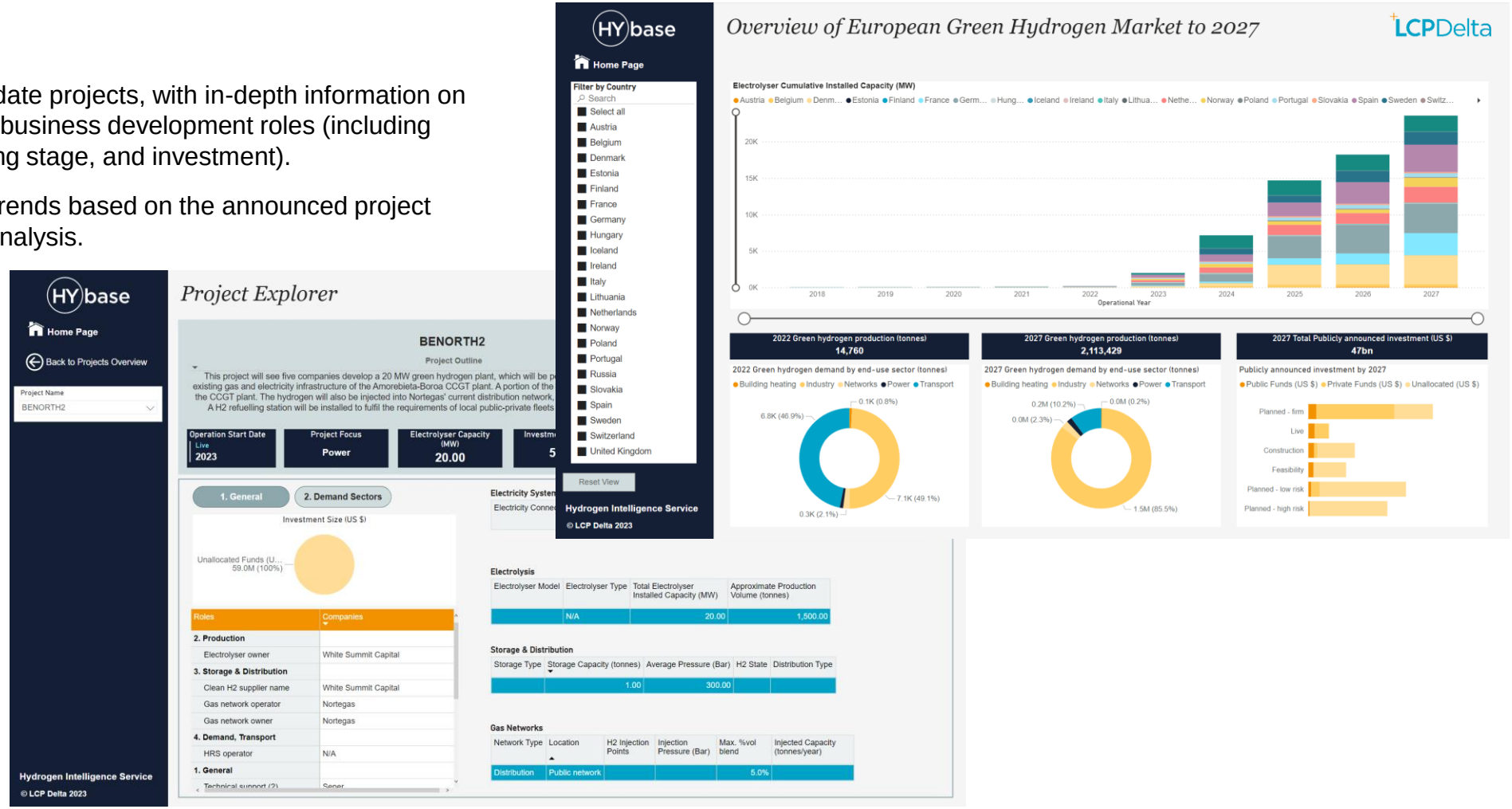
# *HYbase: European Green Hydrogen projects database*

Published January 2024 (Quarterly updates)

## Synopsis

Portal includes over 800 up to date projects, with in-depth information on a project level basis to support business development roles (including details on stakeholders, planning stage, and investment).

The tool also provides market trends based on the announced project pipeline, including an offtaker analysis.



# *Green Hydrogen Market Report*

Published April 2023 (annual updates)

## Synopsis

This report explores the current and future electrolysis market across Europe, analysing data from our HYbase database of electrolyser projects, focusing on the 'new wave' of clean hydrogen project activity. It covers the current picture from 2011 through to the end of 2022 and looks forward to 2027. The report:

- Summarises how the electrolyser market has changed in 2022
- Identifies the electrolysis capacity pipeline in Europe to 2027, highlighting the leading markets where projects will emerge
- Provides insights into the electrolyser manufacturers supplying the market and the public funding awarded for projects
- Analyses the green hydrogen demand by end-use sector to provide an understanding of what is driving clean hydrogen demand

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What has changed in the market over the last 12 months?

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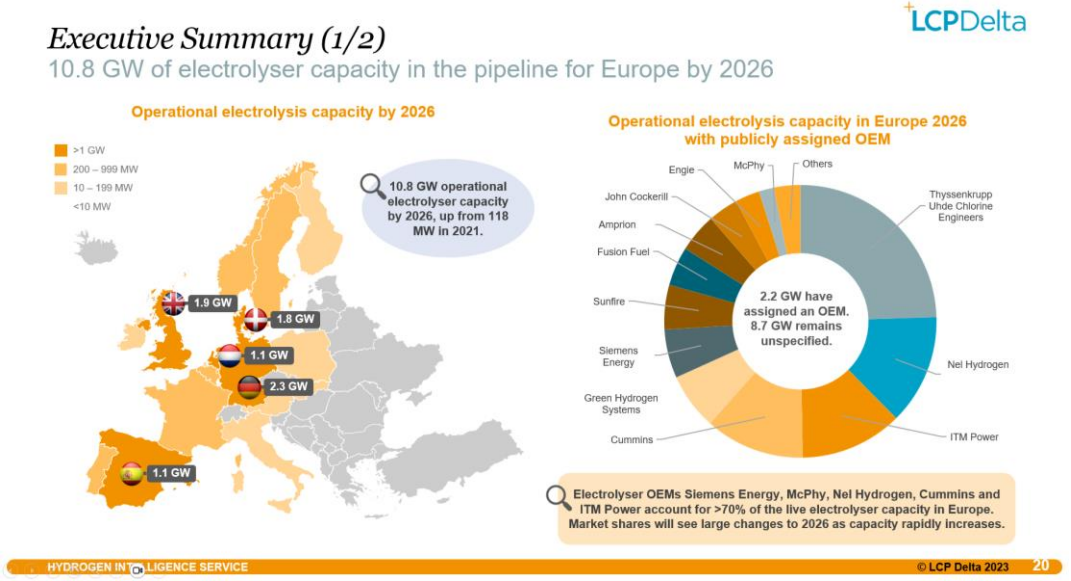
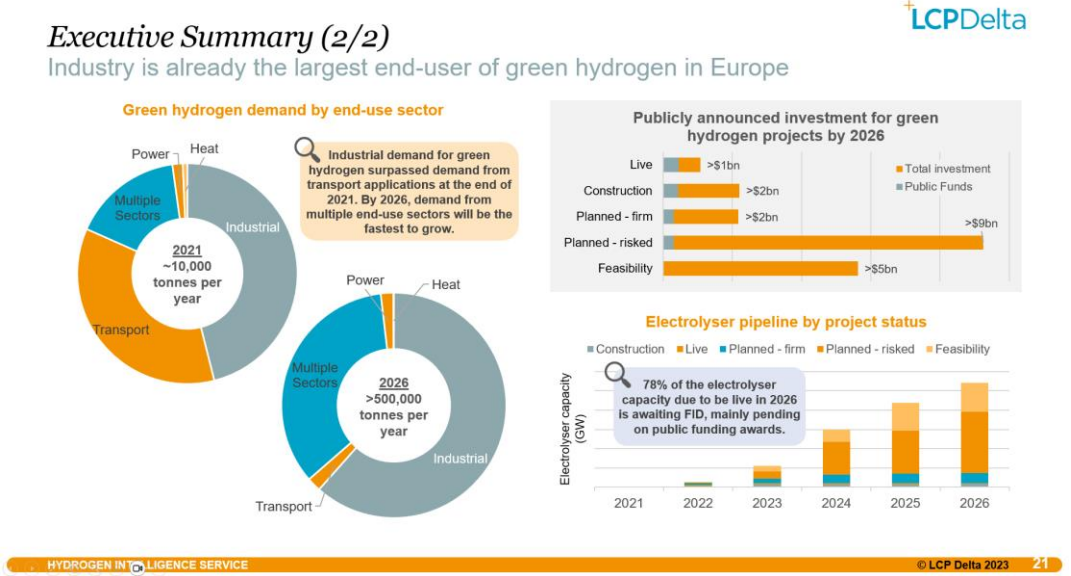
HYbase platform includes live and interactive data on green hydrogen projects across Europe.
Access HYbase here.



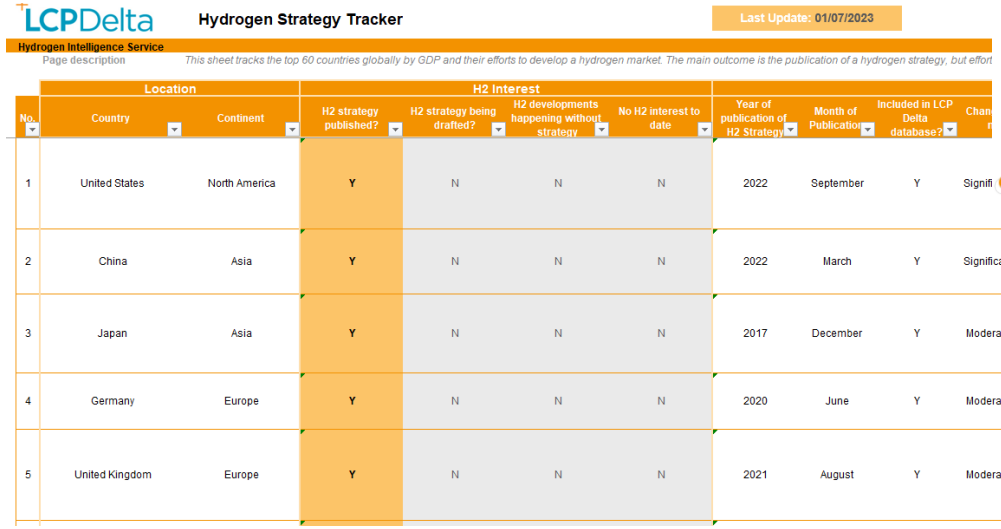



# *National Hydrogen Strategies*

Published July 2023 (quarterly updates)

## Synopsis

The National Hydrogen Strategies Viewpoint should be read in conjunction with its Excel database. The database provides specific insights into the strategy details by value chain stage along with information on available subsidies and funding. This viewpoint aims to highlight and compare the focus of each national strategy reviewed and provides LCP Delta's view on what is unique (and therefore could mark a difference) about each country's plan.



LCPDelta Hydrogen Strategy Tracker

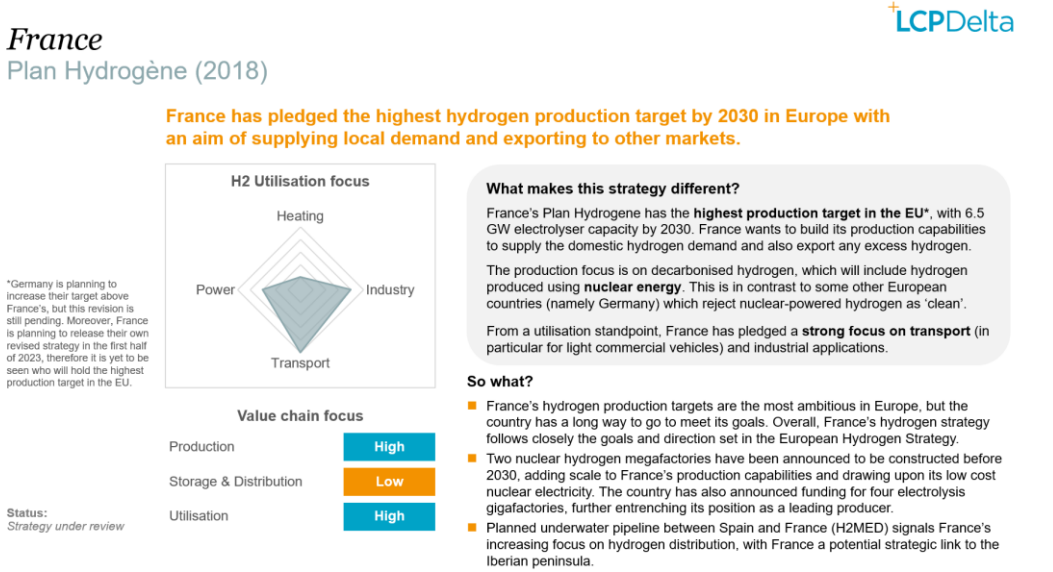
Last Update: 01/07/2023

Hydrogen Intelligence Service

Page description: This sheet tracks the top 60 countries globally by GDP and their efforts to develop a hydrogen market. The main outcome is the publication of a hydrogen strategy, but effort

| No. | Location: Country | Location: Continent | H2 Interest: H2 strategy published? | H2 strategy being drafted? | H2 developments happening without strategy | No H2 interest to date | Year of publication of H2 Strategy | Month of Publication | Included in LCP Delta database? | Chan |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | United States | North America | Y | N | N | N | 2022 | September | Y | Signifi |
| 2 | China | Asia | Y | N | N | N | 2022 | March | Y | Significant increase |
| 3 | Japan | Asia | Y | N | N | N | 2017 | December | Y | Moderate increase |
| 4 | Germany | Europe | Y | N | N | N | 2020 | June | Y | Moderate increase |
| 5 | United Kingdom | Europe | Y | N | N | N | 2021 | August | Y | Moderate increase |

| | | |
|---|---|---|
| 1 | US. The US Inflation Reduction Act (IRA) has raised the national ambition by offering an uncapped tax credit scheme and clarifying the emissions threshold for hydrogen production. | |
| 2 | (Strategy published) China has published its Hydrogen Industry Development Plan (2021-2025). The plan includes a phased approach to building a domestic hydrogen industry and asserting leadership in tech and manufacturing. Hydrogen is also mentioned as a key energy vector in China's 14th Five Year Plan. Progress remains highly segmented by geographical clusters, with major companies clustering in Beijing, Shanghai, Guangdong, Jiangsu, Shandong | https://www.csis.org/analysis/china-unveil; China maps |
| 3 | (Strategy revised) Japan was the first country in the world to formulate a national hydrogen strategy in 2017. However, Japan's hydrogen roadmap has been criticized for prioritising low-priority applications, grey and blue hydrogen, and for lacking a focus on domestic green hydrogen production. Consequently, it was revised in June 2023. The revision includes a subsidy scheme for the clean hydrogen supply chain based on carbon intensity, and targets for investment in the sector over the next 15 years. | https://fuelcellsworks.com/news/a-look-at; https://www. |
| 4 | (Revising existing strategy - pending publication) Germany announced it will review its H2 strategy in 2022, looking to double its production targets, implement IPCEIs quicker, push additional subsidy schemes, and introduce a Carbon CfD framework. Revised strategy is due to be adopted in the first half of 2023. | https://www.bmwi.de/Redaktion/EN/Publikationen/Energ |
| 5 | (Strategy revised - targets increased) The UK Hydrogen Strategy was first published in 2021, and has since been accompanied by two "Hydrogen Strategy Updates to the Market" in July and December 2022. The UK doubled its production target to 10GW of low carbon hydrogen production capacity by 2030 (from an original 5GW) in the British Energy Security Strategy (April 2022). The UK's Hydrogen Business Model was released in December 2022 which will provide revenue support for hydrogen producers to overcome operating cost gap between low-carbon hydrogen and high carbon fuels. | https://assets.publishing.service.gov.uk/government/up |



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*France*

Plan Hydrogène (2018)

**France has pledged the highest hydrogen production target by 2030 in Europe with an aim of supplying local demand and exporting to other markets.**

H2 Utilisation focus




*Germany is planning to increase their target above France's, but this revision is still pending. Moreover, France is planning to release their own revised strategy in the first half of 2023, therefore it is yet to be seen who will hold the highest production target in the EU.

Value chain focus

| | |
|---|---|
| Production | High |
| Storage & Distribution | Low |
| Utilisation | High |

Status: *Strategy under review*

**What makes this strategy different?**

France's Plan Hydrogene has the **highest production target in the EU***, with 6.5 GW electrolyser capacity by 2030. France wants to build its production capabilities to supply the domestic hydrogen demand and also export any excess hydrogen.

The production focus is on decarbonised hydrogen, which will include hydrogen produced using **nuclear energy**. This is in contrast to some other European countries (namely Germany) which reject nuclear-powered hydrogen as 'clean'.

From a utilisation standpoint, France has pledged a **strong focus on transport** (in particular for light commercial vehicles) and industrial applications.

**So what?**

- France's hydrogen production targets are the most ambitious in Europe, but the country has a long way to go to meet its goals. Overall, France's hydrogen strategy follows closely the goals and direction set in the European Hydrogen Strategy.
- Two nuclear hydrogen megafactories have been announced to be constructed before 2030, adding scale to France's production capabilities and drawing upon its low cost nuclear electricity. The country has also announced funding for four electrolysis gigafactories, further entrenching its position as a leading producer.
- Planned underwater pipeline between Spain and France (H2MED) signals France's increasing focus on hydrogen distribution, with France a potential strategic link to the Iberian peninsula.

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# *Hydrogen long-duration energy storage*

Published September 2023

## Synopsis


Hydrogen storage is key to realising an integrated energy system in Europe. Although operational H2 storage projects today are limited, 8 TWh of hydrogen storage projects are planned across Europe out to 2030.

Planned storage capacity would only provide storage for 1% of expected hydrogen availability (under set targets). This would not be enough volumes to meet peak demand. More notably, flexibility requirements of storage sites are likely to fall short, and multiple well developments per site should be considered to maximise injection and withdrawal rates.

Large risks such as demand, price and regulator risks remain unaddressed, hindering project development. Initial commercial arrangements are starting to be drafted; however, the UK and Europe are taking significantly different approaches.


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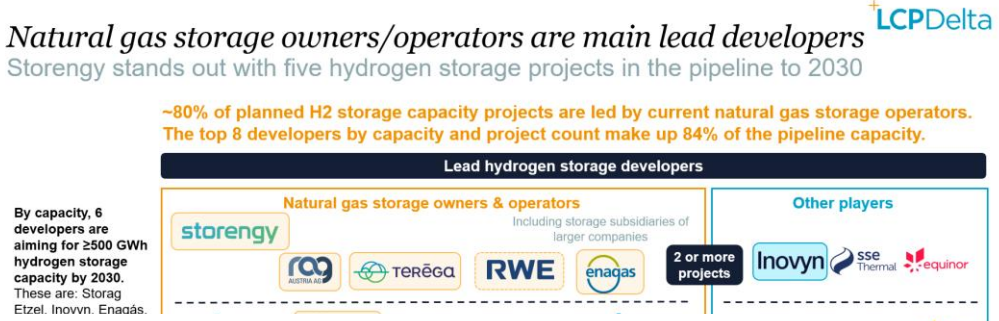


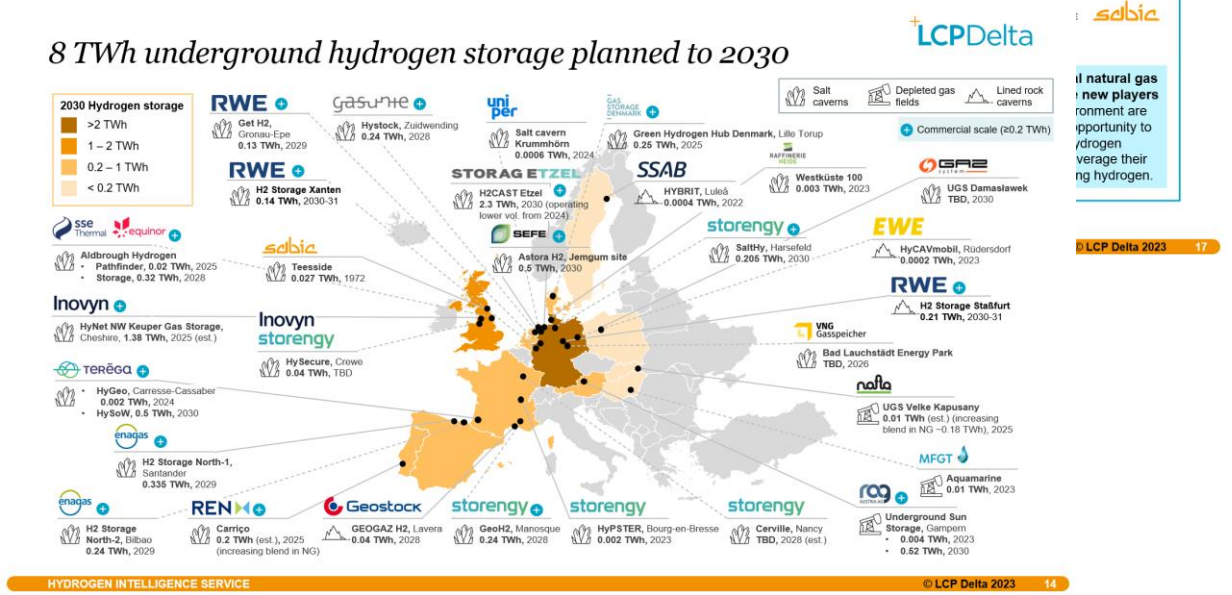

# *How are gas DSOs preparing for hydrogen?*

Published June 2023

## Synopsis

As the clean hydrogen market grows, projects will move from collocating production near demand centres to transporting hydrogen through networks. The regulatory framework to support these networks is only starting to be defined in some markets, and gas DSOs have a key role in shaping these. This report explores:

- What different strategies gas DSOs are following to decarbonise their networks, and their approach to hydrogen
- How hydrogen network projects are supporting emerging regulation
- What regulation exists for hydrogen networks today, and how these compare
- Which markets have the best conditions for hydrogen networks to develop

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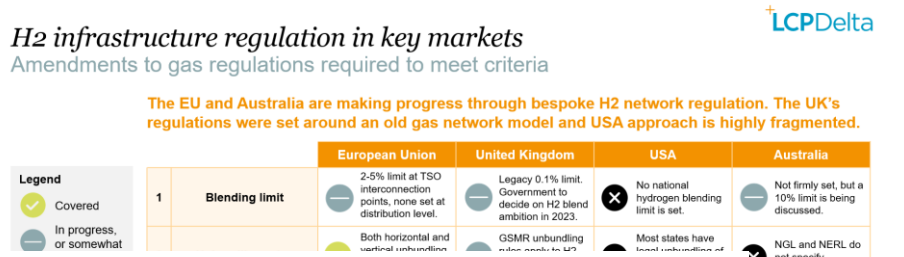


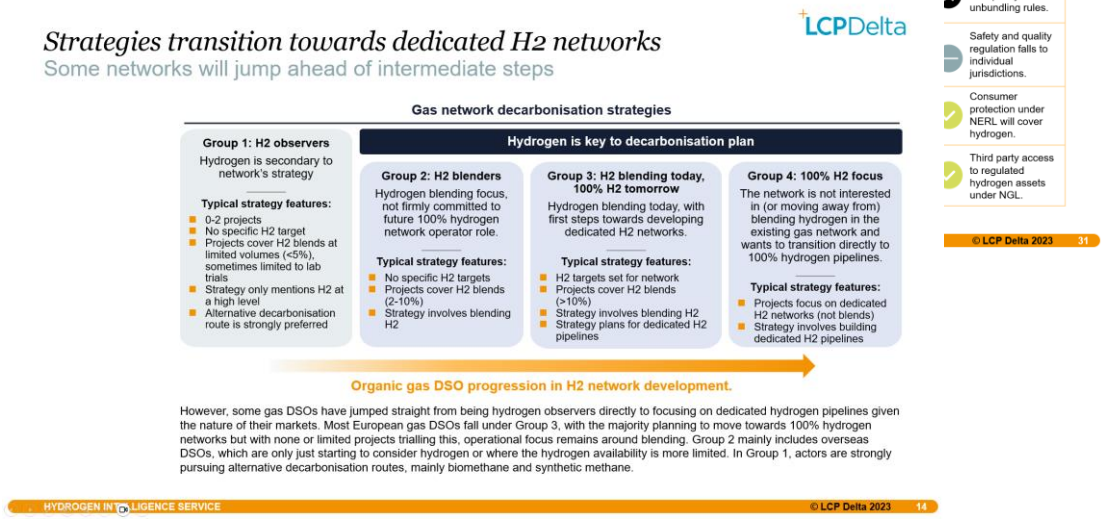

# *Will Hydrogen trucks scale in Europe by 2030?*

Published March 2023

## Synopsis

Fuel cell electric trucks are emerging as an alternative to decarbonise heavy-duty vehicles which account for 6% of total greenhouse gas emissions in the EU. LCP Delta forecasts there will be ~32,000 hydrogen fuel cell electric rucks on European roads by 2030.

The major challenges this decade will be increasing the limited availability of FCEV trucks commercially available, scaling up the refuelling network and improving the investment case for fleet operators to invest in the technology. This report addresses how the market is progressing against these roadblocks and the expected deployment of FCEV trucks in Europe.

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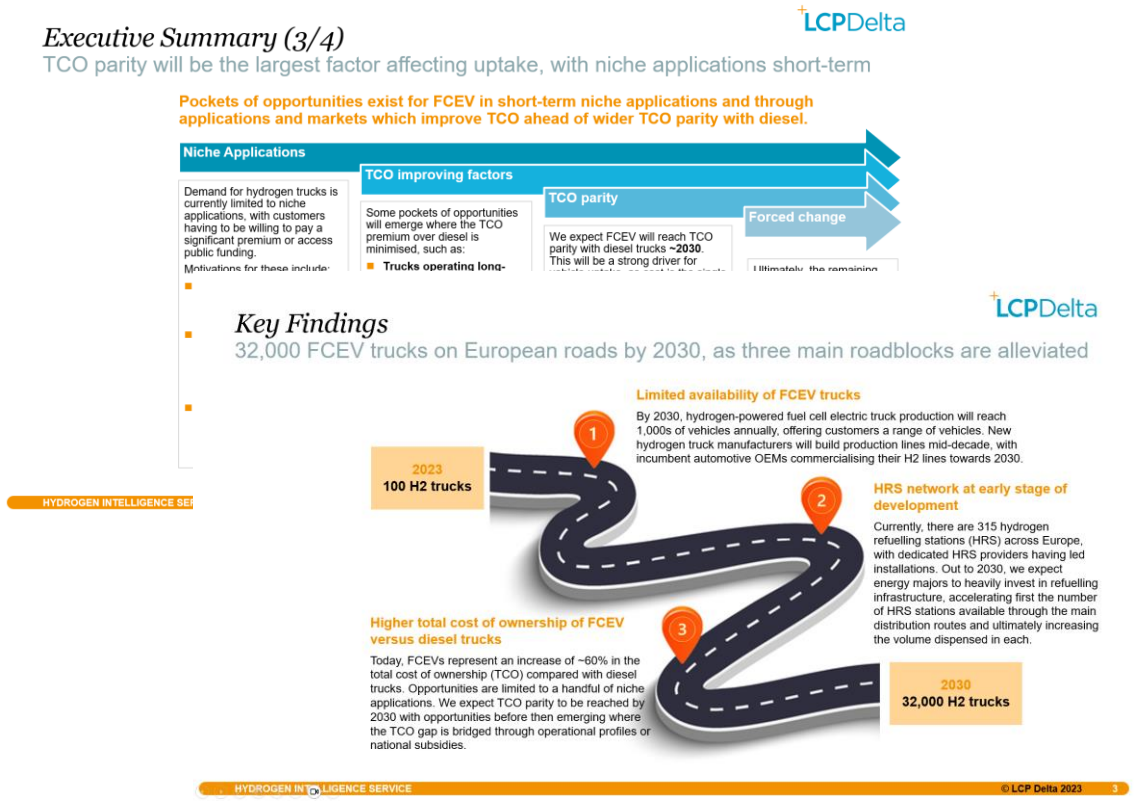

# *Clean H2 demand in Industry: Outlook to 2030*

Published July 2022

## Synopsis

The industrial sector has seen increasing attention as the primary sector for the application of clean hydrogen across Europe. The difficulty in decarbonising the industrial sector coupled with the widespread, large-scale use of hydrogen in refining and chemicals production means many of the most ambitious green and blue hydrogen projects are targeting these industrial applications.

This report identifies the industrial sectors and countries which have the best conditions for generating demand for clean hydrogen across existing sectors using grey hydrogen today, as well as emerging sectors where clean hydrogen can play a new role in decarbonisation. It also provides forecasts for clean hydrogen demand across six countries and nine sectors.

DELTA-EE

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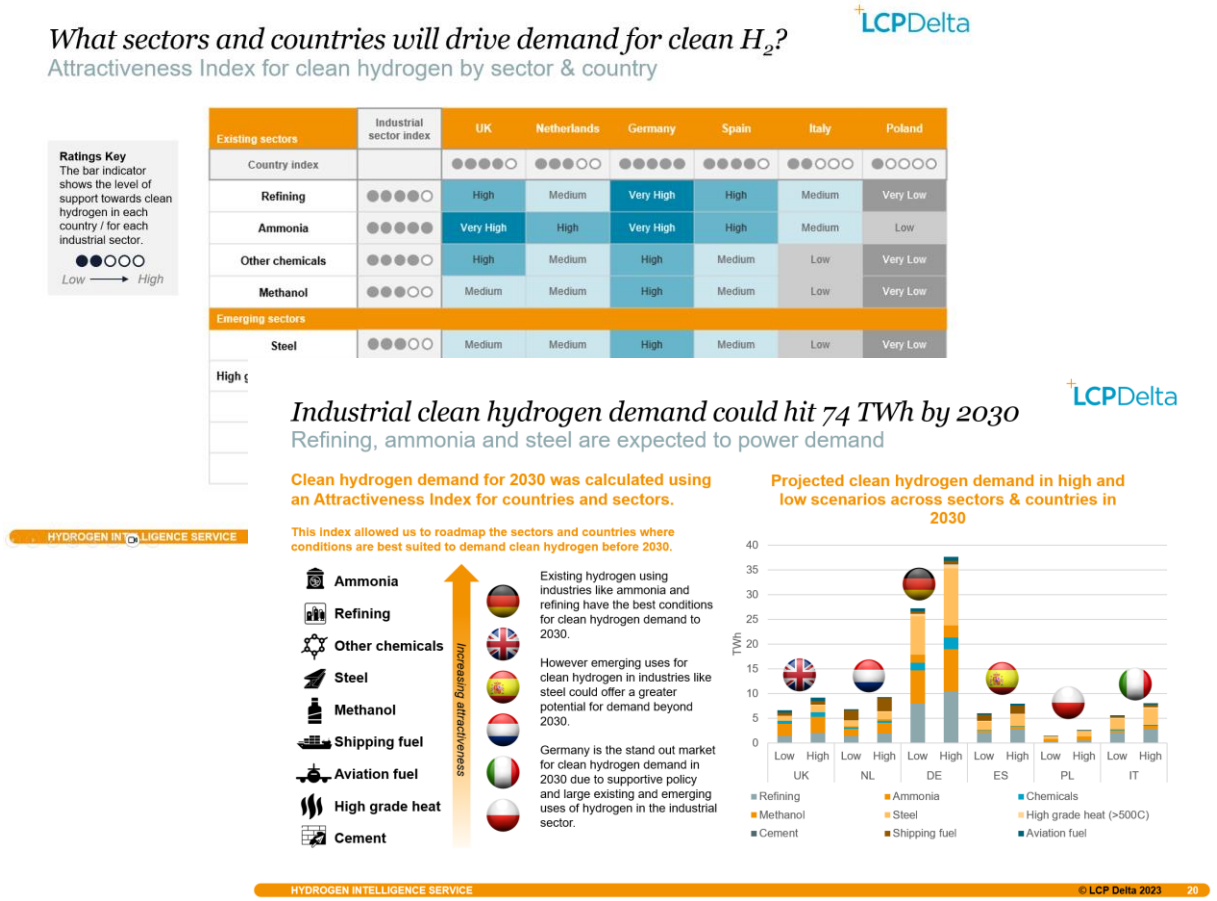
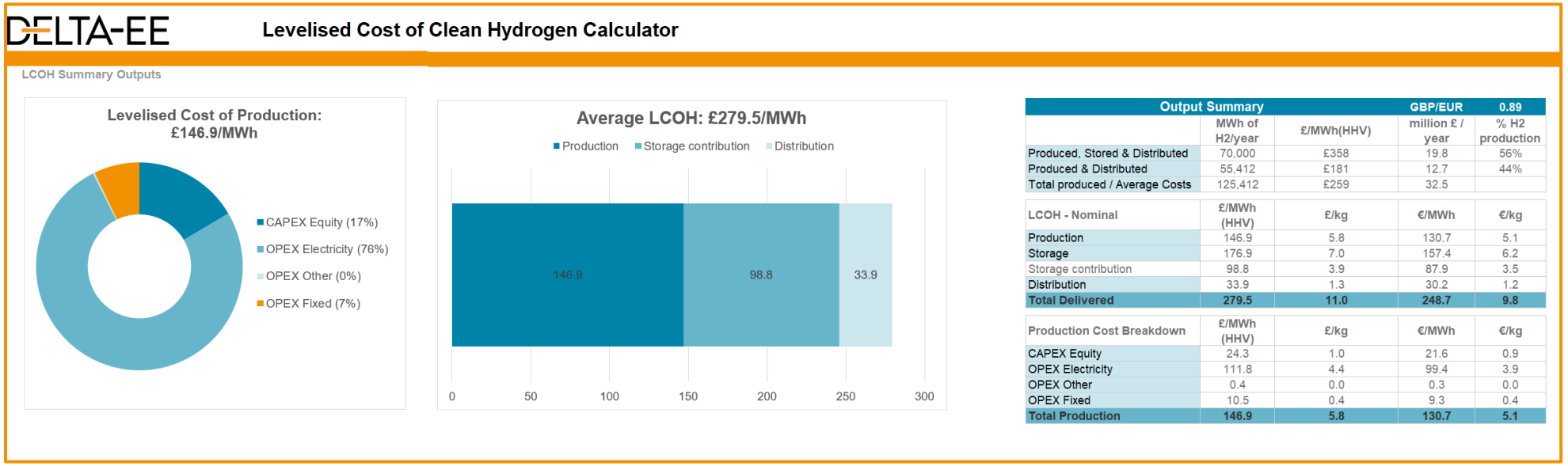


# *Levelised cost of hydrogen (LCOH) calculator tool*

Published April 2022

## Synopsis

This Excel calculator is designed to be a flexible tool for estimating an average delivered LCOH, including production, storage and distribution costs based on the user's input parameters.




| Output Summary | | | GBP/EUR | 0.89 |
|---|---|---|---|---|
| | MWh of H2/year | £/MWh(HHV) | million £ / year | % H2 production |
| Produced, Stored & Distributed | 70,000 | £358 | 19.8 | 56% |
| Produced & Distributed | 55,412 | £181 | 12.7 | 44% |
| Total produced / Average Costs | 125,412 | £259 | 32.5 | |

| LCOH - Nominal | £/MWh (HHV) | £/kg | €/MWh | €/kg |
|---|---|---|---|---|
| Production | 146.9 | 5.8 | 130.7 | 5.1 |
| Storage | 176.9 | 7.0 | 157.4 | 6.2 |
| Storage contribution | 98.8 | 3.9 | 87.9 | 3.5 |
| Distribution | 33.9 | 1.3 | 30.2 | 1.2 |
| **Total Delivered** | **279.5** | **11.0** | **248.7** | **9.8** |

| Production Cost Breakdown | £/MWh (HHV) | £/kg | €/MWh | €/kg |
|---|---|---|---|---|
| CAPEX Equity | 24.3 | 1.0 | 21.6 | 0.9 |
| OPEX Electricity | 111.8 | 4.4 | 99.4 | 3.9 |
| OPEX Other | 0.4 | 0.0 | 0.3 | 0.0 |
| OPEX Fixed | 10.5 | 0.4 | 9.3 | 0.4 |
| **Total Production** | **146.9** | **5.8** | **130.7** | **5.1** |

**Input parameters include:**

- Hydrogen production technology
  - Green - PEM, ALK & SOE
  - Blue - SMR & ATR
- Production size (MW)
- Year of installation (2020-2050)
- Energy prices
- Storage asset type
- Storage sizing
- Distribution route and distribution distances among others

# *Project Profiles*

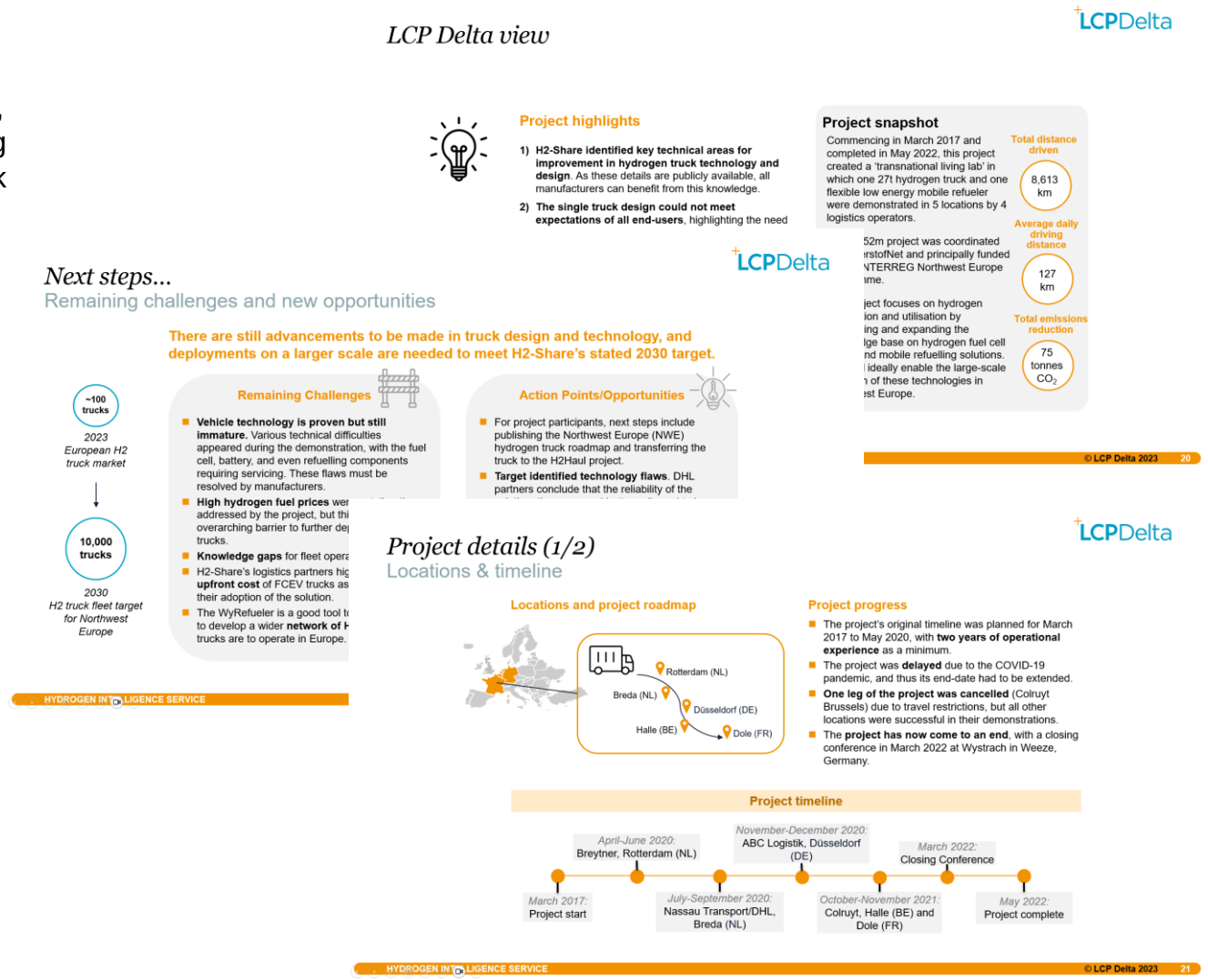
## Ongoing

### Synopsis

Detailed take-aways from strategic hydrogen projects across the globe, unpicking project investment, stakeholder involvement and key learning for next of a kind projects. Project profiles are based on direct feedback from project developers and other stakeholders.

Existing project profile library includes:

- MultiPLHY
- HyPSTER
- H2Pioneer
- HySynergy
- Windgas Hassfurt
- HYGRO
- BenortH2
- REFHYNE
- H2 Future
- Green Hysland
- Jupiter 1000
- HyDeploy - Phase 2
- Energiepark Mainz
- Hydrospider
- Haeolus
- Dolphyn
- H&R Oelwerke
- HanseWerk H2 engine
- HECTOR
- H2Share
- Hydrogen Park SA



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