

STUDY 01/2024

# Mind the Gap: Venture Funding of Hydrogen Start-ups

EU and US Investment Patterns and  
Policy Implications



Net Zero  
Insights



# Preface



**Jorgo Chatzimarkakis**

CEO | Hydrogen Europe

Our continent's influence on the global startup ecosystem is growing, and European venture capital is pivoting towards physical climate tech startups, especially in manufacturing. Within a hydrogen market that is still taking shape, Europe stands at the forefront of early-stage investment, particularly in electrolyser manufacturing and project development. While the United States and China attract substantial capital for large-scale projects, Europe has carved out its niche in nurturing early-stage enterprises within the hydrogen supply chain. This is specifically thanks to R&I funding instruments offered by the likes of the Clean Hydrogen Partnership, and a bustling startup network and acceleration ecosystem as shown by the work of H2UB.

As we celebrate Europe's prowess in innovation, we acknowledge the challenges our hydrogen companies face in accessing growth-stage equity funding, in an extremely capital-intensive sector. Institutional and strategic investors in Europe have a huge opportunity to tap into a pool of ESG aligned mature companies, either by taking a direct equity stake or commitment towards growth hydrogen and climate funds.

Looking ahead, with the enactment of the Green Deal Industrial Plan and the adoption of key regulations in 2023, we anticipate an increasing need for growth capital and acquisition perspectives to propel the sector to greater heights. We encourage the use of public tools like InvestEU to attract necessary capital in Europe and establish a robust growth and acquisition investment framework.

Finally, considering the challenges faced by late-stage climate tech VC funding in 2023, placing a heightened emphasis on commercialisation, i.e. customers and sales, becomes a pivotal catalyst for fostering the growth of European scale-ups. To achieve this, a strong public commitment is essential to support hydrogen demand, notably through the Hydrogen Bank, and to de-risk the development of industrial facilities for scale ups.



**Dr. Jörg Bergmann**

CEO | Open Grid Europe

The development of the hydrogen economy and the clean energy transition in Europe need to be accelerated. Growing cutting-edge innovation from lab to industrial scale as fast as possible is key to address this challenge. Ecosystems are the soil where the seeds for tomorrow's hydrogen champions are planted. H2UB is the biggest Open Innovation Platform in Europe for Hydrogen technology connecting the brightest entrepreneurs, innovators and companies to make the clean energy transition happen.

With this study, H2UB is making a valuable contribution to map the status-quo of venture financing of Hydrogen start-ups in Europe and to highlight the need for coordinated European action. Particularly extended demand-side incentives to bring down the green premium on hydrogen will be key to support the ramp-up of the hydrogen market. We as Germany's biggest transmission system operator are ready to join forces with other players along the value chain to support this transition.

# Executive Summary

In the emerging hydrogen economy, Europe is in a good starting position to become the home of the next generation of global hydrogen champions. Not only does it have a strong industrial base, but it is also in a leading position in hydrogen innovation when it comes to patents.<sup>1</sup> On the other side of the pond, the US launched the IRA in 2022, which is an uncapped long-term investment plan for climate tech worth between \$360B and \$1,200B.<sup>2</sup> Against this backdrop, we have analysed the funding of hydrogen start-ups to map investment trends and to localise Europe's position with regard to transatlantic competition.

## Key Findings (KF)

- **KF1 Climate Tech & Hydrogen is more crisis resilient:** Climate tech began booming globally in 2021. The drop in this market in 2023 was much softer than in the overall venture market. Driven by policy incentives and external shocks, hydrogen outgrew the broader climate tech market.
- **KF2 Hydrogen has different financing requirements:** Nearly all hydrogen start-ups focus on hardware. Hence, they are more CAPEX-heavy compared to climate tech.
- **KF3 The US leads venture funding of scale-ups:** Europe has caught up significantly in terms of overall venture funding. Central & Northern European countries play a major role in this funding. However, late-stage funding in the US is still five to six times higher, when equity is considered.
- **KF4 Funding follows impact:** We found that the allocation of funding is in line with climate impact expectations. The car industry, however, is an outlier.

- **KF5 Mission- and strategy driven investors are most active:** The majority of investors on our Top 10 list are either mission- or strategy-driven. Thus, they either have a clear focus on climate impacts or they align their investment strategy as CVCs with their company's core business, and thus have a longer-term strategic interest in specific technologies.
- **KF6 Europe has a negative acquiree/-acquirer balance-sheet:** More companies are sold to buyers outside Europe than vice versa. Acquisition activity in the hydrogen sector is currently low, but by comparing it with more established sectors, like battery or solar, it is likely that acquisition activity will increase as the sector matures.

## Policy Implications

We propose a mix of supply- and demand-side instruments to bring Europe back on a competitive track, in line with what Cleantech for Europe<sup>2</sup> suggests (see p. 25 ff for more details):

- Use the EU Emissions Trading Systems revenues to support more first-of-a-kind (FOAK) projects
- Increase hydrogen demand by topping up the Hydrogen Bank's budget
- Harmonise standards with the US and Canada to build a transatlantic marketplace for clean hydrogen
- Extend public guarantees to de-risk the procurement of next-generation hydrogen technology



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## CHAPTER I

# State of Venture Investment in Climate Tech & Hydrogen

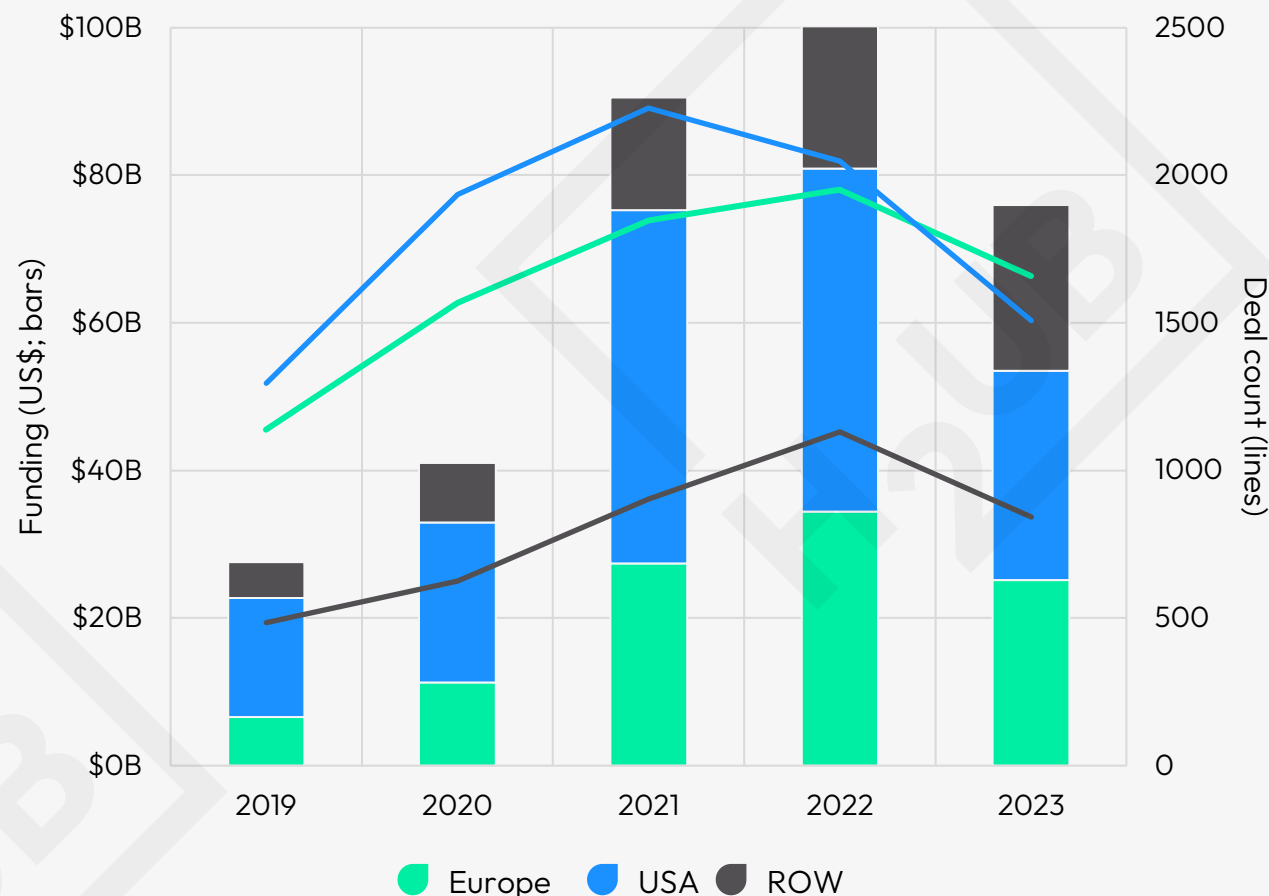
Funding & Deal Activity in Climate  
Tech and in Hydrogen

Heatmap: Funding and Deals across  
Europe

Financing Mix in Climate Tech &  
Hydrogen

# Climate tech is more crisis-resilient

Climate Tech Funding (bars) & Deal Activity (lines)



## Climate Tech Funding and Deal Activity

- Worldwide funding of climate tech has increased steadily since 2019 – more than double in 2021 (from \$41B to \$90.5B) and reaching an all-time high in 2022.
- Total funding is 65 % higher in the US than in Europe (\$104B vs. \$60B between 2019 and 2023). The Inflation Reduction Act (IRA), introduced in September 2021<sup>1</sup>, is a key driver of this funding gap.
- In 2023, global funding declined by 37 %. This decline was particularly sharp in the US, while monitored funding in the rest of the world (ROW) remained stable.
- Given that the macro environment was dominated by geo-political turmoil, inflation, tightened monetary policy and sinking valuations, climate tech funding remained more stable than the overall venture market.<sup>2</sup>
- Many first-time investors continued to join the climate tech market even in this difficult environment<sup>3</sup> although it is unclear whether they are just tourists, or if they will continue to play a role.

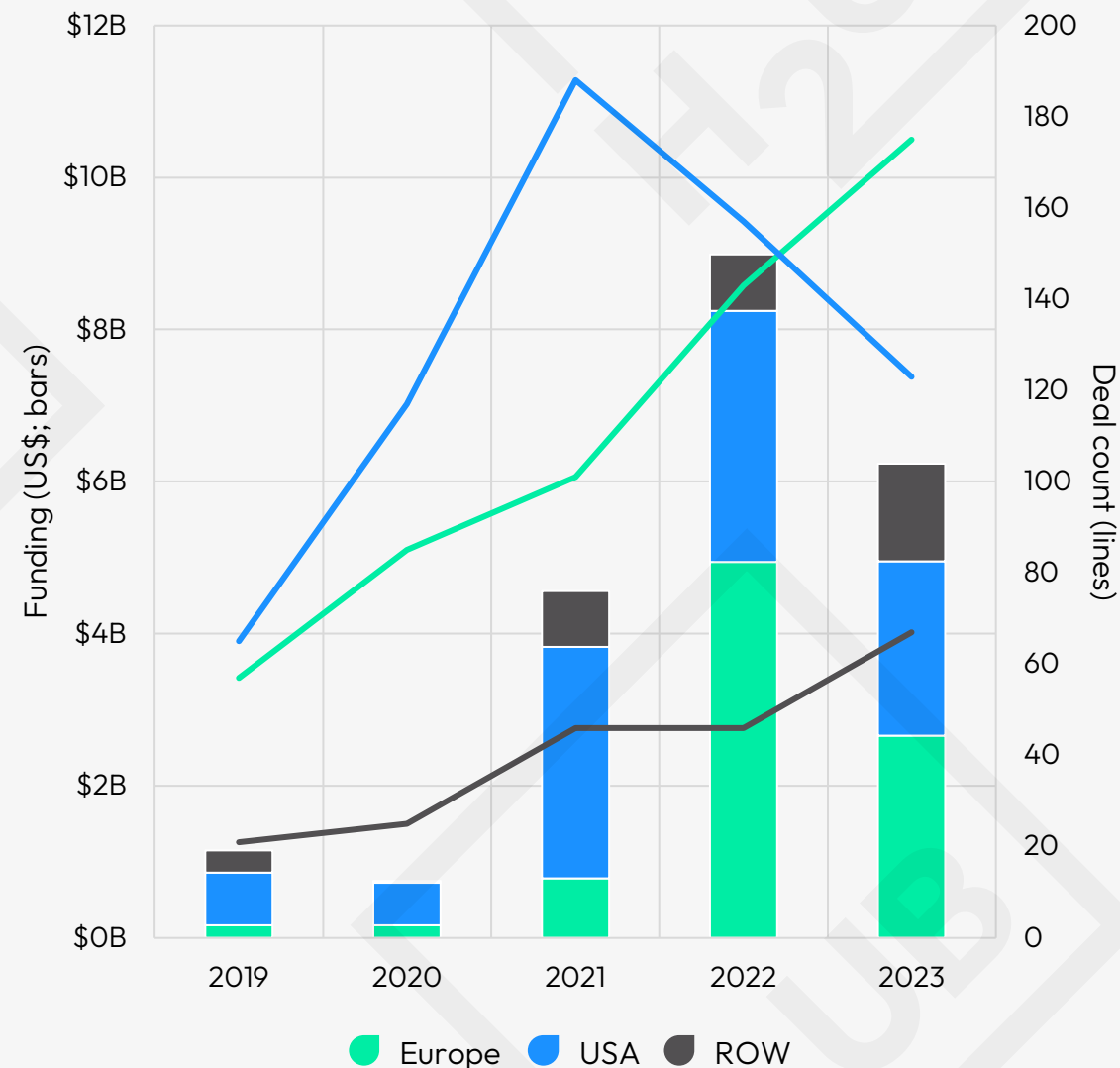
<sup>1</sup> Congress.gov // <sup>2</sup> Cleantech for Europe 2024 // <sup>3</sup> PWC 2023

# Policy incentives & external shocks drive growth

## US takes the lead in Hydrogen Funding, Europe follows

- While hydrogen represented only 4 % of the climate tech market in 2019, this share doubled in 2023.
- In the US, the funding boom took off in 2021, when funding increased by an impressive 450 %. This was mostly due to a significant increase in large deals as investors anticipated the significant demand-side incentives of the IRA.
- In Europe, funding took off in 2022. The largest chunk of funding was allocated to a single deal in the form of venture debt (H2 Green Steel; see page 21). The growth of hydrogen funding in Europe was partly driven by policy incentives (e.g. CBAM, EU Green Deal), but was also driven by Russia's invasion of Ukraine.
- In 2023, funding decline was less pronounced in Europe in relative terms than the US. Deal activity continued to rise in Europe but was characterised by high activity in smaller deals. In contrast, in the US big deals in particular declined (see page 12).

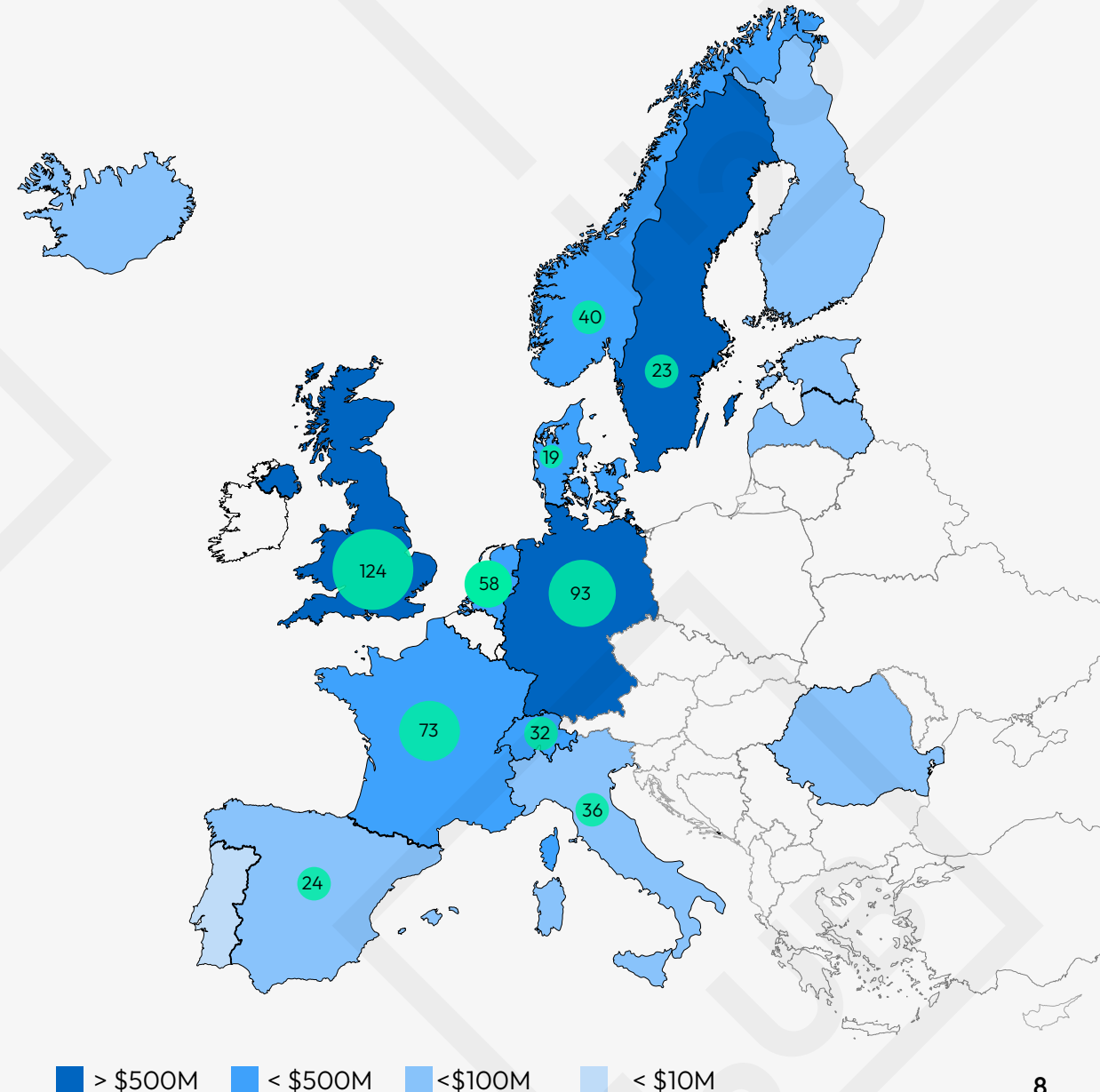
## Hydrogen Funding & Deal Activity



# Central & northern countries dominate European funding

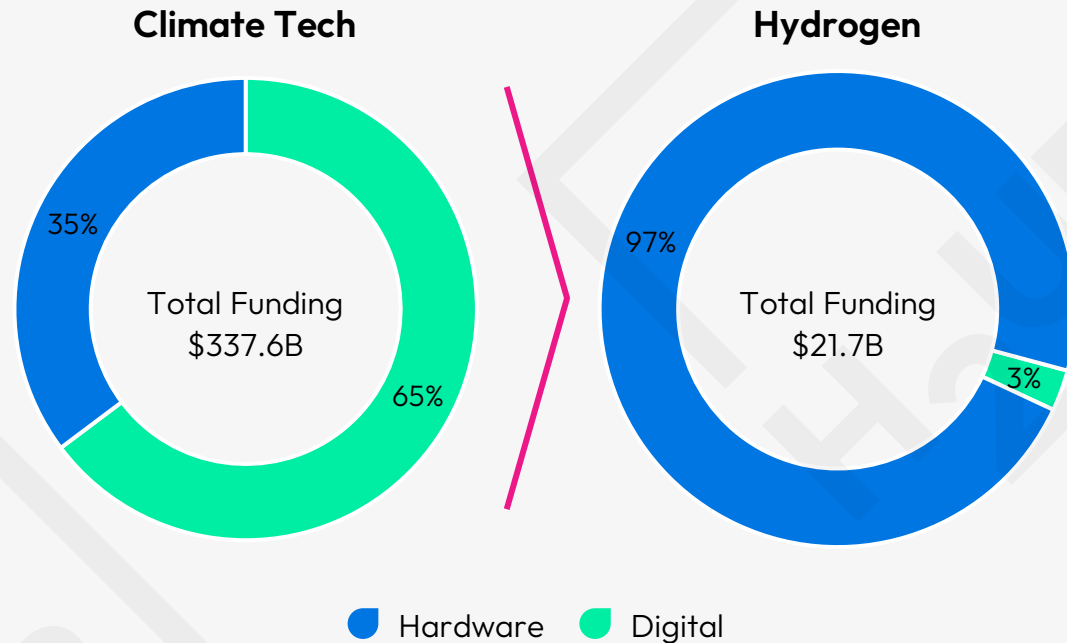
The map shows the European hydrogen funding (colours) and the deal count (bubbles) across European countries from 2019 to 2023.

- Central and northern countries dominate the hydrogen funding landscape : The highest funding volumes are allocated to start-ups from Sweden, Germany and the UK. In southern countries, funding volumes are much lower.
- Although the deal activity in the UK is quite high, average funding allocated is comparably low. The broad approach to pre-seed financing by Innovate UK contributes to this pattern.
- The tremendous funding volumes allocated to H2 Green Steel make Sweden an outlier, in statistical terms. Average deal size is 15 times higher than in Switzerland or about 20 times higher than in Germany, which are ranked 2<sup>nd</sup> and 3<sup>rd</sup> for average deal size.
- Additionally, funding intensity shows funds invested in proportion to GDP (see page 33; annex). That metric indicates that hydrogen investment is of high priority in the northern countries Estonia, Denmark and Finland.





# Hydrogen is a hardware game<sup>1</sup>



## Soft- and Hardware Funding in Climate Tech & Hydrogen

- In the hydrogen sector, 97 % of venture funding is allocated to hardware-driven start-ups. In contrast, hardware makes up only about 35 % of venture funding in climate tech.
- Hardware innovation is much more CAPEX- and asset-heavy than digital innovation. Development cycles are also longer due to technical complexity. Scaling-up to an industrial level is riskier and more capital intensive for hardware innovation than it is for digital products. As a result, hydrogen's financing mix is unique (see page 10).
- Nevertheless, digital solutions are an essential part of the hydrogen puzzle; they unlock efficiency and enable market making from project planning to actual trade.



**Flore de Durfort**  
CEO | ATMEN



"In the nascent hydrogen sector, public and private actors are focusing on building hardware and infrastructure. Hence, investors often hesitate to allocate funds to pure software initiatives relying on a work-in-progress backbone. However, this perspective shifts if the software layer plays a crucial role in mitigating overall market investment risks."

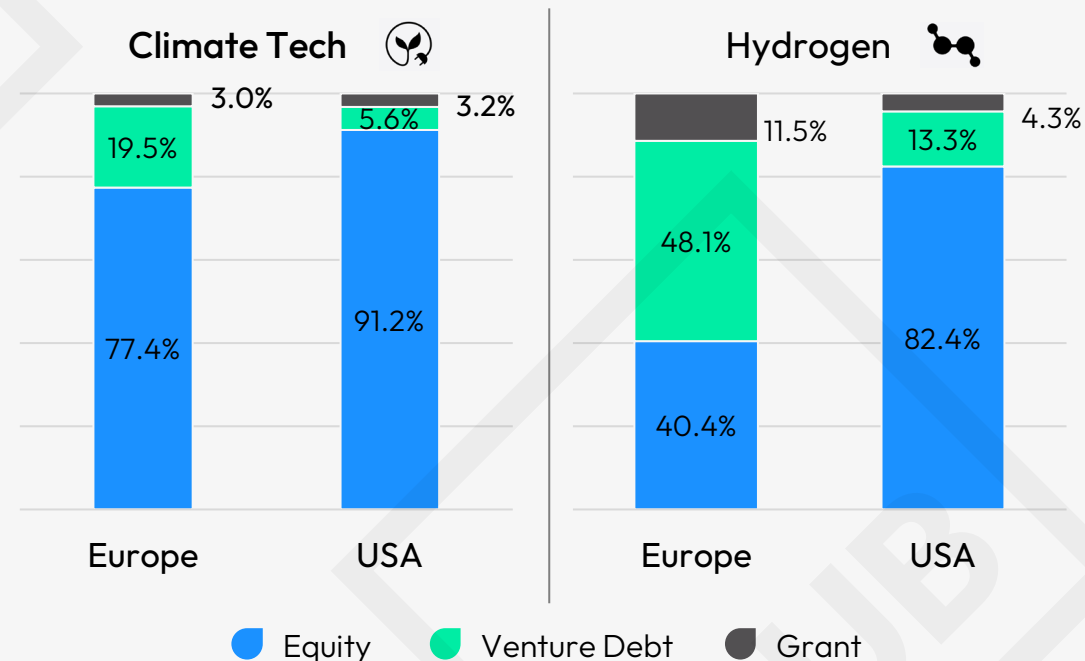
# More venture debt in hardware-heavy hydrogen

- Overall Climate Tech funding is 70 % higher in the USA (2019 to 2023).
- In Hydrogen, this gap is much smaller. Consequently, the Hydrogen sector is more relevant in the European Climate Tech scene, than in the US – looking at the share in total funding.
- However, the financing mix is different in Hydrogen. As more hardware is involved (see page 9), but risk is high, grants and venture debt are more relevant to develop and build projects/products.
- This is reflected by H2 Green Steel, which absorbed the major share of European venture debt funding (total funding \$5.2B out of which \$3.2B are venture debt).

## Climate Tech & Hydrogen funding in Europe & the USA by type

Total Funding (2019–2023)

	Europe	USA
Climate Tech 	\$93.3B	\$143.9B
Hydrogen 	\$7.1B	\$9.0B
Share	7.6 %	6.3 %



## CHAPTER 2

# Deep Dive: Hydrogen Venture Investment in Europe & the USA

Hydrogen equity deal activity in  
Europe & the USA by funding stage

Hydrogen equity funding volumes by  
funding stage

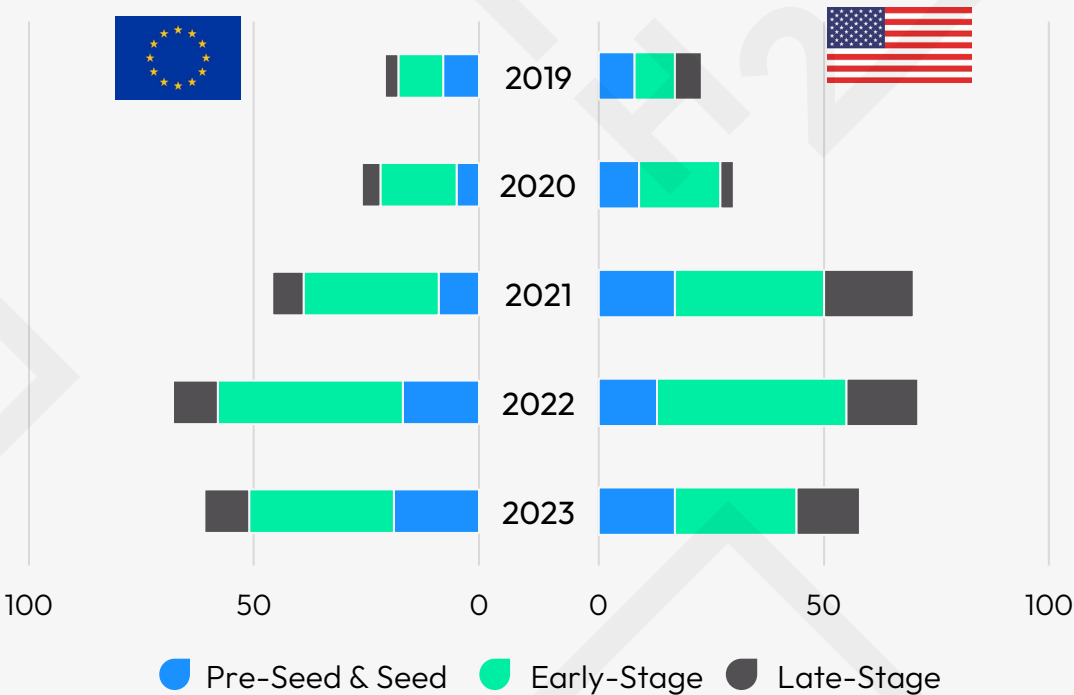
In-depth analysis of the deal  
distribution

# Europe strong in early-stage deals, but lags behind at later stages

Equity is the most pertinent form of venture financing. While venture debt and grants have their merits, equity financing stands out for its holistic approach, offering not only financial backing but a partnership that aligns interests, provides long-term commitment, shares risks, and brings strategic value to the startup. This is why equity is analysed in depth here.

- Deal activity in equity investments increased significantly in 2021, both in Europe and the US.
- Looking at the deal count, Europe and the US are on par. However, there is a gap when it comes to late-stage deals
- In Europe, pre-seed and seed as well as early-stage (Series A, B) deals surged from 2021. Late stage increased, but on a lower level.
- In the US, pre-seed & seed investment activity was lower, but late-stage deals were significantly higher between 2019 to 2023, with a peak in 2022.

Hydrogen equity deal activity in Europe & the US by funding stage



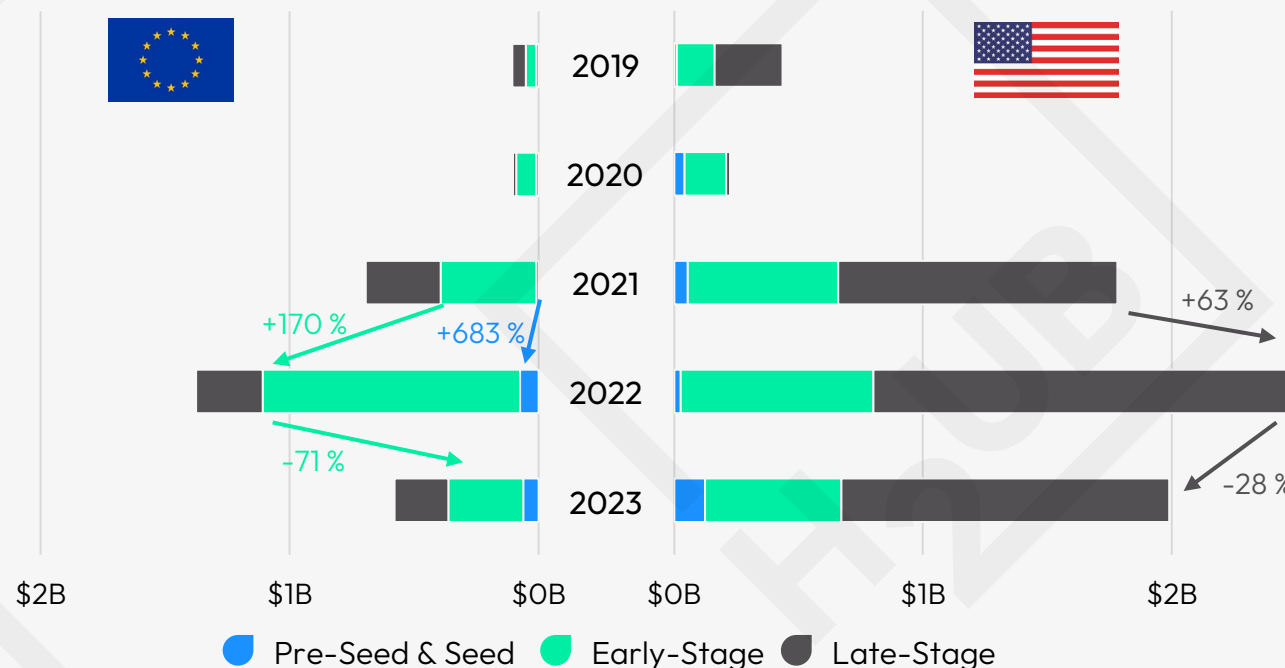
Total Deals (2019-2023)

	Europe	USA
Pre-Seed & Seed	58	64
Early-Stage	130	129
Late-Stage	34	59

# The US has a significant head start in late-stage equity funding

## Hydrogen equity funding volumes in Europe and the US by funding stage

- In line with the deal count, the volume of equity funding increased by leaps and bounds in 2021.
- The funding volumes at the Pre-Seed & Seed stage as well as the Early-Stage (Series A, B) in Europe are more or less on par with the US.
- However, at the Late Stage, there is an immense gap between the continents: equity funding at this stage is over five times higher in the United States than in Europe.
- In 2023, only Pre-Seed & Seed funding remained stable. Early- and Late-Stage funding declined significantly. In a difficult macro-environment, this is a backlash for the scale-up of next generation Hydrogen technology.



Total Funding (2019-2023)

	Europe	USA
Pre-Seed & Seed	\$0.17B	\$0.27B
Early-Stage	\$1.84B	\$2.29B
Late-Stage	\$0.86B	\$4.87B

Scale-up-gap



As an entrepreneur in the European hydrogen sector, I believe it's crucial for us to bridge the funding gap between Europe and the US in the later stages of financing. Closing this gap is essential for Europe's economic competitiveness and is a call to action against climate change, contributing to a sustainable future.

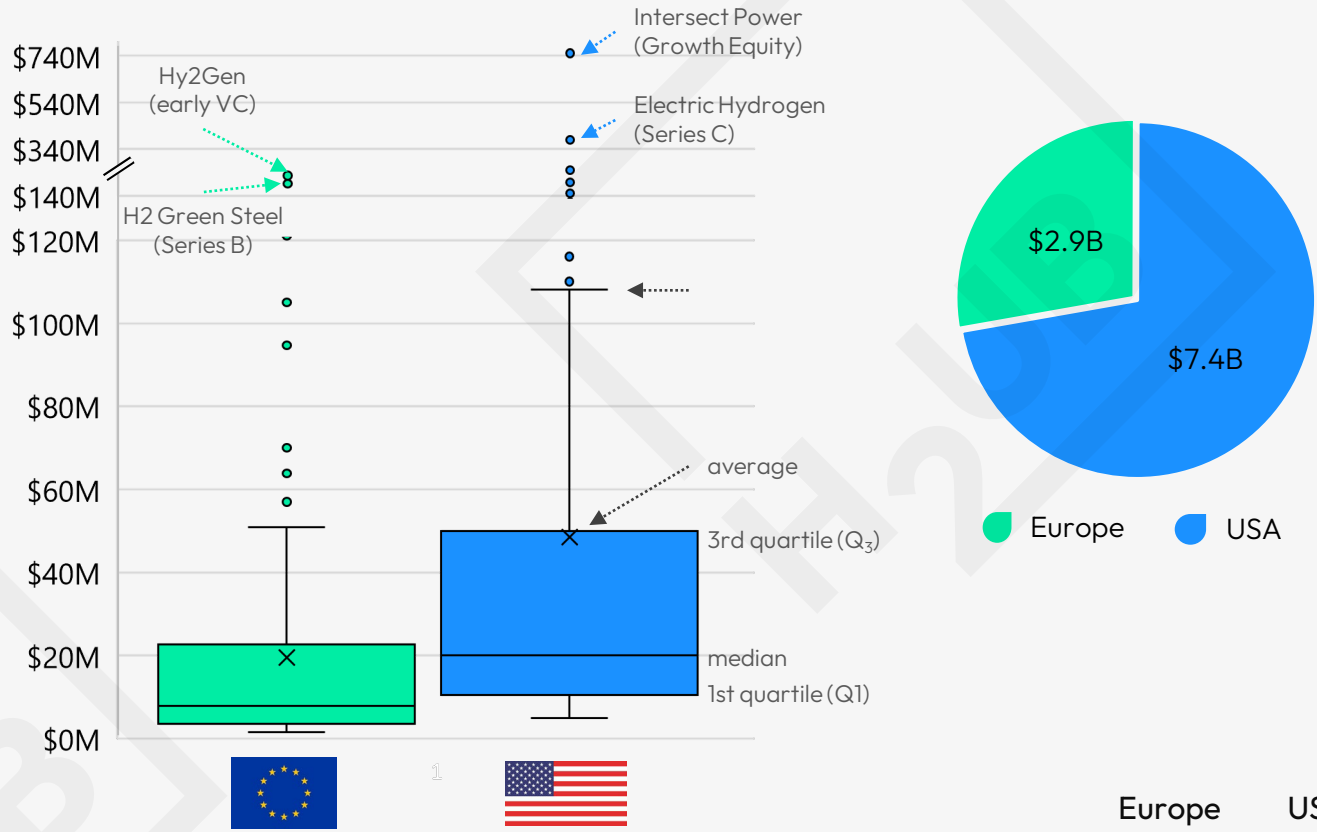
Investing significantly in the European hydrogen industry is more than just a business consideration; it's a personal commitment to shaping a greener tomorrow and contribute to the momentum towards a carbon-neutral world.

**Florian Hildebrand**

CEO | GREENLYTE CARBON TECHNOLOGIES



# ‘Everything is bigger in the US’: Deal sizes in Europe and the USA



## Distribution of equity deals in Europe and the US

- Generally, equity investment is 250 % higher in the US, although the deal count is only 30 % higher. A closer look at the distribution reveals that deals of all sizes are bigger in the US, as indicated by the interquartile range (\$40M. vs. \$19M)
- In Europe, 50 % of equity deals are between \$1.5M (minimum) and \$7.8M (median). In contrast, the US distribution is much wider, with 50 % of the deals being between \$5M and \$20M.
- Looking at the other 50 % of the distribution (from the median line to the 4th quartile), the spread becomes much greater.

## CHAPTER 3

# Follow the money: Who invests in which start-ups & technologies?

Top 10 investors & top deals from pre-seed to late-stage

Acquisition activity in hydrogen

Investment by technology & field of application

# Mission- or strategy-driven investors dominate Top 10

- The most active investors are AP Ventures (APV) and Breakthrough Energy Ventures. APV is a fund focused on decarbonisation through hydrogen-related technologies.<sup>1</sup> Breakthrough is a mission-driven investor seeking to push the clean energy transition forward.
- The European Innovation Council (EIC) Fund is also very active. EIC offers funding, often as a blend of equity and grants, for a range of European high-impact start-ups.
- Besides the deep- & climate tech investors IP Group, Horizons and Braemar, CVCs from oil and gas companies are also among the Top 10.



**Andrew Hinkly**

MANAGING PARTNER | AP VENTURES

“Since the AP Ventures team started investing in hydrogen technologies ten years ago, we have seen huge momentum behind low-carbon hydrogen as a force for decarbonisation. Start-ups focused on hydrogen and its derivatives are becoming more sophisticated and proliferating into wider applications across the energy value chain, and our growing portfolio is a reflection of that trend.”

## Top 10 investors in hydrogen across all start-up phases

Institution / Company	Investor Type	Number of Deals	HQ
AP Ventures	Venture Capital	36	UK
Breakthrough Energy Ventures	Venture Capital	26	USA
European Innovation Council Fund	Venture Capital	13	Belgium
Aramco Ventures	Corporate Venture Capital	11	Saudi Arabia
Equinor Ventures	Corporate Venture Capital	10	Norway
Horizons Ventures	Venture Capital	9	Hong Kong
Venture Kick	Venture Capital	8	Switzerland
Braemar Energy Ventures	Venture Capital	8	USA
IP Group Plc	Venture Capital	7	UK
TotalEnergies Ventures	Corporate Venture Capital	7	France

<sup>1</sup>AP Ventures is backed by many Limited Partners (LPs) with a strategic interest in hydrogen technology, such as Mitsubishi, Equinor and the fertiliser manufacturer Yara.

# Most top rounds are with US-based start-ups

Pre-Seed &amp; Seed

Start-up	H2 value chain	Technology	Amount	Year	HQ
Type One Energy	Production	Fusion power	\$29M	2023	USA
Destinus	Aviation	Hypersonic airplanes	\$29M	2022	Switzerland
Enervenue	Storage	Storage vessels	\$12M	2020	USA

Early-Stage

Start-up	H2 value chain	Technology	Amount	Year	HQ
H2 Green Steel	Steel	Direct reduced iron	\$192M	2022	Sweden
H2 Mobility	Mobility & Logistics	Refueling stations	\$121M	2022	Germany
Eodev	H2 Utilisation	PEMFC & FCEV	\$49M	2023	France

Late-Stage

Start-up	H2 value chain	Technology	Amount	Year	HQ
Electric Hydrogen	Production	PEM	\$380M	2023	USA
Ohmium	Production	PEM	\$250 M	2023	USA
Nikola Motor Company	Mobility & Logistics	BEV & FCEV	\$210 M	2021	USA

## Top 3 rounds by funding stage

- Five out of nine start-ups in our list of top deals are US-based, although European start-ups are very prominent at the early stage. In earlier phases, investments still flow into different areas of the H2 value chain, whereas at the late stage there is a stronger focus on hydrogen production.

Top rounds per stage:

- Type One Energy: Manufactures stellarators to generate electricity by nuclear fusion, which generates no emissions and produces power with high safety and reliability. Funded by Breakthrough Energy and the US Department of Energy.
- H2 Green Steel: Building a steel plant with green hydrogen produced on site. Raised \$5B to date with investors like Hitachi Energy, the Swedish Energy Agency and the European Investment Bank.
- Electric Hydrogen: Manufactures the world's most powerful electrolyser (100MW) which is the world's first hydrogen unicorn with investors like Microsoft, Amazon and Breakthrough Energy.



The hydrogen sector is unique in that it requires significant investment to develop and commercialise new technologies. As a result, strategic investors and corporate venture capitalists (CVCs) play a critical role in supporting start-ups and emerging companies in the hydrogen market. These investors not only provide the necessary capital to fund research and development, but even more importantly bring valuable expertise and industry connections to the table.

By supporting technologies along the entire value chain, these investors are able to align their own interests with technology, which is critical in an early-stage market. Governments also play a key role in shaping the development of the hydrogen market through policies and regulations that promote the use of hydrogen as a clean energy source.

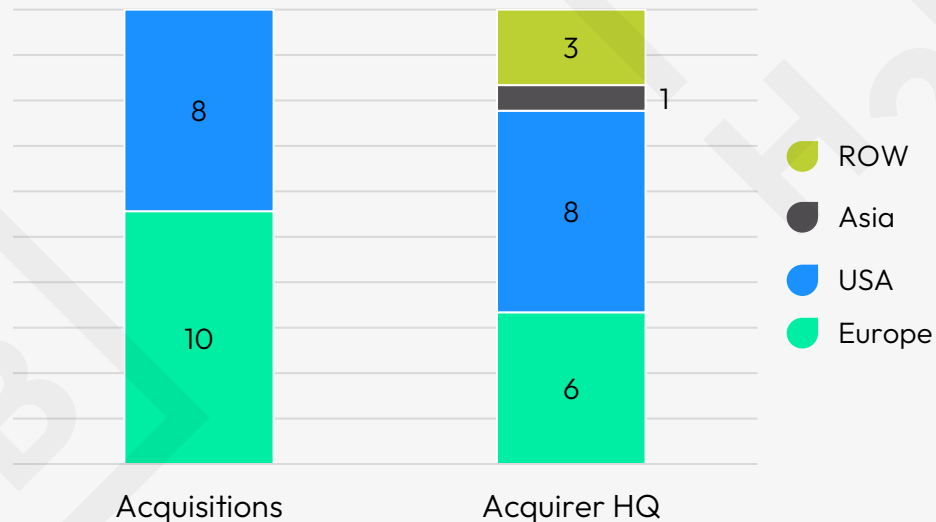
**Dr. Jens Busse**

INVESTMENT DIRECTOR | EVONIK VENTURE CAPITAL

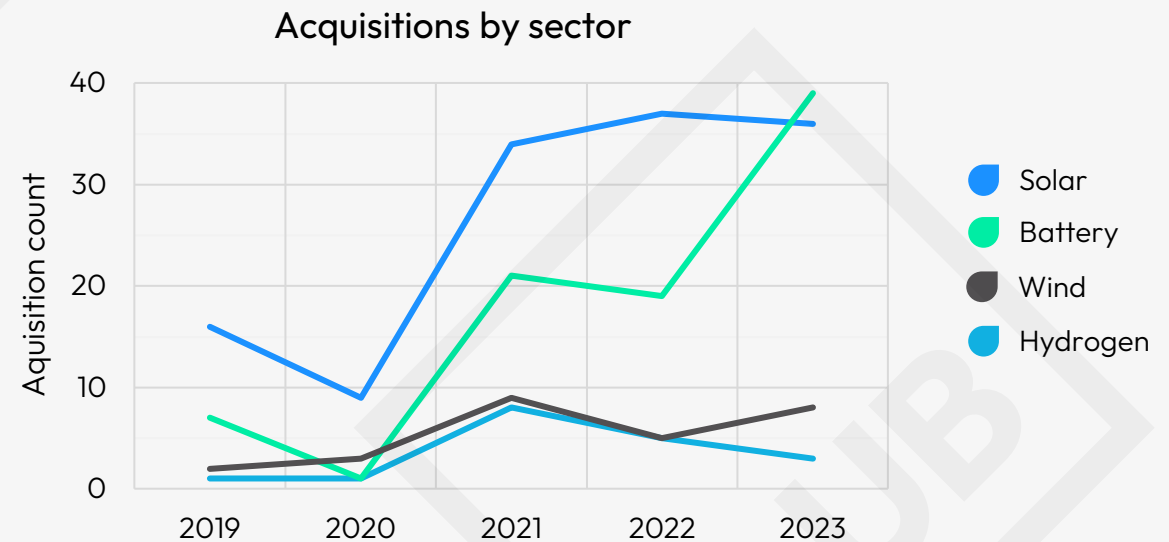


## Acquisitions at a low level, but more to expect

- Acquisition activity in the hydrogen sector is currently at a low level.
- Europe has a negative acquiree/acquirer balance sheet. However, the number of observations is still too low to show a clear trend.

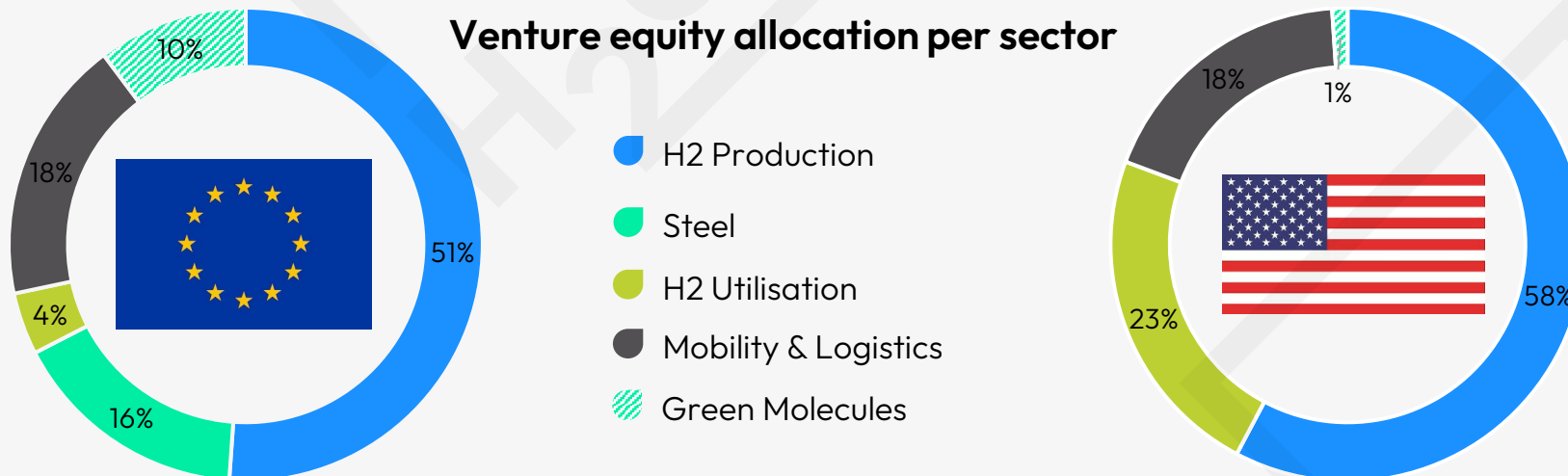


- Acquisitions are likely to increase as the hydrogen sector matures as acquisitions of cutting-edge technologies as well as strategic expansions or consolidations become more likely. This trend has been seen in the battery and solar sectors.

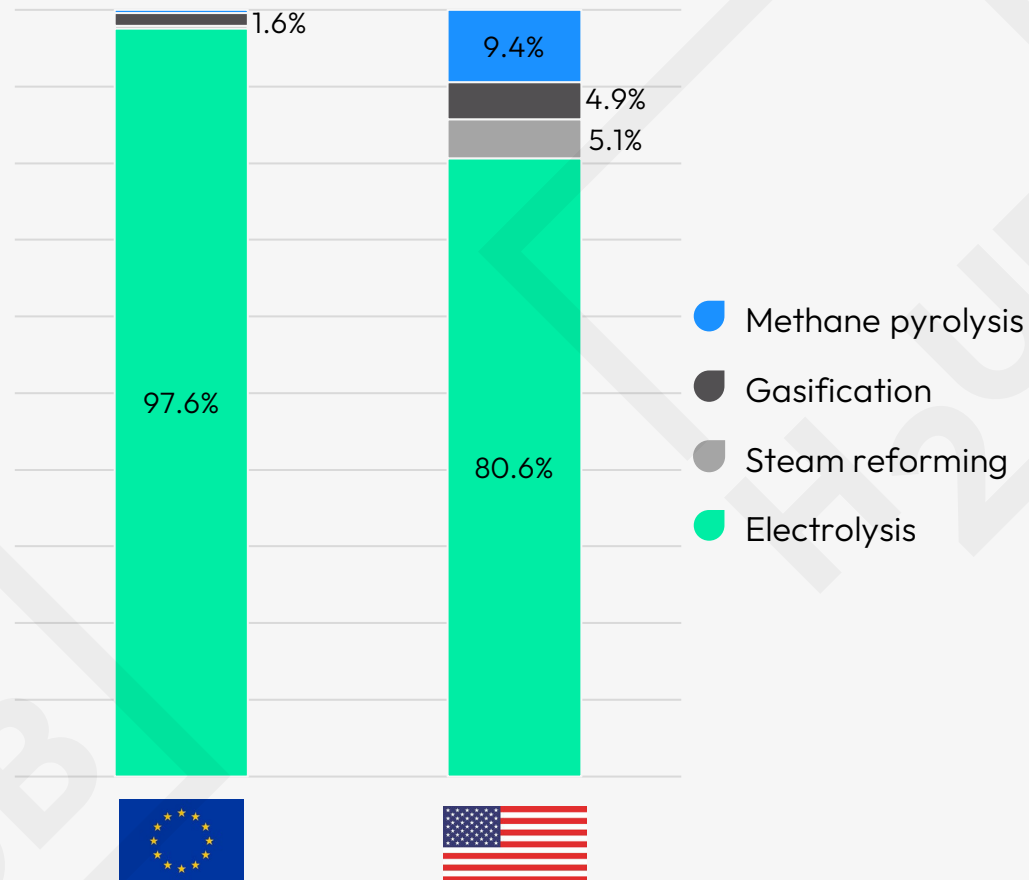


# Transformation rules! But where to start?

- H2 production is the most relevant part of the value chain in terms of overall investment. This highlights the massive potential of the market and the need to solve bottlenecks in technology and industrial production to bring down the levelised cost of hydrogen.
- Aside from H2 production, patterns in Europe and the US are rather different. A significant share of European equity is invested in mobility & logistics or in steel & green molecules (e.g. methanol or ammonia).
- In the US, steel barely plays a role and there is a much stronger focus on production than in Europe and the funds invested in H2 production are allocated to a broader mix of technologies, such as pyrolysis (see page 22).
- Mobility and logistics are more relevant in the US. Metro trains and buses, jet aviation, and shipping are amongst the most relevant sectors in this cluster.
- In terms of H2 utilisation, the most relevant technology fields are long-duration grid balancing and generator technologies.



# IP, resource availability & incentives drive investment



## Equity investments in H2 production technology in Europe and the US

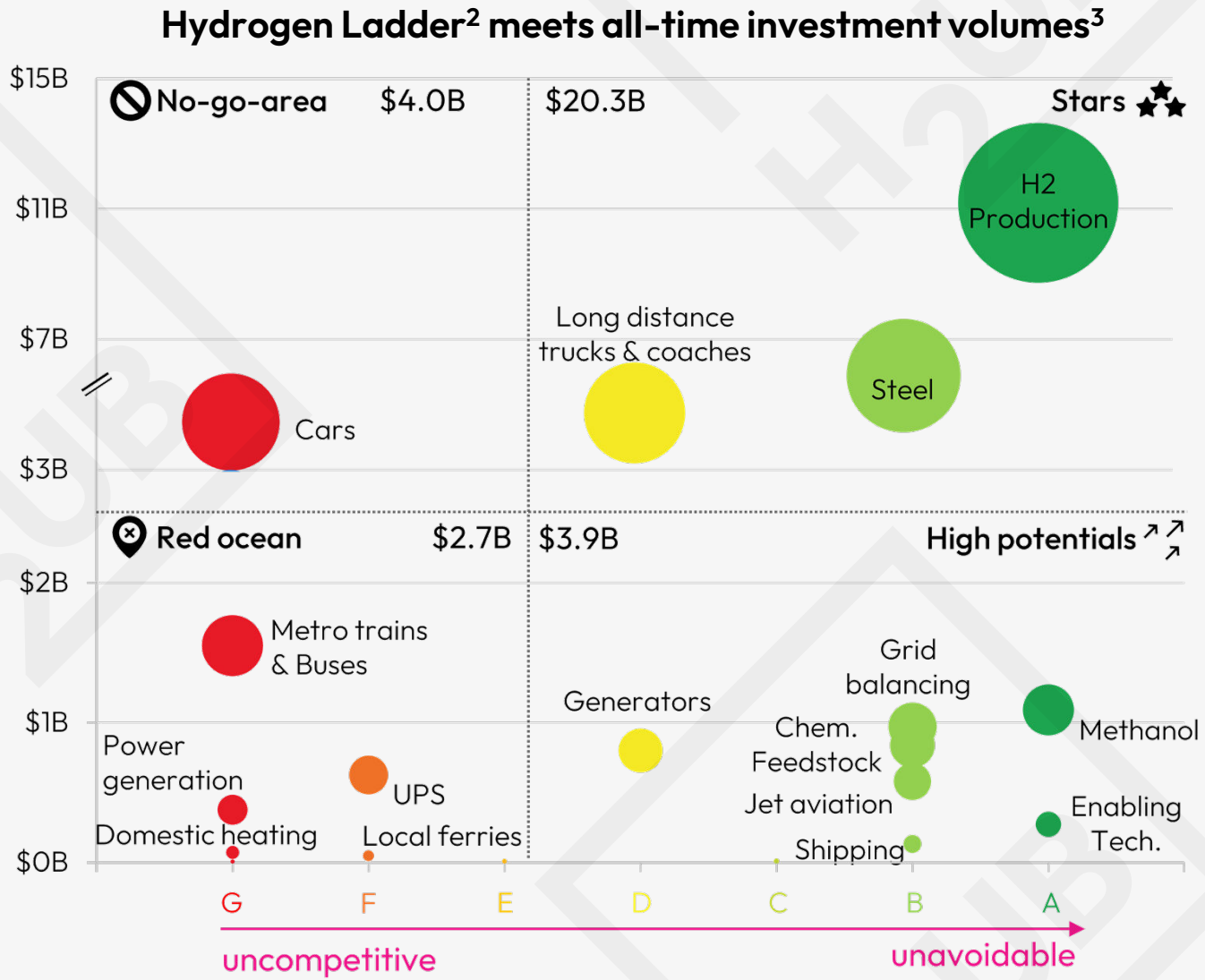
Global hydrogen demand today is met almost entirely by fossil fuel-based production technology. Gas has the largest share. Electrolysis with green/low-carbon electricity is one route to decarbonise H<sub>2</sub>-production. Other possible routes are Methane Pyrolysis or Gasification of waste/biomass, both using Carbon Capture and Utilisation/Storage.

- Overall, the biggest share of venture funding is allocated to H<sub>2</sub> production technology. However, the pattern of this funding in Europe and the US differs.
- In Europe, Electrolysis is by far the most important technology, absorbing around three quarter of the funds invested. The share of methane pyrolysis is much smaller
- In the US, the overall technology mix is more diverse, with the highest share of funding being allocated to Methane Pyrolysis (exemplified by the Monolith Late-Stage deal).
- There are three major reasons for this: firstly, the US has much stronger knowledge/IP in gas- and waste-based H<sub>2</sub> production than in electrolysis;<sup>1</sup> secondly, natural gas resources are much cheaper in the US than in Europe; and thirdly, the IRA offers strong incentives for carbon capture technologies, which is also visible in final investment decisions (FIDs).<sup>2</sup>

# Betting on the right horses?

Some studies stress that venture investment in climate technology does not fully align with climate impact.<sup>1</sup> Seeking to advance this analysis for hydrogen in a meaningful way, we have plotted investment by technology against the hydrogen ladder devised by Michael Liebreich.<sup>2</sup> The results indicate an overall high impact of the funds invested.

- Stars: unavoidable fields of application with high funding. H2 production tech and steel are key to decarbonising sectors in which emissions are hard to abate.
- High Potentials: unavoidable, yet still underfunded technologies such as methanol or jet aviation.
- Red Ocean: high competition with alternative technologies, as in domestic heating or power generation
- No-go-area: impact and investment are out of balance, as is the case for cars.



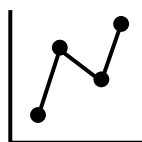
<sup>1</sup>PWC 2023 // <sup>2</sup>Liebreich 2023; <sup>3</sup>H2 Production and Enabling Tech. added by the authors; figures for all time funding, including exit + post-exit rounds



# KEY FINDINGS & POLICY IMPLICATIONS



## Key Findings (1/2): Venture investment trends



### Climate tech & hydrogen are more crisis resilient

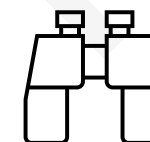
Climate tech began booming globally in 2021. Although the market saw a notable drop in 2023, it was much softer than in the overall venture market. During the boom, many new players invested, but it is unclear if they are tourists or came to stay. Driven by policy incentives and external shocks, hydrogen outgrew climate tech.



### Hardware-heavy hydrogen has different financing requirements

Hydrogen start-ups almost exclusively focus on hardware. Hence, they are more CAPEX-heavy than climate tech, where roughly two thirds of financing goes into digital business models.

Scaling up to an industrial level is more capital intensive, and grants and venture debt play a more important role in the venture financing mix.



### The US is ahead in venture funding for scaling-up

Europe has caught up significantly in terms of overall venture funding. Central & northern countries play a major role in funding. However, the largest chunk of funding was allocated to a single deal (H2 green steel).

When only equity is considered, all classes of deals are bigger in the US. For late-stage funding in particular, we observe an enormous gap in scaling-up, indicating a significant US advantage in building the next global H2 champion.

## Key Findings (2/2): Who invests in which technologies?



### Funding follows impact - with few exceptions

Mapping the funding allocated to fields of application by using Liebreich's Hydrogen Ladder, we show that the allocation of funding is in line with climate impact expectations. The auto industry, however, is an outlier in which funding and impact are out of balance. Otherwise, H<sub>2</sub> production dominates funding, showing the need to bring down the green premium by increasing the efficiency of technology.



### Mission- or strategy-driven investors are the most active

As the hydrogen market is still in its infancy, most investors on our Top 10 list are either mission- or strategy driven. Thus, they either have a clear focus on climate impact (most prominently breakthrough energy ventures) or align their investment strategy as CVCs with their company's core business and have a strategic interest in specific technologies.



### Europe has a negative acquiree/-acquirer balance-sheet

Europe currently has a negative acquiree/acquirer balance, i.e. more companies are sold to buyers outside Europe than vice versa.

Acquisition activity in the hydrogen sector is currently at a low level. However, comparison with more established sectors like battery or solar suggests that acquisition activity will most likely increase as the sector matures.

## KEY FINDINGS &amp; POLICY IMPLICATIONS

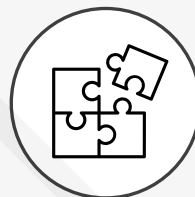
## Policy implications: Overview

A new generation of global hydrogen champions is now coming to the fore. Some of the technology is cutting edge, while some has existed for 10 or 20 years, and has been waiting for the right time to be scaled up. The right time is now.

Europe has a competitive advantage in hydrogen innovation technologies, particularly in electrolyzers – as far as patenting is concerned. Nevertheless, when it comes to expanding these innovations from the lab to the industrial scale, Europe's position is much worse than that of the US, as our analysis has shown.

While Europe has caught up with the US in early-stage investment to a remarkable degree, there is still a huge gap between Europe and the US in terms of scaling-up.

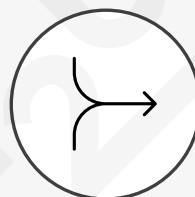
Our research highlights four policy implications that can help Europe address this gap; these suggestions are in line with Cleantech for Europe.



**Use EU Emissions Trading Systems revenues to support more first-of-a-kind projects**



**Increase hydrogen demand by topping up the Hydrogen Bank's budget**



**Harmonise standards with the US and Canada to build a transatlantic marketplace for clean hydrogen**



**Extend public guarantees to de-risk the procurement of next-generation hydrogen technology**

A new generation of global hydrogen champions is being built these days. To master the clean energy transition, European hydrogen companies need to move from raising tens of millions of euros to validate their technologies to billions of euros to build large-scale plants like their US counterparts. This will only be enabled by significant demand-side incentives and market-making through transatlantic harmonisation of standards, both coordinated at European level to overcome small-scale policy.

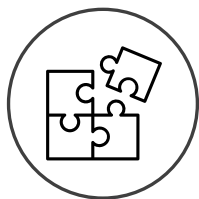
**Philipp Offenberg**

DIRECTOR EUROPE | BREAKTHROUGH ENERGY





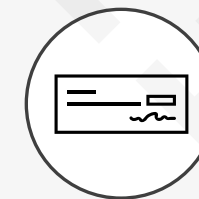
## Policy implications (1/2)



### Use EU Emissions Trading Systems (ETS) revenues to support more first-of-a-kind projects

First-of-a-kind (FOAK) projects are a special challenge for many hydrogen start-ups. These are usually expensive milestones, as they demonstrate next-generation technology at industrial scale for the first time. However, the funds required often exceed VC tickets, and the projects are still too risky for private equity to jump in.

The Innovation Fund is already addressing this gap, but is suffering from a lack of resources, both financially and in terms of personnel.<sup>1</sup> Additional resources should be provided from national ETS allowances. According to Cleantech for Europe, an additional 10 % contribution would provide €2.5B annually<sup>2</sup>, leveraging matched funding from the private sector on top of this sum.

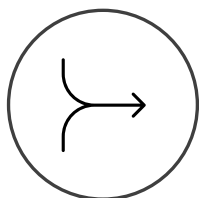


### Increase hydrogen demand by topping up the Hydrogen Bank's budget

With the European Hydrogen Bank, the European Commission established an important mechanism to stimulate the demand for clean hydrogen. The initial budget market for auctions of clean hydrogen, based on the contracts for difference principle, was €0.8B. Germany injected an additional €0.35B from the national budget under the auctions-as-a-service scheme.<sup>3</sup> In contrast, the IRA is an uncapped long-term investment plan comprised of public funding of an estimate of \$369B and \$1,200B.

The takeaway is straightforward, if the EU does not manage to mobilise additional resources to reduce the green premium on hydrogen, European competitiveness will suffer.

## Policy implications (2/2)



### Harmonise standards with the US and Canada to build a transatlantic marketplace for clean hydrogen

Carbon intensity is the key metric to measure the climate impact of hydrogen. In a nutshell, it depends on the energy and feedstock input at the production stage and subsequent downstream energy inputs (e.g., for storage or transportation).

International standards for the certification of hydrogen and its derivatives like ammonia, eMethane and eMethanol are still patchy,<sup>1</sup> effectively hindering the generation of an international market and the associated economies of scale.

Therefore, standards for carbon intensity, GHG calculation methods as well as downstream sector boundaries must be harmonised.



### Extend public guarantees to de-risk the procurement of next-generation hydrogen technology

When selling cutting-edge equipment, manufacturers of hydrogen technology often face requests for multiple bank guarantees to mitigate buyer risks. At the same time, these firms often encounter challenges when seeking project loans from financial institutions. This is why public institutions jump in, offering both loan and manufacturing guarantees to financial institutions and thus mitigating risks for lenders.

The EIB manufacturing guarantee mechanism is focused on the wind industry; InvestEU (€26B budget) is heavily oversubscribed.<sup>2</sup> Thus, guarantee mechanisms must be extended to tackle the scaling-up gap between the European and US hydrogen sectors.

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Chigozie is an Analyst at Net Zero Insights, where he uses data as a tool to unearth the ebb and flow of mature and emerging markets. His goal is to enable global decarbonization - while advancing social wellbeing - by focusing on technologies, business models, and financiers who are making a difference.



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H2UB is Europe's leading Open Innovation Platform for the whole hydrogen value chain. We collaborate with the brightest entrepreneurs, corporates & investors to reach one goal: the net zero energy transition.

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# Annex & Bibliography

Funding Intensity in Europe Heat Map

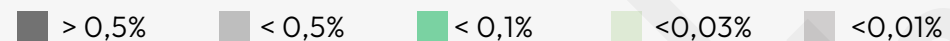
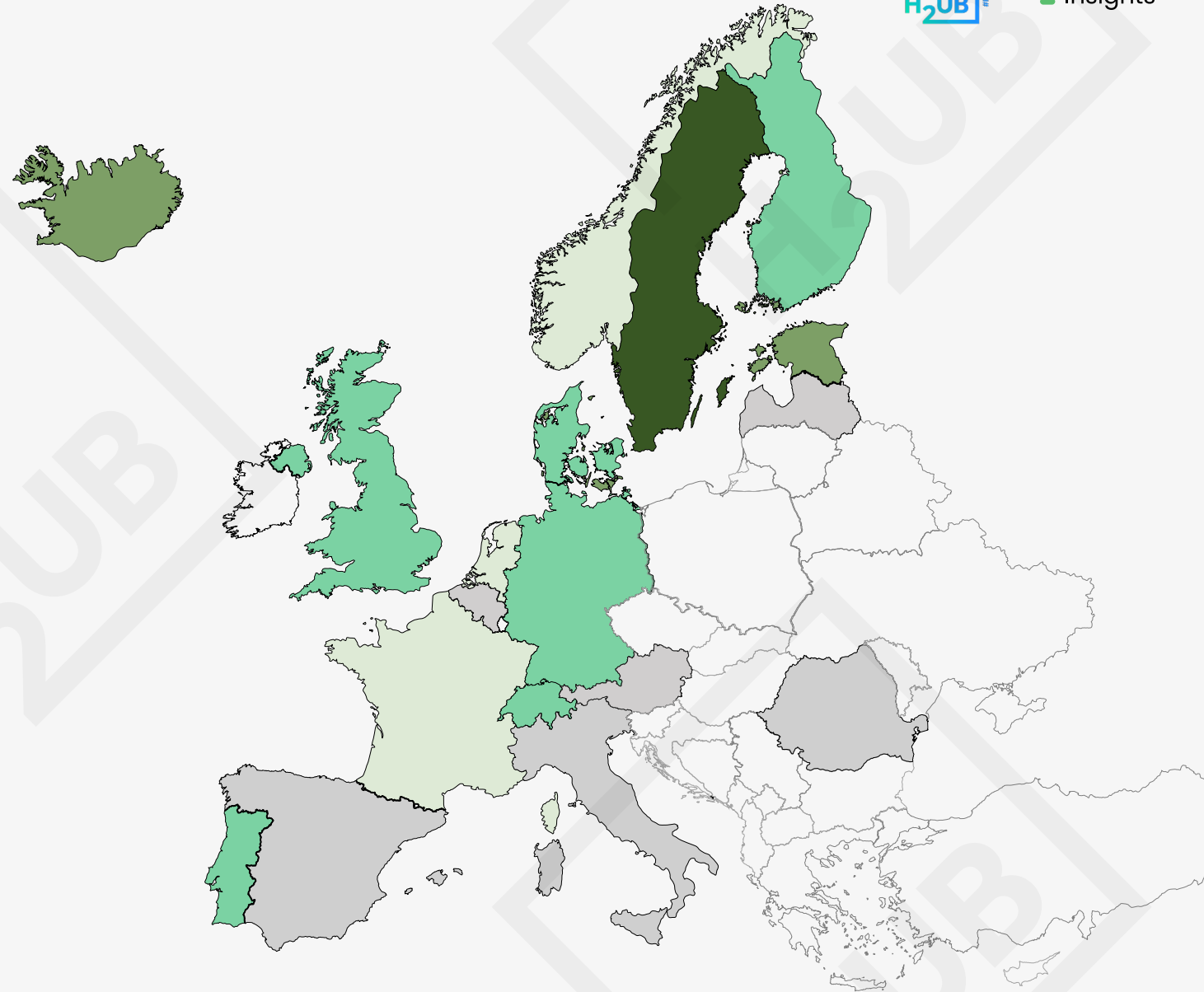
Methodology Net Zero Insights Data  
& Hydrogen Ladder

References & Glossary



# Funding Intensity in Europe

- The map shows the Funding Intensity across European countries.
- Funding Intensity is defined as the volume of venture funding allocated to hydrogen start-ups based in the country from 2019-2023 in proportion to GDP
- We combined the Net Zero insights data with GDP Data for 2022 extracted from Statista (2023)



# Methodology: Net Zero Insights Data

## Origin of Net Zero Insights data

- Programmatic monitoring: Automated programmatic monitoring to continuously gather data from a wide range of sources.
- Partnerships with ecosystem players: Collaborations with key players within the industry ecosystem provide us with valuable insights and access to proprietary data, enriching the depth and breadth of our analysis.
- Innovators submitting their own data: We encourage innovators and industry stakeholders to contribute their data; this provides a unique perspective and enhances the accuracy of our assessments.

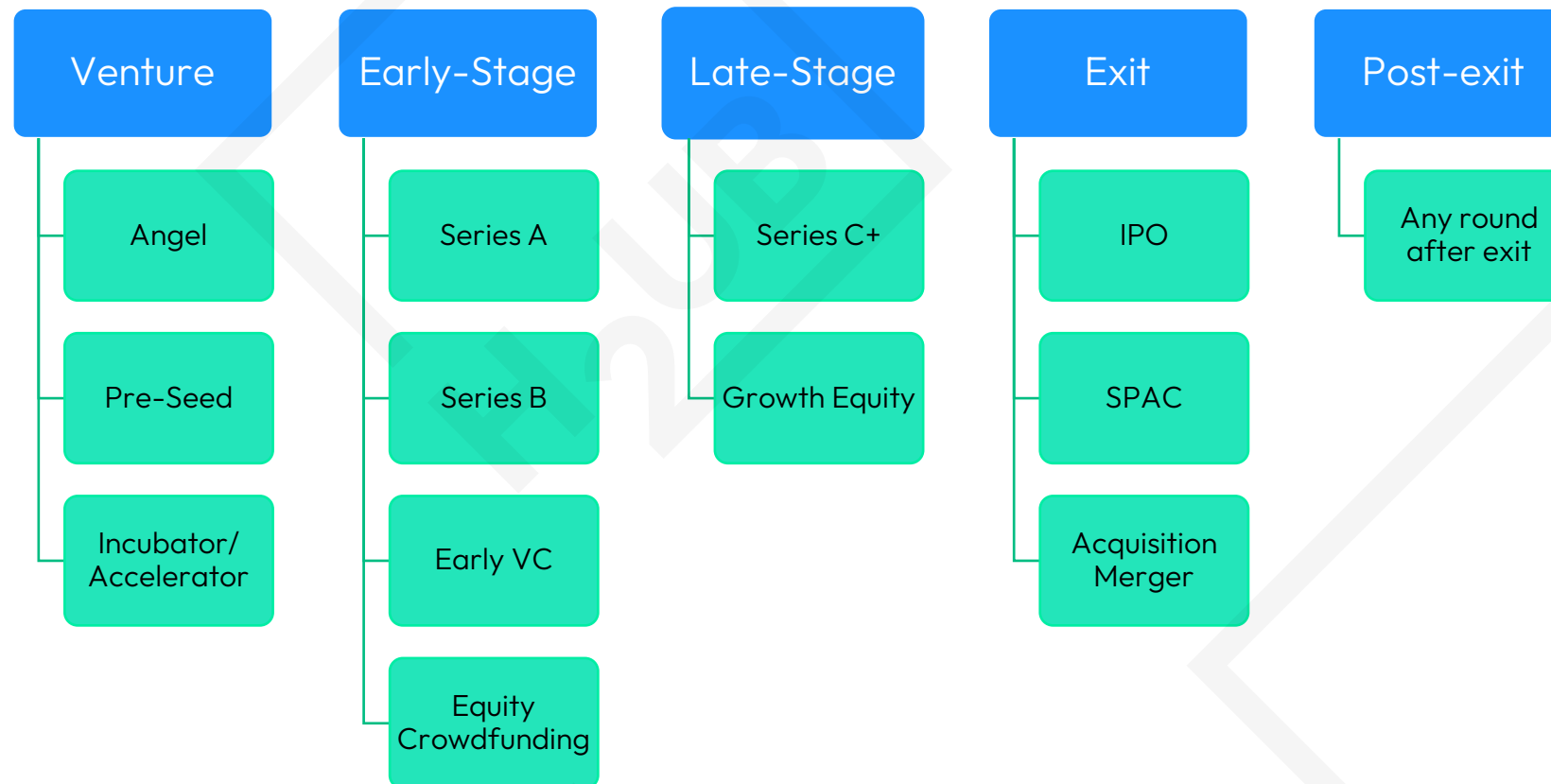
## Implementation of the Hydrogen taxonomy

Our analyst manually classifies hydrogen companies by:

- Value chain: production, storage, distribution, and utilisation
- Technology: electrolysis (alkaline electrolysis cell (AEC), polymer electrolyte membrane (PEM), or solid oxide electrolyser cell (SOEC)), fuel cell (anion exchange membrane cell (AEM), polymer electrolyte membrane fuel cell (PEMFC), solid oxide fuel cell (SOFC), or ammonia (NH<sub>3</sub>)), biomass gasification, coal gasification (incl. CCUS), combustion engine, fuel cell electric vehicle (FCEV), geological hydrogen storage, hydrogen fuel station, hydrogen liquefaction (LH<sub>2</sub>), hydrogen tank storage, liquid organic hydrogen carrier (LOHC), methane pyrolysis, methanol (CH<sub>3</sub>OH), plasma gasification, steam methane reforming (incl. CCUS), or Syngas
- Production source/colour: green hydrogen, blue hydrogen, turquoise hydrogen, or white hydrogen
- Offering: digital product or physical product
- Application: energy, transport, or industry
- Environmental objectives: climate change mitigation, or the transition to a circular economy

# Methodology: Classification of funding stages

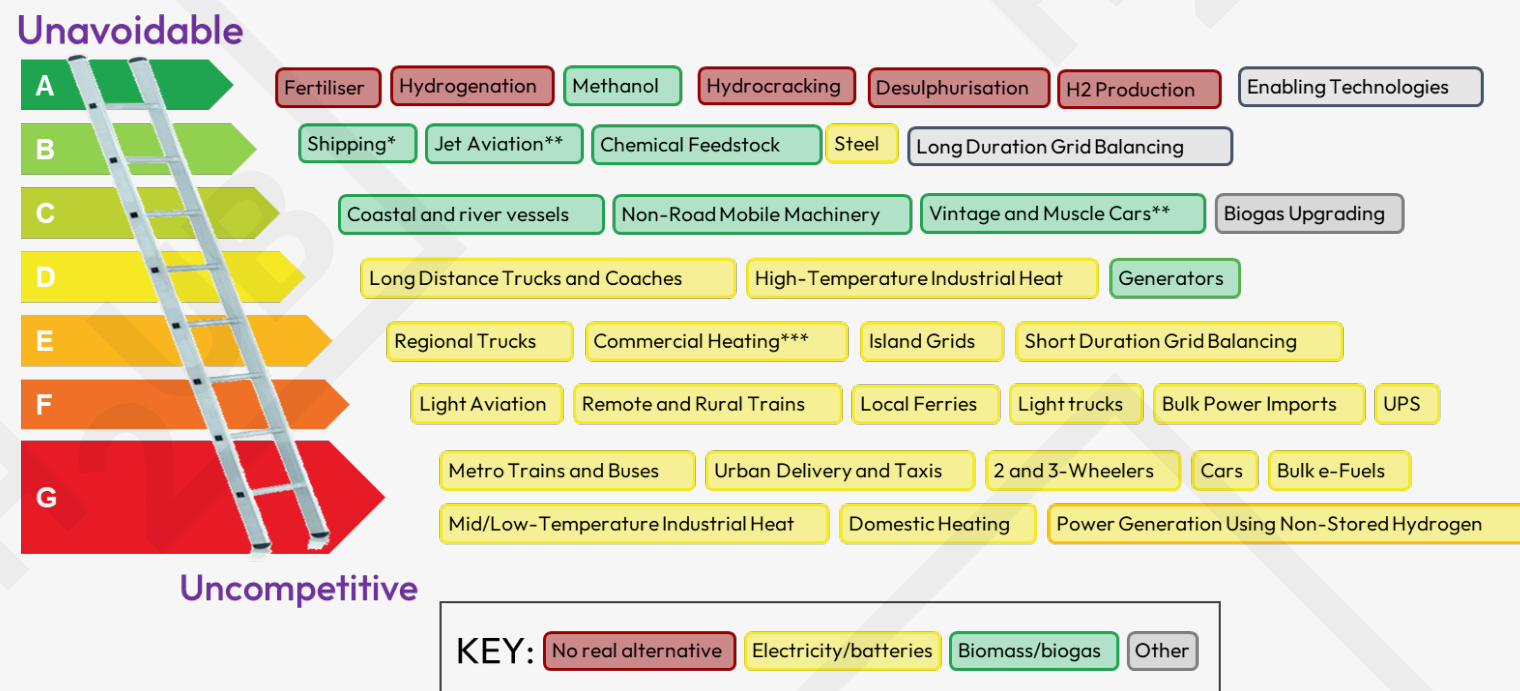
Net Zero Insight's analysts manually classify deals according to the hierarchy below:



# ANNEX

## Methodology: The Hydrogen Ladder

- Hydrogen is considered the “Swiss army knife” of the energy transition. Hydrogen is very versatile – but not necessarily the first choice for every field of application. The Hydrogen Ladder developed by Michael Liebreich from Liebreich Associates illustrates this.
- The Hydrogen Ladder shows the likelihood of hydrogen being significant for specific use cases.
- The ladder is based on various factors including cost, safety, science and geopolitics. It is updated regularly. In this study, version 5.0 was used to classify hydrogen start-ups listed in the Net Zero Insights Database in order to map funds raised according to the logic of the ladder.
- The results are shown on page 23.



\*As ammonia or methanol \*\*As E-Fuel \*\*\*As hybrid system

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# Glossary

## B

**BEV** Battery Electric Vehicle

**Biomass** Includes agriculture residues and waste.

## C

**CBAM** Carbon Border Adjustment mechanism launched by EU. It puts a price on carbon intensive goods entering the EU.

**CAPEX** Capital Expenditure. Funds used by a company to acquire or maintain assets.

**CVC** Corporate Venture Capital

## E

**Electrolysis** Process of using electricity to split water into Hydrogen and Oxygen.

**Equity funding** refers to the process of raising capital by selling shares or ownership stakes in a company to investors, in exchange for an ownership interest in the business.

**EU ETS** EU Emissions Trading System. Cornerstone of the EU's policy to combat climate change and its key tool for reducing greenhouse gas emissions cost-effectively.

**EU Green Deal** Roadmap to make Europe the first climate-neutral continent by 2050.

**EIC** European Innovation Council. Europe's flagship programme to identify, develop and scale up breakthrough technologies and game changing innovations

## F

**FCEV** Fuel Cell Electric Vehicle

**FID** Final Investment Decision. Final stage to decide to go ahead with investment or not.

**FOAK** First-of-a-kind

## G

**Grant** A sum of money given by the Government.

**Gasification** Process which converts carbon-based materials into gases.

**GDP** Gross Domestic Product

**GHG** Greenhouse Gas

## H

**Hydrogen Ladder** Illustrates the distribution of hydrogen (H<sub>2</sub>) value chains concerning their notable usage.

## I

**IRA** The Inflation Reduction Act. US law that sanctioned a \$369 billion expenditure on clean energy initiatives.

## L

**LP** Limited Partner. A person or entity who contributes capital to a venture fund.

## M

**Methane Pyrolysis** Process of splitting methane into hydrogen and carbon.

## P

**PEM** Proton Exchange Membrane

## S

**Steam Reforming** Process of Hydrogen production by reaction of natural gas and steam water

## T

**TSO** Transmission System Operator. Entity entrusted with transporting Natural Gas

## U

**UPS** Uninterruptable Power Supplies

## V

**Venture Debt** A loan given to a startup to help it stay afloat while it's in the process of securing investments through selling company shares.