

2021 —

# H y d r o g e n S t a r t u p s

**Accelerators of innovation:  
an opportunity for the Ruhr region**



# F O R E W O R D

What do California's Silicon Valley and the Pearl River Delta in South East Asia have in common? They have both been a driving force behind high-tech revolutions and ground-breaking technologies. They have built economic ecosystems that promote innovation, enable added value at record levels and create many new jobs.

Germany, on the other hand, missed out on the economisation of the internet and then the launch of the smartphone, even though important spadework for these technologies was done here. We can't allow this to happen again with the next breakthrough innovation. And that is hydrogen.

H<sub>2</sub> is the prerequisite for achieving the Paris climate goals. It is needed wherever electri-

city cannot be used. Hydrogen will pave the way for a decarbonised economy, emission-free mobility and climate-neutral heat generation. This energy carrier could trigger a new German economic miracle. And the Ruhr region has what it takes to be the starting point and centre of this development.

As Germany's largest metropolitan area, the Ruhr region is the perfect place for urban H<sub>2</sub> projects in which millions of people can participate. Research institutes in Mülheim and Oberhausen are pushing technologies such as the fuel cell. The chemical industry in Essen has been using hydrogen for decades. Duisburg is planning to replace coking coal with hydrogen for the production of "green steel". And the conversion of exist-

ing natural gas grids for H<sub>2</sub> transport will eventually bring hydrogen into people's homes - a cost-effective way to decarbonised heat. This is also being tested in the Ruhr region - in Holzwickede near Dortmund.

The startup scene in the Ruhr region has a key role to play and can give our region the decisive edge. The region is one of Germany's leading clusters in the field of H<sub>2</sub> startups and can generate the speed needed in the global race to become the first decarbonised economy. Young companies and universities with a strong practical orientation in Bochum and Dortmund can develop H<sub>2</sub> solutions with global application potential. This H<sub>2</sub> report paints an impressive picture. It shows us that if all the forces from research, the new economy, traditional in-

**Katherina Reiche**

Chairwoman of the Board of Directors at Westenergie AG and Chairwoman of the National Hydrogen Council



dustry and politics work together towards one goal, great things are possible. The Ruhr region could become a "Hydrogen Valley" in the heart of Germany and Europe. And who knows? Perhaps Bottrop will then become the "Palo Alto" of the fuel cell and Gelsenkirchen the "Shenzhen" of the hydrogen economy!

*Katherina Reiche*

Katherina Reiche





## K E Y R E S U L T S

**1 Ecological transformation:** Hydrogen will play a fundamental role in the energy transition in the coming decades - the 24-fold increase in annually installed electrolysis capacities between 2015 and 2019 already points to the enormous market volume of the sector.

**4 The Ruhr region is a H<sub>2</sub> startup cluster:** Startups are a central vehicle for accelerating the development of the hydrogen economy. An analysis of the distribution of H<sub>2</sub> startups in Germany shows that North Rhine-Westphalia and Bavaria are home to over half of them - with the Ruhr region and the Munich metropolitan area clearly standing out with 18 % each.

**2 Innovation through cooperation:** The Ruhr region has all key prerequisites needed for the development of a hydrogen ecosystem - strong H<sub>2</sub> research, an enormous density of relevant players, a multitude of possible applications in established industries and strategic initiatives that bundle existing projects.

**5 Hardware meets software:** Startups bring digital innovations into the hydrogen economy that increase technological efficiency and create decisive competitive advantages in the medium to long term. The establishment of the first European H<sub>2</sub> startup hub in the Ruhr region can therefore be seen as another key asset for the area.

**3 Increase dynamics:** Germany currently lacks the necessary speed to establish an internationally leading H<sub>2</sub> economy. Whereas in 2014, 16 % of all new global electrolysis patents were registered in Europe, by 2019 the figure had fallen to 9%, while the USA and above all China have significantly increased their share.



# 1 . B A C K G R O U N D

## 1.1. Starting point and objectives

The fight against global climate change and the requisite reduction of greenhouse gas emissions demand an enormous economic and social transformation. This is not a new insight, but at the moment legally binding and coordinated political initiatives in Europe are gaining significantly in momentum - first and foremost the European Green Deal which aims to make Europe climate neutral by 2050. This show of political strength opens up a window of opportunity where green innovations in all sectors of the economy are being promoted through new legal frameworks and funding. In contrast to the digital transformation of the last few decades, it is primarily industrial regions that are facing great challenges, but also seeing new opportunities.

Hydrogen is a promising option in this transformation process. In the fields of industrial production and in the heating and mobility sectors, it could prove to be a genuine low CO<sub>2</sub>, or even, in its green variant, a CO<sub>2</sub>-free alternative to other energy sources. When hydrogen is used, for example in fuel cells, no carbon dioxide is produced - only heat and water together with electricity. This means that (green) hydrogen can play a key role in reducing greenhouse gas emissions in Germany without restraining industrial production.

As an industrial centre in the heart of Europe, the Ruhr region has a chance of becoming one of the most important innovation clusters in the field of (green) hydrogen. There is a very lively hydrogen startup

scene in the region, which speaks for the dynamism and innovative strength at the interface between research and industry. The aim of this report is to highlight this strength and to demonstrate what is needed in order to take the H<sub>2</sub> cluster in the Ruhr region to the next level.





## 1.2. The political transformation

The economic opportunities offered by hydrogen are also becoming increasingly important in public perception, although there is a high level of polarisation. Without going into the debate in detail, the key facts to note are: Green hydrogen, which is the focus of developments in the long-term, is not an existing energy source, but an energy carrier. As such, it must always be produced by using electricity. If it is to play a central role in the energy transition, there must be a stronger expansion in renewable energies worldwide. Looking at the European Green Deal, this is precisely the political goal for the coming decades and it is supported by a broad political majority. This is why hydrogen is gaining relevance.

Since the consequences of energy policy and of technological developments are not entirely foreseeable, there are risks in relying on hydrogen. But it is at least as risky to wait and see. The mobility industry and the Tesla automotive group are the most prominent examples of how sectors that have grown over decades can be disrupted, and even established players are struggling with innovation gaps. Against this background, it is not surprising that 13 of the 56 strongest economies in the world have adopted H<sub>2</sub> strategies in recent years. Another 13 countries are preparing strategies and in 28 initial discussions are at least underway (World Energy Council Germany 2021). Ultimately, such political activities are instrumental in creating new framework conditions and establishing facts in a still rather uncertain market.

Figure 1: H<sub>2</sub> strategies in the 56 strongest economies worldwide

Source: World Energy Council Germany 2021

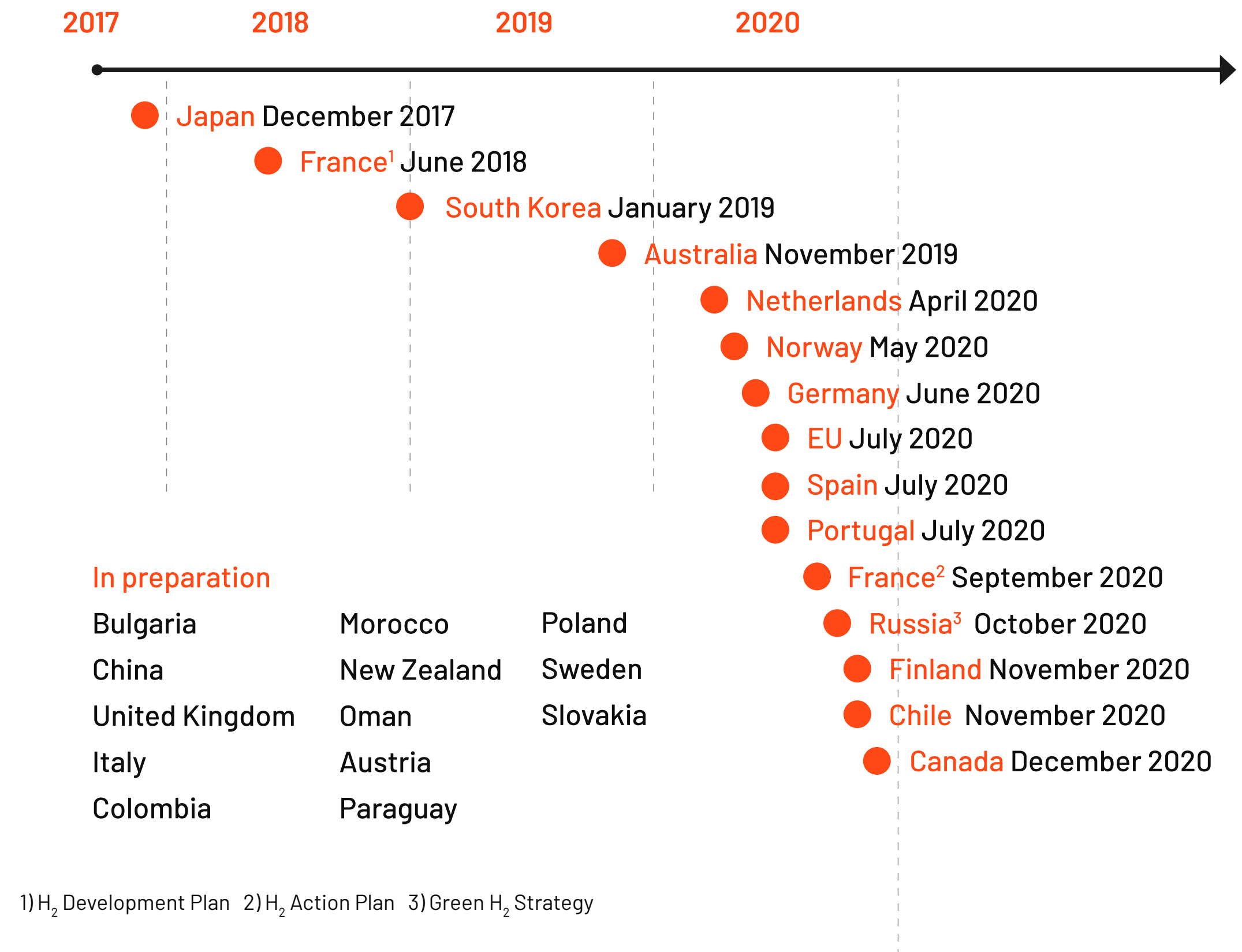
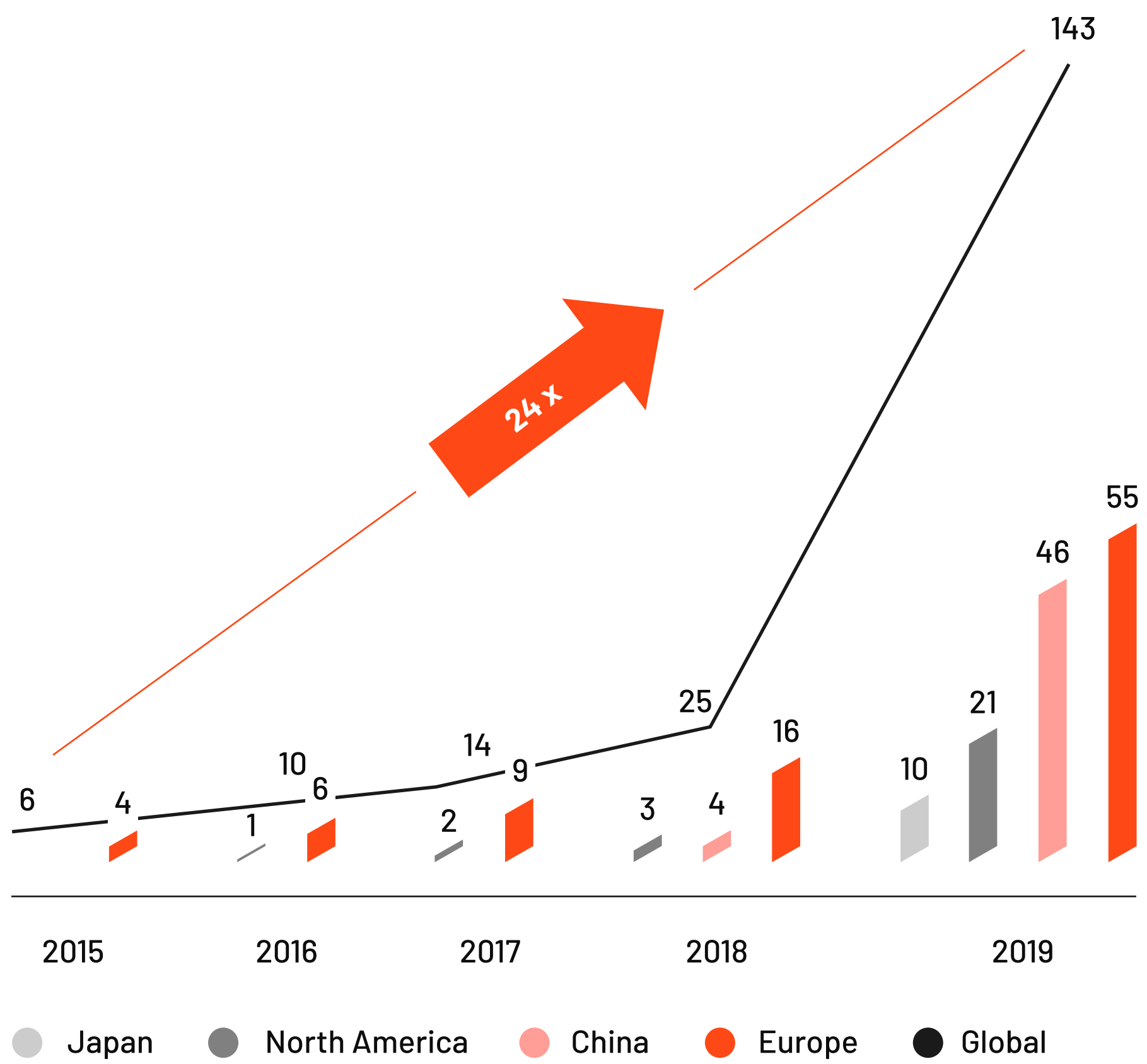


Figure 2 : Electrolysis capacity (in megawatts) becoming operational annually 2015-2019, by region

Source: Own chart based on International Energy Agency 2020



Government investments, subsidies and legally binding measures to regulate CO<sub>2</sub> are the most important political framework conditions for the development of a global hydrogen economy. The growth of the sector can be roughly estimated by looking at the rapid increase in the production of hydrogen (Figure 2 ). While Europe is currently still leading the way, the USA and China in particular are clearly catching up. These changes create opportunities in particular for strongly industrialised countries and regions that have the scientific know-how as well as the necessary infrastructure alongside established companies in the relevant sectors such as the energy industry and steel production. In contrast to the digital economy, a local ecosystem is a fundamental prerequisite for the hydrogen economy. This is precisely what makes the Ruhr region one of the most promising European loca-

tions for this future technology. The region and the German economy as a whole can benefit in the long term by making domestic industries fit for the future on the one hand and by exporting new machines and technology on the other.



*"The development of a hydrogen economy holds huge opportunities for North Rhine-Westphalia in terms of ecology and economy: if used systematically, hydrogen can enable us to save 25% of our current CO<sub>2</sub> emissions in the future. This could create up to 130,000 additional jobs. Thanks to our central location in Europe and our industrial strength, we have everything it takes to become the top hydrogen location in Europe. Our Hydrogen Roadmap North Rhine-Westphalia shows the way - and is an incentive for companies, startups and research institutes to go full steam ahead with innovative solutions in the field of hydrogen."*

*– Prof. Dr Andreas Pinkwart, Minister for Economic Affairs, Innovation, Digitalisation and Energy of the State of North Rhine-Westphalia*

### **1.3. Importance of the ecosystem**

The basic prerequisite for the development of a hydrogen economy is the existence of an ecosystem that covers the entire value chain, starting with the generation and provision of (renewable) energy for the production of the gas in large electrolysis plants, through storage and transport and finally its use, for example in fuel cells in the mobility sector or as an energy carrier in steel production. Research institutes and industry must cooperate if we are to succeed in building up a well-functioning and sustainably profitable ecosystem. What matters now is combining scientific innovations with practical experience from industry, creating synergies and jointly leveraging the economic potential of hydrogen (Hebling et al. 2019).

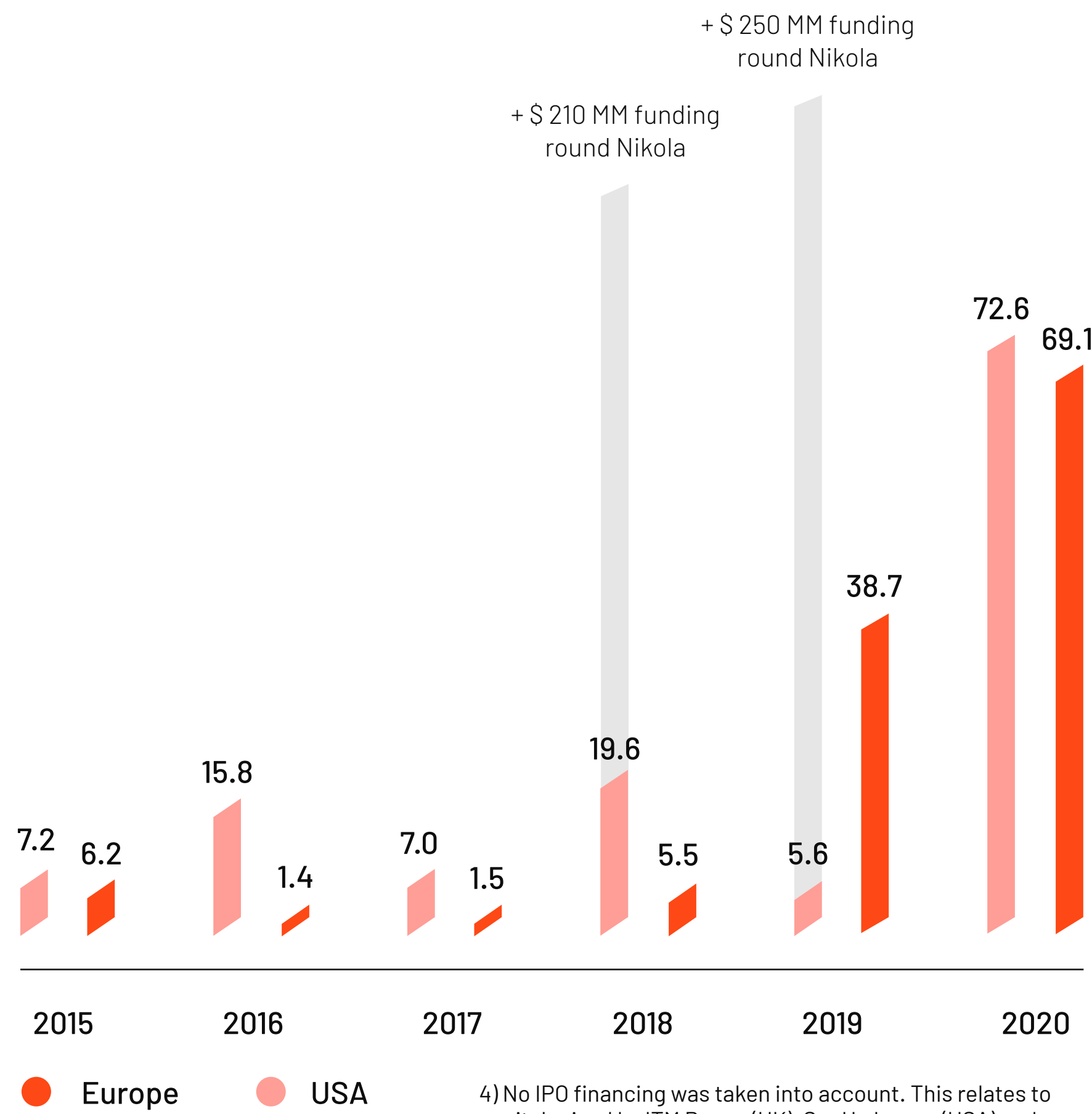
In addition, governments must offer subsidy programmes and incentive systems to boost innovation in the hydrogen economy. At the moment the costs of producing clean hydrogen are still relatively high and the market volume is rather small - a constellation that should be bridged by political initiatives and financial incentives. The goals of these programmes at national and multilateral level are a close exchange between industry and science, feasibility studies or launching pilot projects in towns and cities - such as H<sub>2</sub> buses in public transport, for example.

When it comes to hydrogen, the goal must be to put the existing technical innovations into practice as quickly as possible. The prerequisite for this, as emphasised above, is an ecosystem that covers the entire value

chain. Governments are pushing these developments, but we also need players with enough courage to get the innovations on the road. Startups play a decisive role here as they are dynamic and willing to take risks (Seitz et al. 2020). They are able to give the hydrogen economy the necessary push and investment figures already indicate how important they are becoming in the H<sub>2</sub> sector (Figure 3).

Figure 3: Investments in young hydrogen companies (founded since 2000) in Europe and the USA in million US dollars<sup>4</sup>

Source: Own evaluation based on data from Crunchbase



<sup>4</sup> No IPO financing was taken into account. This relates to capital raised by ITM Power (UK), SunHydrogen (USA) and Nikola (USA).

*"The potential of H<sub>2</sub> for the decarbonisation of large industrial sectors is finally being recognised. Since the real potential of H<sub>2</sub> can only be unleashed on a large industrial scale, it is important that investors along the entire value chain simultaneously focus on scaling: We need investments in new technologies in order to optimise and increase efficiency and also in the expansion of production capacities and in infrastructure. Industrial centres such as the Ruhr can and must set the right signals, and public authorities, industry heavyweights, private investors as well as SMEs and startups must all play an equally active role. A huge future market is emerging!"*

– Robert Gallenberger, Partner at the Industrial Technologies Fund of btov Partners





# 2 . T H E R U H R

## as a hydrogen region

### 2.1. Basics and fields of application

The hydrogen economy can be roughly divided into three areas: production, storage and distribution as well as usage of the energy carrier. Up to now, hydrogen has mainly been produced from gases such as methane or natural gas. Another possibility is the production through electrolysis of water – a process that, in view of the long-term goal of CO<sub>2</sub> neutrality, is likely to be of the greatest importance in the future. The term green hydrogen is used if the electricity needed for production comes entirely from renewable energy sources. Electrolysis is therefore a key technology in the hydrogen economy.

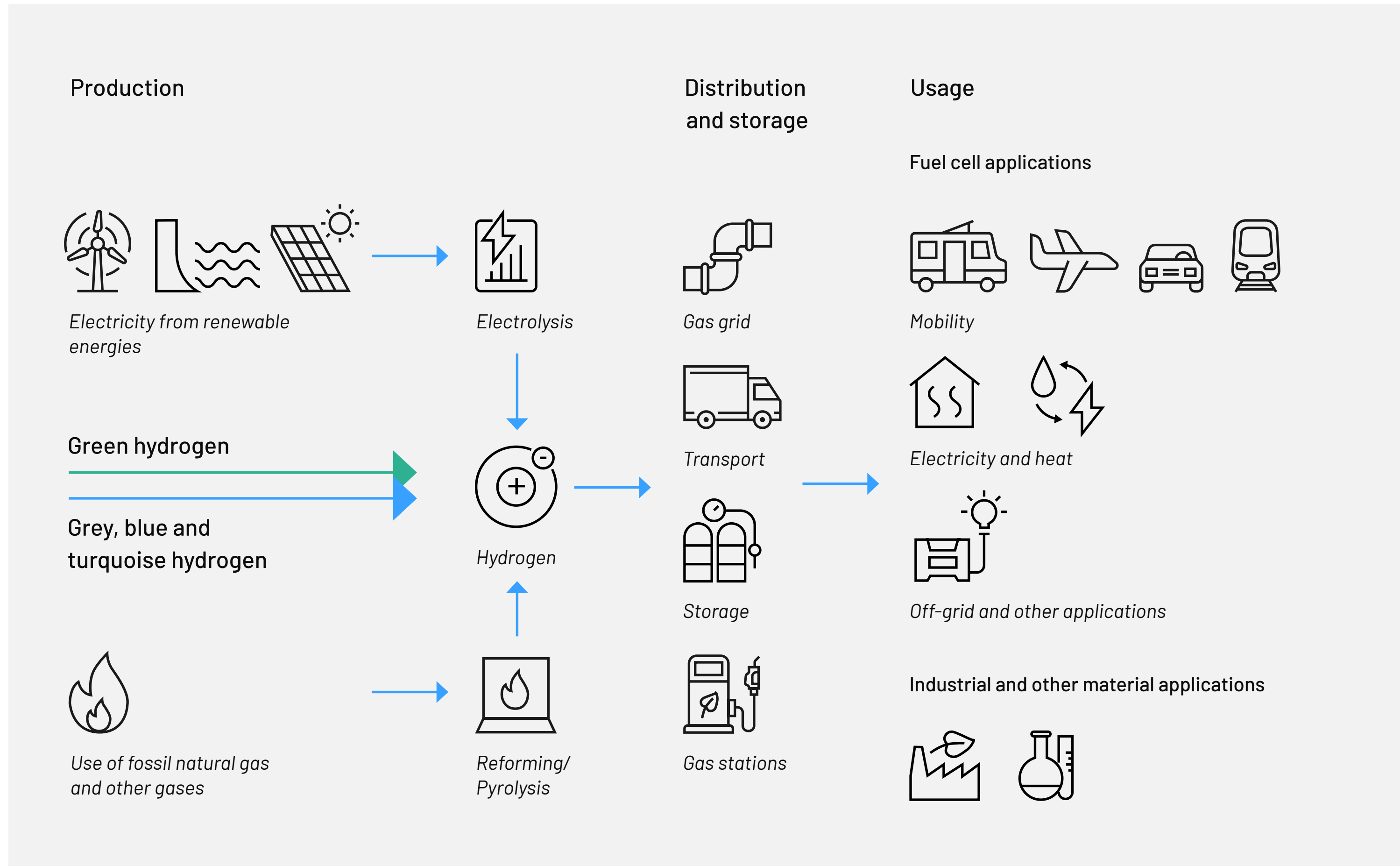
The existing gas pipeline network plays a central role in hydrogen distribution and this gives the Ruhr region a huge advantage: Air Liquide already operates a 240-kilometre H<sub>2</sub> pipeline in the Ruhr and neighbouring regions – the longest in Europe – and supplies large industrial consumers. In addition, the Essen-based gas network operator OGE is planning to convert existing gas pipelines to create the first publicly accessible hydrogen grid.

The basic technology for the usage of hydrogen is the fuel cell which can be used in various applications: for example in mobility and logistics, i.e. in cars and trucks, in trains and even in aviation. The use of fuel cell systems for electricity and heat is also well developed. However, whereas these

fields of application are in part struggling with efficiency problems, one particularly promising area of use is in industry. This is precisely where the Ruhr region has its strengths. It is home to a diversity and density of industries that benefit from climate-friendly hydrogen – from steel production to the chemical industry and refineries (International Energy Agency 2019). The enormous potential within the region is illustrated by the example of Thyssenkrupp's Duisburg steelwork, which alone is responsible for 2.5% of Germany's CO<sub>2</sub> emissions and which is aiming for CO<sub>2</sub> neutrality by 2050 (Handelsblatt, 2019).



Figure 4: Sketch of the hydrogen economy:  
"From wind turbine to electric motor"



*"Evonik is committed to the development of the hydrogen economy: We are involved in various stages of the value chain in the hydrogen economy. We already transport and produce hydrogen for our customers and our processes, we are researching new solutions to produce speciality chemical products with lower emissions and we want to close the gaps in the hydrogen economy."*

*– Dr Harald Schwager, Deputy Chairman of the Executive Board Evonik*

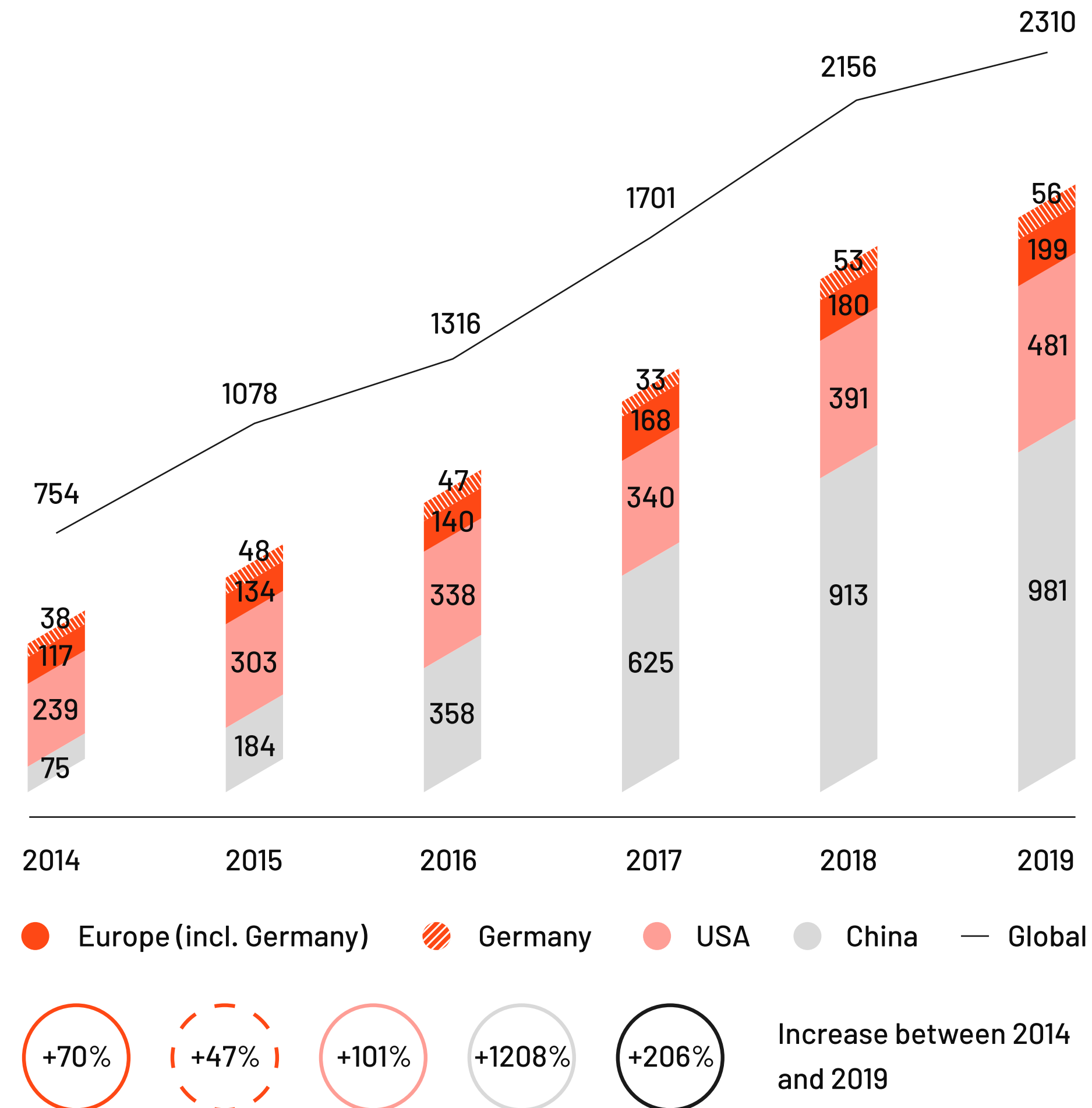


## 2.2. Research meets industry

Research work focussing on practical applications is a decisive factor in the international competition for innovation. A look at the development of relevant patents indicates where Germany stands internationally in the field of hydrogen. Overall, the number of patents filed annually in the field of electrolysis - which can be seen as an indicator of the expected market ramp-up - roughly tripled worldwide between 2014 and 2019. There was a particularly sharp increase in China. Starting from a relatively low level, China has now clearly overtaken the USA and Europe, with the European share of newly filed patents falling from 15.5 % in 2014 to 8.6 % in 2019. These figures are a clear indication of how important it is to continue to strengthen existing research clusters, particularly in the Ruhr region, and to ensure that theory and practice are combined.

Figure 5: Number of annually registered patents in the field of electrolysis between 2014 and 2019

Source: Own analysis based on data from the Fuel Cells and Hydrogen Observatory



With its unique characteristics, industrial history and experience, the Ruhr region has the necessary potential and the opportunity to develop into one of the central European hydrogen clusters. The region is home to several universities and has large research capacities in the hydrogen sector - for example at the universities of Bochum, Dortmund and Duisburg-Essen, as well as the Westphalian University of Applied Sciences. In addition, there are a number of non-university research institutions with correspondent specialisations, the most important being the Fraunhofer UMSICHT Institute in Oberhausen, the Max Planck Institute for Chemical Energy Conversion in Mülheim, the Hydrogen and Fuel Cell Center (ZBT) in Duisburg and the "Gas- und Wärme-Institut" in Essen.



However, apart from research and individual practice-related projects, the emergence and development of a hydrogen ecosystem is also dependent on coordinated efforts by established players who can create the necessary infrastructure and a broad demand base through major investment projects. And the Ruhr region is well positioned in this respect: in addition to the initiatives of locally rooted companies such as E.ON, Westenergie, Thyssenkrupp, RWE and EVO-NIK, specialized firms such as Air Liquide and Linde are active in the region. Grid operators OGE and Amprion are planning to expand production capacities and distribution grids - both in and outside the region.

The strength of the Ruhr region lies above all in combining industrial power with scientific expertise in cooperation projects (IW Consult 2020). In addition, the GET H<sub>2</sub> initiative in the Ruhr region is a genuine flagship

project at the interface between industry and research, connecting companies along the entire value chain to create a nationwide hydrogen infrastructure. A hydrogen ecosystem is thus being established which will extend from the heart of the region throughout North Rhine-Westphalia and parts of the Netherlands and Belgium and that benefits above all from the chemical, petrochemical and steel industries (Agora Energiewende and AFRY Management Consulting 2021). This H<sub>2</sub> cluster will not only help to secure endangered jobs in the regions, but also generate many new employment opportunities (Ludwig Bölkow Systemtechnik 2019).

*“The role of hydrogen as an energy carrier is gaining real momentum – not just in research but also in industrial testing. This is crucial since research has to go hand in hand with the technical development of innovations. As a storable and CO<sub>2</sub>-free energy carrier, hydrogen can be used in diverse fields, from industrial manufacturing (steel, chemistry) to transportation and heat supply. Demand will be particularly high in industry-heavy areas such as the Ruhr region. The biggest obstacle: the lack of renewable energy in Germany. Political action must be taken!”*

*– Prof. Dr Angelika Heinzl, Managing Director of the Hydrogen and Fuel Cell Center (ZBT)*



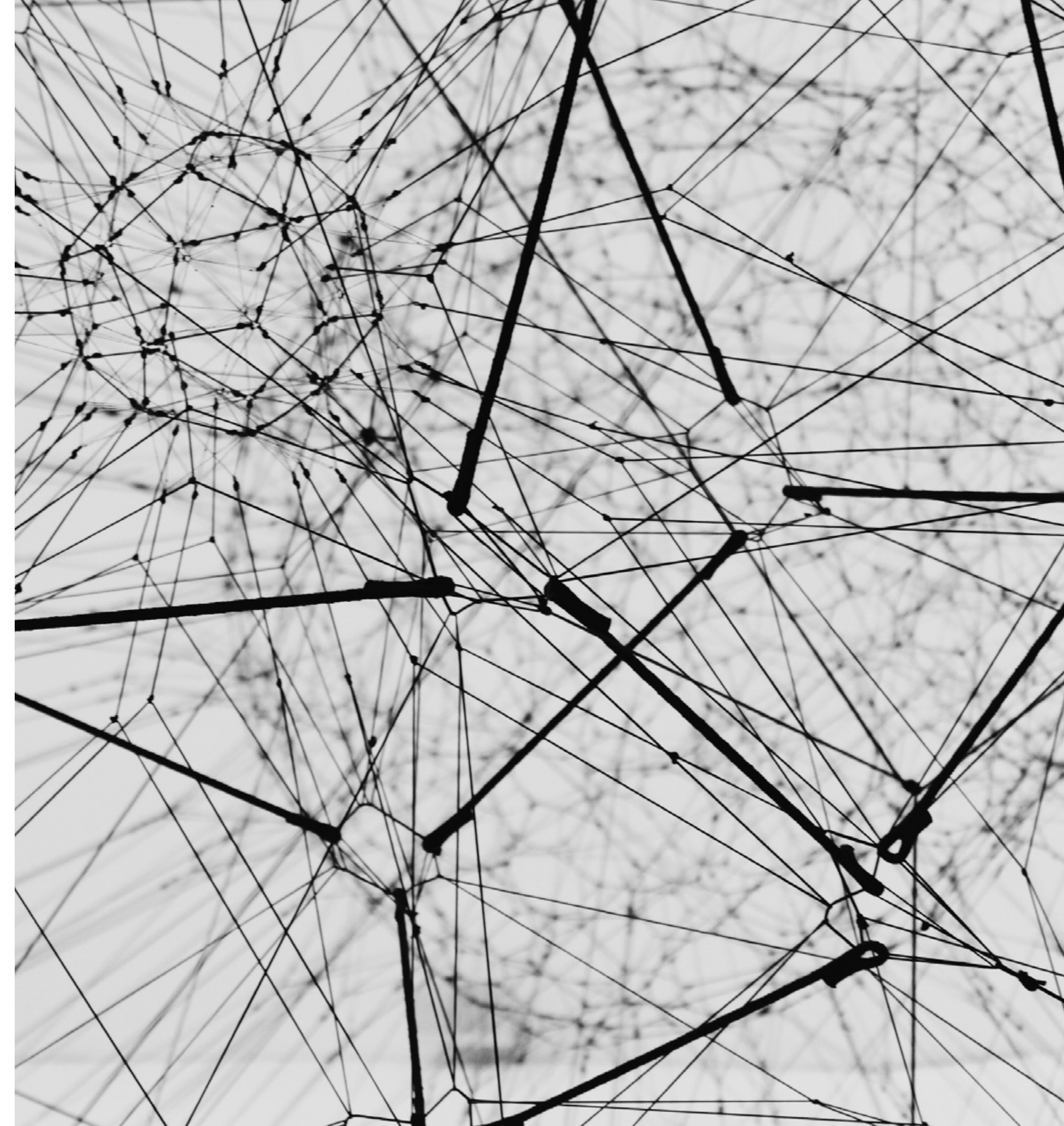
### 2.3. Projects and new networks

Building an ecosystem in a new and capital-intensive field such as hydrogen is a real challenge. This is why traditional support programmes based on existing structures quickly reach their limits. The lack of clear market opportunities restricts financing options and the differing interests of relevant players can hinder dialogue. However, cooperation is needed along the entire value chain, linking all actors with their various competencies and goals: producers of renewable energies, innovators in the field of electrolysis, corporations that are driving the expansion of the infrastructure both financially and technologically as well as consumers, to name but a few.

Industry and policymakers have all recognised the need for new joint ventures and

this has led to greater momentum on many levels. The European Clean Hydrogen Alliance, launched in 2020 as an initiative of the EU Commission, aims to bring together all stakeholders involved - first and foremost companies - and to promote investment as the overriding goal (European Commission 2020). In Germany, the mission of the National Hydrogen Council, also launched last year, is to promote the implementation of the National Hydrogen Strategy. The GET H<sub>2</sub> initiative, mentioned above, has set itself the goal of developing a hydrogen market as well as the related infrastructures and value chains in Germany and Europe.

There is a need for cooperation in the H<sub>2</sub> sector at all levels: the EnergyAgency.NRW plays an important role in North Rhine-Westphalia. One of its networks, the Fuel Cell, Hydrogen and E-Mobility Network NRW,







which was founded back in 2000, has developed into a hub that facilitates access to funding programmes and initiates numerous projects. In addition, other regional associations have been formed in the Ruhr region. The h2-netzwerk-ruhr e. V. was founded as early as 2008, and in recent years in particular the landscape has become more dynamic: Good examples are new initiatives such as the Hy.Region.Rhein.Ruhr association in Duisburg, the bundling of competencies in the H<sub>2</sub> Unit of Essen Economic Development Agency or the H2UB in Essen, which is the first hub to bring together European startups, companies and research. However, it is important to create a common basis that bundles the different networks and aligns them towards a common goal.

Projects such as the conversion of the Ruhrbahn fleet from diesel to fuel cell buses from 2024 to 2033 make the transition to the hydrogen economy particularly tangible. The RH2INE initiative endorsed by the North Rhine-Westphalian Ministry of Economic Affairs and the Dutch province of South Holland should also be mentioned. It aims to create a climate-neutral Rhine-Alpine transport corridor. In this context the Port of Duisburg is already working on the decarbonisation of freight transport and inland shipping. Nevertheless, as important as the various projects may be, at their core they should all be geared towards building a comprehensive H<sub>2</sub> ecosystem in the Ruhr region.

*"With our established industry, leading research institutes and strong infrastructure, we in the Ruhr region have what it takes to get the hydrogen market off to a good start. Innovative startups are also bringing the necessary dynamism into the region. To be successful in international competition, we need to combine these strengths and work more closely together - because hydrogen is teamwork. That is why we are happy to cooperate in initiatives such as Essen's H<sub>2</sub> Advisory Board that aims to improve networking in the region."*

*- Bernd Tönjes, Chairman of the Board of Executives RAG-Stiftung*



# 3 . D E V E L O P M E N T

## of the Ruhr cluster

### 3.1. H<sub>2</sub> startup cluster in the Ruhr region

Hydrogen is not only a topic of interest to research and industry. With the change in political and social framework conditions, startups also see new market opportunities here. This is clearly reflected in the growth in the number of startups in the H<sub>2</sub> sector: Until 2010, there were virtually no startups in the hydrogen industry in Germany, the few exceptions being largely involved in specialized electrolysis and fuel cell technology applications. Since 2015, however, a clear increase in startup dynamics can be observed: 41 of the 57 identified hydrogen startups based in Germany were founded during this period. These startups are active in all three fields of application - production, storage and distribution as well as usage.

Startups are extremely important in the development of a hydrogen ecosystem: they put novel ideas into practice and are therefore key indicators of the innovative strength of a particular region. The distribution of the 57 German startups shows that two federal states, North Rhine-Westphalia and Bavaria, account for more than half of German hydrogen startups - with the Ruhr region and the Munich metropolitan area clearly standing out as H<sub>2</sub> innovation clusters (Figure 6). The Ruhr alone is home to 18 % of all German hydrogen startups. The Ruhr region's strength in terms of research, industry and infrastructure is therefore also reflected in the startup scene. This confirms the huge potential of the region and its chances of making a name for itself as an international cluster in the field of hydrogen (Hirschfeld et al. 2020).

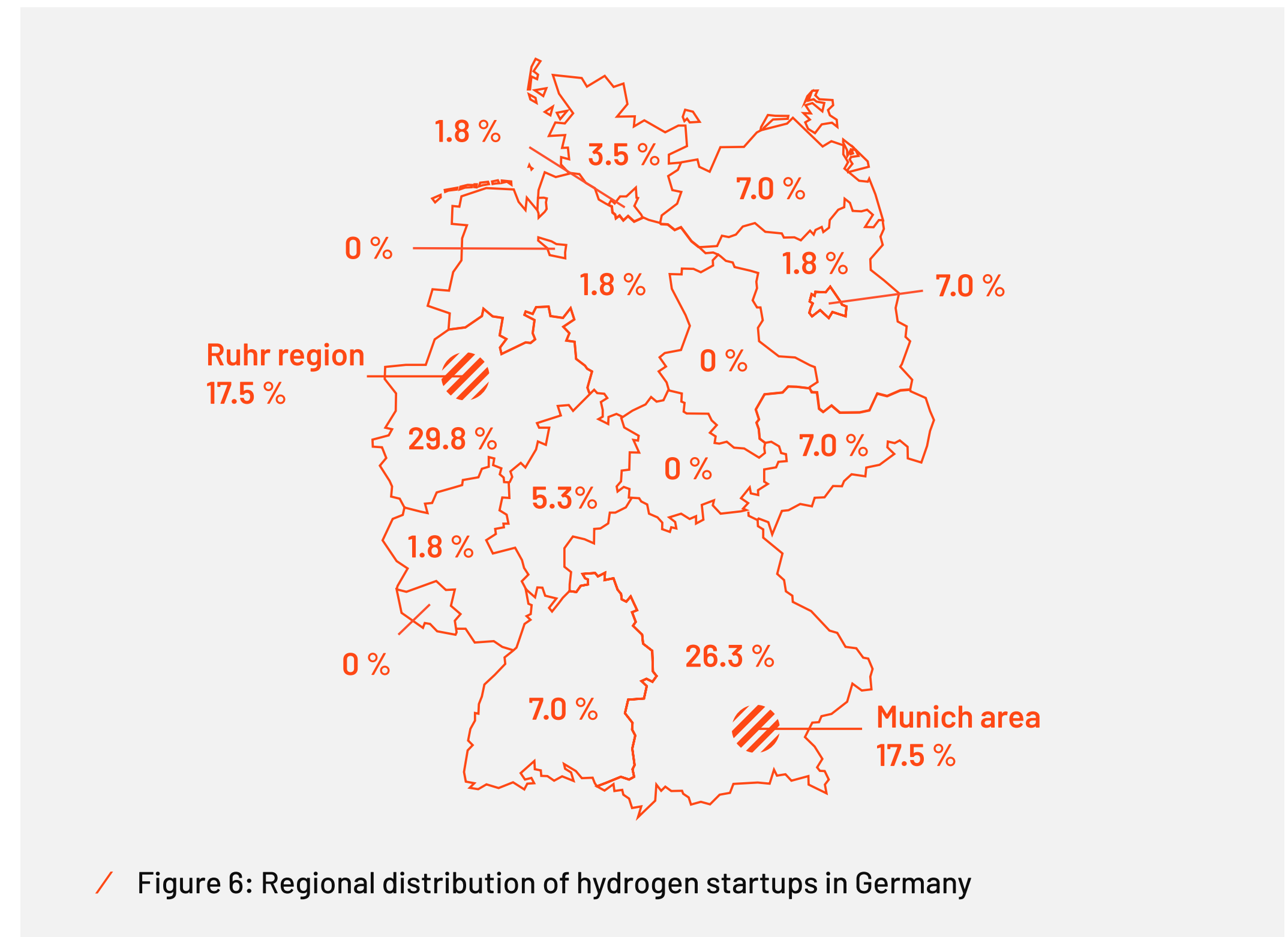


Figure 6: Regional distribution of hydrogen startups in Germany

The locational advantages of the Ruhr region are not only reflected in the number of startups but also in the fields of specialisation of the H<sub>2</sub> startups here. Most of the newly founded companies in the region focus on industrial applications and in putting research results into practice – for example in the field of electrolysis (see highlights in Figure 7). Publicly funded projects such as NEWELY or LIKELY, where a wide variety of players are involved in the further technical development of electrolysis, are good examples of the links between research, industry and startups. Alongside their research expertise, startups in the Ruhr region also stand out for their smart solutions with an industrial focus, producing, among other things, components for hydrogen filling stations or cutting torches.

*"The dynamism of startups is a crucial success factor in the hydrogen market ramp-up. However, unlike in the digital world, they need partners who, in addition to financial resources, also contribute skills along the entire value chain. OGE has set up the H<sub>2</sub>UB with the aim of creating a centre and beacon of cooperation where established companies, research institutes and startups can contribute their strengths and mutually benefit from each other."*

*– Ralf Werner, CIO OGE*







/ Figure 7: Hydrogen startup landscape

/ \* Ruhr area





### 3.2. More dynamism through startups

Startups are pioneers who are always looking for competitive advantages and consequently put scientific innovations into practice as quickly as possible. In the H<sub>2</sub> sector, in particular, research-based startups are enormously important because they are in close contact with the scientific world, but at the same time have a business mindset and never lose sight of the end product. Membrasenz, one of the many startups in the Ruhr, is working precisely at this interface: Their research into the development of a membrane needed in electrolysis is a vital contribution to one of the key technologies in the hydrogen economy, increasing the region's chances of becoming an international leader in this field. To achieve this, an H<sub>2</sub> ecosystem must be developed

where state funding is directed specifically at startups and at the same time the attractiveness of the location for investors is strengthened.

*"Even when I was studying energy and process technology in Serbia, my focus was always on the links between research and practical applications - the potential in the field of hydrogen has always fascinated me. In 2011, I moved to the Ruhr University Bochum where I was in charge of important projects and worked with top international people in the field of hydrogen. But the connection to industries in the region is just as important to me: having customers and partners close by is an enormous advantage in the field of hydrogen."*

*– Dr Jelena Stojadinovic, Founder and CEO Membrasenz*





The startup Membrasenz is a prime example of how innovative research can be transferred into commercial practice. In 2011, as part of a research project at the Ruhr University Bochum, founder Dr Jelena Stojadinovic began developing a membrane whose material properties make alkaline electrolysis more energy-efficient. She filed a patent application for the promising new development and received various grants to finance the spin-off including an EXIST business startup grant. Membrasenz was founded in 2015. The membrane is now nearly ready to be launched on the market and the company is cooperating with several partners on setting up production.

Although the public image of startups is strongly dominated by B2C companies such as Zalando, startups already generate the majority of their turnover in the B2B sector - 69 % to be precise (Kollmann et al. 2020). This makes them important partners of established companies which benefit both as customers and through profitable joint ventures with the startups. In the Ruhr region, the greatest potential of new hydrogen technologies lies in the reduction of greenhouse gas emissions in industrial production processes. This poses particular challenges for small and medium-sized companies which find it more difficult to implement technological developments alongside their core business. Startups such as PMR Tech are pushing such innovation processes and making a decisive contribution to the future viability of the

industrial sector. Central prerequisites are strategic partnerships with industry and opportunities for on-site exchange.

*"Industry is showing great interest in our product and overall you can sense a lot of dynamism in the field of innovative hydrogen solutions. At the same time, the road to market maturity as a hardware startup is not easy - especially when it comes to financing. Industry is therefore very important for companies like us, not only as a customer, but also as a strategic partner. Our aim is to exchange ideas on the ground, build trust and convince people."*

*- Phillip Reisenberg, Founder and CEO PMR Tech*



The startup PMR Tech, founded in Herne in 2019, wants to push the industrial transformation forward. The product, a hydrogen-oxygen gas generator based on a water electrolyser, has successfully completed initial practical tests and is on its way to go to market. With the help of the generator, hydrogen and oxygen can be used in a cutting torch, for example on steel, as a climate-friendly alternative to the natural gas or propane gas currently used. Thanks to the wide range of possible applications, this also offers smaller companies the opportunity to improve their CO<sub>2</sub> balance.

Startups are often important vehicles for innovation, especially in the hardware sector: In the H<sub>2</sub> sector, funding programmes offer founders the opportunity to set up business models focused on research transfer and to act as a link between science and business. As a result, startups with a scientific background are emerging, equally active in research projects and product development, bringing together different actors in their work and bundling resources. This is exactly where the H<sub>2</sub> startup ProPuls comes in, a company that is pushing innovative processes in electrolysis and fuel cell technology in collaboration with various partners.



ProPuls

As a spin-off from the Westphalian University of Applied Sciences, ProPuls is contributing its hydrogen expertise to practical fields. ProPuls holds patents in both electrolysis and fuel cell technology and is working on numerous R&D projects - in cooperation with research institutes, established companies and other hydrogen startups. For example, the company is involved in the EU-funded projects Promet H<sub>2</sub> and NEWELY which aim to develop improved and cost-effective electrolysis processes, and, together with the Westphalian University of Applied Sciences and the startup iGas Energy, is planning test facilities in the electrolysis research project Hydra15.





### 3.3. Digital expertise through startups

The successful development of the hydrogen economy depends to a large extent on the establishment and expansion of technical infrastructures and components. At the same time, the ecosystem must think digitally from the outset if it is to be competitive internationally. There is a high demand for digital solutions in the hydrogen sector in order to increase efficiency in the networking of the infrastructure, for example. The advantage of startups is that they often already have the necessary digital expertise or even digital products that can be used in the H<sub>2</sub> sector.

The startup Easy Smart Grid, for example, is developing control systems with which excess electricity from renewable sources

can be diverted in real time. The BlockcENTive project is developing a blockchain application that secures and manages the feed-in and use of green hydrogen as well as its certification in the form of e-certificates. And finally, startups such as IOX offer versatile hardware and software solutions that can be used to push digitalisation and optimisation of production processes. The players in the hydrogen economy should actively exploit these potentials in order to build the most efficient applications possible right from the outset.

In order to connect the old and the new economy, the hydrogen ecosystem must actively promote networking - formats such as the H<sub>2</sub> Tech Innovation Night organised by the H2UB and the digihub Düsseldorf Rheinland are good examples of how this

can be done. Events, network meetings and face-to-face talks are enormously important for startups in order to establish direct contacts with industry. At the same time, the mainstream economy should communicate its needs clearly to startups in the form of reverse pitches or startup challenges. This would enable startups to see where the market opportunities are and give industry the chance to see for itself the added value of cooperation. Strategic partnerships can then be formed that will speed up the development of the ecosystem tremendously.

*"The huge interest in our expert event "Digital Drives Hydrogen" on March 4 and in our new Tech Trend Report show that, unlike in all the other industrial sectors, digitalisation is not just a simple transformation issue, but the crucial factor in setting the course for a universal circular hydrogen economy, with North Rhine-Westphalia and Germany as future H<sub>2</sub> business centres in Europe and worldwide."*

*– Dr Klemens Gaida and Peter Hornik, Managing Directors of the Digital Innovation Hub Düsseldorf/Rheinland*

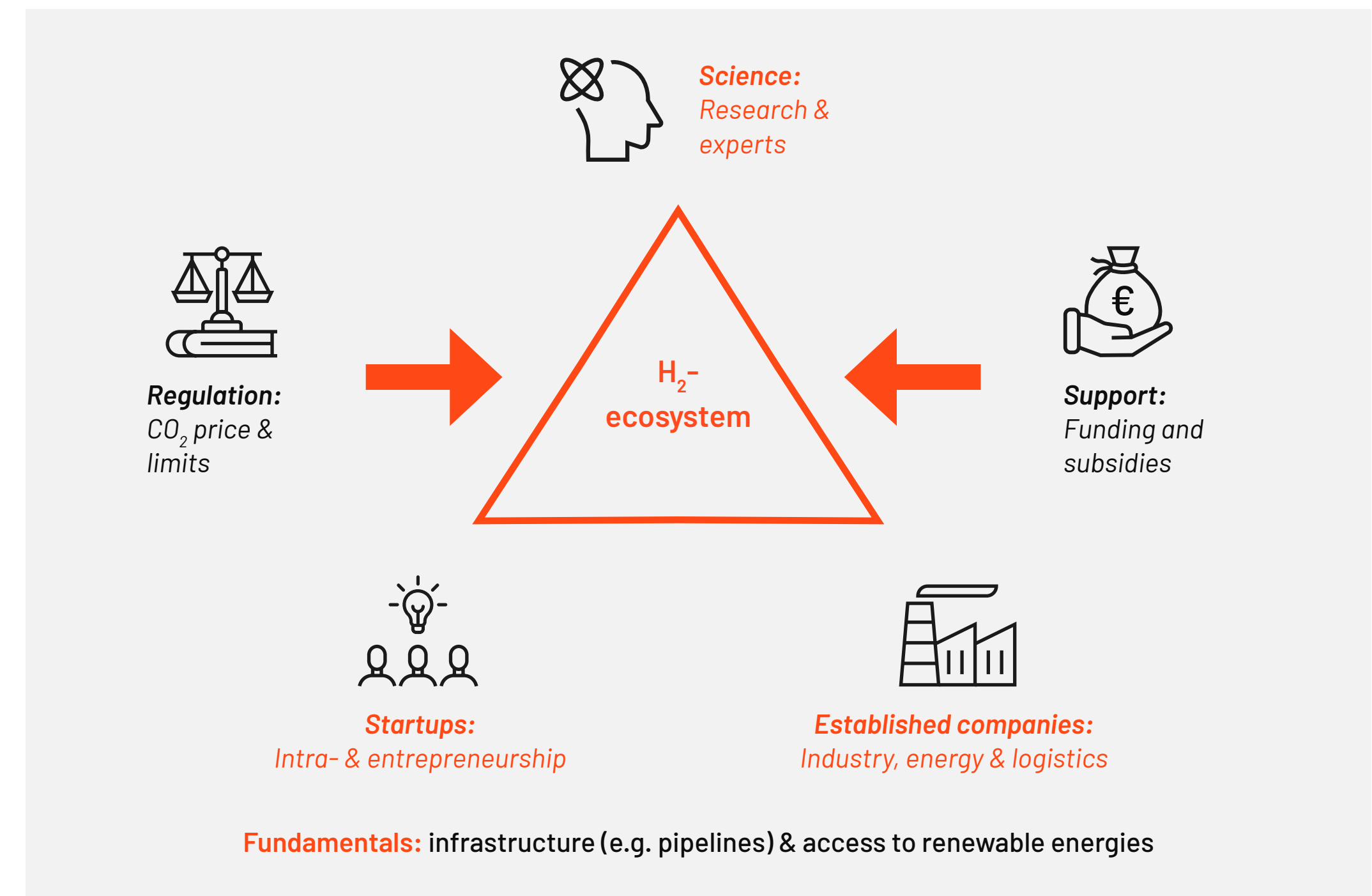
# 4 . W I N D O W O F O P P O R T U N I T Y

- why now?

*"Hydrogen has long been seen as an issue solely for the big players: However, the increasing number of small companies being founded in the H<sub>2</sub> sector highlights the potential of startups in this field. They are essential drivers of innovation, add dynamism to the market ramp-up and are an important bridge between theory and practice. In order to exploit these opportunities to the full, we must continue to promote the transfer of research into practice as well as cooperation between startups and established companies."*

*- Franziska Teubert, Managing Director Startup Association*

With the German National Hydrogen Strategy and the European Union's Green Deal, policymakers have expressed their will to build up and support the hydrogen economy in the long term, sending a clear signal to business, science and society. These proclamations are linked to stricter regulation of emissions and support for the energy transition in the form of subsidies - both are important drivers of the hydrogen ecosystem. The development of production capacities and infrastructures, in particular, is dependent on public funding as this is the only way to reduce the production price significantly. The Ruhr region, with its industrial heavyweights, the density of H<sub>2</sub> research and the high level of startup activity in this sector, has all the important prerequisites needed to build up one of the leading inter-



/ Figure 8: The hydrogen ecosystem



national clusters in the hydrogen economy. What we have to do now is to exploit the current momentum in order to strengthen the ecosystem even further.



Four recommendations for the next stages of development of the hydrogen ecosystem in the Ruhr region can be derived from this report:

**1** In most fields of application the use of hydrogen is still at the outset, so research is a central component in the hydrogen market ramp-up. In order to succeed in international competition, H<sub>2</sub> research in the Ruhr region must be pushed forward with a stronger focus on applications and established on a broader basis. The aim should be to expand research output in the region, increase the number of qualified employees and give more weight to ideas and stimuli from practice. To this end, the funding of the existing institutions should be reassessed and potential for expansion identified – especially at the interfaces between practical projects and joint ventures.

**2** A new entrepreneurial spirit has been growing in the field of hydrogen and lots of new companies are being set up – with the Ruhr region leading the way. This development should be strengthened by promoting more spin-offs from universities and research institutes. An inter-university platform should be set up, located, for example, at the University of Duisburg-Essen and the ZBT. The incubator Cube 5 in Bochum, which supports potential founders at the Horst Görtz Institute for IT Security, could serve as a model for this. The platform must also be open to founders from outside the Ruhr region in order to create a pull-effect. At the same time, the H2UB in Essen should be given special support as a national and international magnet for existing startups, so that the Ruhr region can become a hydrogen hotspot in the startup ecosystem. Startport in Duisburg is an

example of a successful best practice in the field of logistics. The important thing here is to create genuine opportunities for people to talk face-to-face, ultimately enabling not only networking but also joint projects.

**3** This report makes it clear that startups bring enormous dynamism into the hydrogen ecosystem. Strategic partnerships between startups and industry offer special opportunities: Startups contribute innovation and speed, while established industry brings experience, customers and, above all, the necessary capital. For such joint ventures to flourish, the ecosystem must offer programmes that reduce the cost of cooperation, financially as well as in personnel, and thus make projects possible in the first place. The DataHub Ruhr, run by Gründerallianz Ruhr, is just one of the companies that undertakes this task



in the field of digital innovation. A comparable programme for industrial applications with a focus on hydrogen would significantly speed up the innovation process between startups and industry. By bringing industry into contact with startups, investment activities of the established economy in the Ruhr region and North Rhine-Westphalia could be strengthened in the medium term and thus benefit the innovative capacity of the area as a whole.

**4** Alongside the political will described above, all players in the hydrogen ecosystem must work together on this task. The increasing number of initiatives, networks and projects is a positive sign. At the same time, however, there is a need for more coordination and a common strategy so that the strengths of the individual activities can be bundled and developed jointly.

This is why it is so important to appeal to the entire H<sub>2</sub> economy in the Ruhr region to work together and to develop lean and pragmatic formats. Close cooperation with neighbouring regions is also needed, with everyone working together to promote hydrogen. This is the only way to make the region the top hydrogen cluster in Germany and Europe and to raise hydrogen to the next level as a central component of the energy transition.





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#### Publisher

Bundesverband Deutsche Startups e.V.

#### Partner and Sponsor

RAG-Stiftung

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#### Design

Dina Wagasowa

#### ISBN

978-3-948895-07-5

