

Regional H₂ clusters: The hydrogen ramp-up needs domestic value chains

1. HYDROGEN CLUSTERS SUPPORT THE ACHIEVEMENT OF THE GOALS OF GERMANY'S NATIONAL HYDROGEN STRATEGY

Domestic value chains in the form of regional systemic hydrogen clusters¹ can make a major contribution to accelerating the hydrogen ramp-up in Germany. Regional systemic hydrogen clusters complement the projects currently focussed on for energy-intensive industries in a meaningful way in order to enable the rapid ramp-up of hydrogen in the area, especially away from the core network. In the latter case, the import of hydrogen and the connection of the sites to the core network are the main topics.

The potential of regional H₂ clusters must be utilised in order to make hydrogen and its derivatives available and used on a large scale against the backdrop of international competition for value creation and technology leadership. On-site applications, for example, in industrial and business parks or in the mobility sector, are used to test and scale complex technologies along the value chain and to develop customised business models. Numerous initiatives such as the more than 200 defined project ideas for regional systemic H₂ clusters as part of HyLand² and analyses, the discussion paper of the German Association of Energy and Water Industries (BDEW)³, the position paper of the German Association of Local Public Utilities (Verband kommunaler Unternehmen, VKU)⁴ and the dena study 'Geschäftsmodelle für dezentrale Wasserstoffkonzepte' (Business models for decentralised hydrogen concepts)⁵ or the activities of the Association of German Hydrogen Regions (Bund der deutschen Wasserstoffregionen, BdWR)⁶ impressively demonstrate the potential offered by regional H₂ clusters. For this reason, regional clusters are essential for establishing Germany as a leading provider of hydrogen technologies and contribute to achieving the objectives of the updated National Hydrogen Strategy. It is necessary to rely on technologies and components that are developed and produced here in order to advance the goal of a resilient energy system and the sovereignty of Germany and Europe.

¹ The NWR defines regional systemic hydrogen clusters as clusters that map the entire value chain locally, from production to application.

² HyLand project website.

³ BDEW (2023): Diskussionspapier für ein Marktdesign für Wasserstoff (Discussion paper for a market design for hydrogen). Version 1.0.

⁴ VKU (2023): Positionspapier 2.0 zum Hochlauf der Wasserstoffwirtschaft (Position paper 2.0 on the ramp-up of the hydrogen economy).

⁵ dena (2023): Geschäftsmodelle für dezentrale Wasserstoffkonzepte - Zeit zum Nachsteuern (Studie) (Business models for decentralised hydrogen concepts – time for readjustment (study)).

⁶ BdWR (2024): Anschlag der regionalen Wasserstoffwirtschaft. Positionspapier des Bund der Wasserstoffregionen (BdWR) (Boosting the regional hydrogen economy. Position paper of the Association of Hydrogen Regions (BdWR)).

The task now is to accelerate the transformation: across the entire value chain, OEMs/small and medium-sized companies (SMEs)/manufacturing industry have already made major investments in production in Germany, including in their own production capacities, intellectual property and expertise, human capital and partnerships.

2. WHAT ARE THE ADVANTAGES OF REGIONAL H₂ CLUSTERS?

2.1 REGIONAL H₂ CLUSTERS ENABLE INDUSTRIAL TRANSFORMATION IN THE REGIONS

Regional clusters are particularly important for leveraging regional industrial and technological potential and enabling local value creation. Regional hydrogen production offers a great opportunity to defossilise their own processes for German SMEs in particular, which are also active in regions outside the planned hydrogen core network. The regional clusters also act as a nucleus for the defossilisation of other application sectors, such as the mobility sector. In addition, the consumer structure in the regions is clearly defined and enables the overall system to be designed to meet demand. This creates the framework for almost complete utilisation of the material flows generated (including regional renewable energy, hydrogen, waste heat) and thus also for increasing the defossilisation potential in the respective regional ecosystems. This holistic approach also has a positive effect on the economic efficiency of the cluster. At the same time, domestic value chains can be established, experience gained and jobs secured in order to ensure the long-term competitiveness of the regions in Germany and Europe.

2.2 REGIONAL H₂ CLUSTERS INCREASE THE RESILIENCE OF THE ENERGY SYSTEM

The establishment of regional systemic H₂ clusters in combination with the planned H₂ import corridors, the centralised hydrogen generation projects, the planned hydrogen core network and the downstream distribution grids will lead to a more resilient energy system. On the one hand, a higher proportion of demand-orientated domestic H₂ production reduces dependence on imports. On the other hand, regional systemic H₂ clusters with additional regional renewable energies can relieve supra-regional grid nodes and electricity distribution grids. Combined heat and power (CHP), including in combination with green gases such as biogas or biomethane, is predestined for the development of hydrogen in regional clusters due to its decentralised distribution across the region, as it makes a significant contribution to securing the climate-neutral supply of electricity and heat locally.

3. WHAT MAKES THE IMPLEMENTATION OF REGIONAL H₂ CLUSTERS DIFFICULT?

Current political conditions are significantly slowing down the regional hydrogen ramp-up and the implementation of H₂ clusters, which is why numerous initiatives have had to be halted due to outstanding funding, among other things. Several aspects complicate the regional approach:

3.1 H₂ CLUSTERS ARE REGARDED AS THE SUM OF INDIVIDUAL ACTIVITIES

H₂ clusters are not currently set up as an integrated whole. In most cases, the various components of the H₂ value chain are viewed as a sum of individual activities, which entails several complications:

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- ◆ Individual players must develop expertise across the entire H₂ value chain, including the energy market and the operation of energy conversion machines (such as electrolyzers, fuel cells or hydrogen engines). These areas of expertise are generally outside the business area and cannot be integrated in an economically viable way.
- ◆ The interfaces between the players are often not precisely defined and only serve individual interests, not the overall interests. The relationships between the stakeholders must be defined, evaluated and synchronised in detailed individual work.
- ◆ Regulatory hurdles must also be overcome in this cooperation. For example, companies that produce H₂ for their own consumption and trade whatever surpluses they produce are acting contrary to their primary business purpose, as they become gas or heat traders.
- ◆ Long-term purchase contracts must be concluded for financing. This requires further close coordination between the stakeholders.
- ◆ An unregulated withdrawal from individual projects jeopardises the development of the entire H₂ cluster.

3.2 REGULATORY FRAMEWORK MAKES COOPERATION BETWEEN PLAYERS MORE DIFFICULT

The regulatory framework, including EU aid regulations, makes cooperation between the players more difficult. The interfaces in the value chain are not addressed or even defined in business terms.

- ◆ Usually only individual components of the projects are funded and these must be applied for individually.
- ◆ Some of the funding programmes are not compatible. In addition, each funding approval reduces the likelihood of another one. This means that funding programmes can fall short of their potential if they are not coordinated with a view to the entire value chain.
- ◆ Smaller H₂ plants are generally in a worse position than (relatively) larger plants when bidding for subsidies due to the lower subsidy efficiency (ratio of subsidies to hydrogen produced). In general, large centralised production sites are preferred over regional H₂ clusters in these processes.
- ◆ A construction cost subsidy must be paid for electrolyzers, even when used for grid purposes, which increases the investment costs.
- ◆ The production and utilisation of hydrogen and its derivatives, including for self-supply, is subject to taxation and therefore increases operating costs.

3.3 APPROVAL PROCEDURE UNSUITABLE FOR INTEGRATED CONCEPTS

Approval procedures for integrated concepts are complex and are further complicated by the existing framework. They represent an obstacle to investment for SMEs and municipal companies.

- ◆ Different authorities are responsible for the approvals of the individual sub-projects. The relevant authorities do not receive the full picture and are therefore unable or only with difficulty to assess the overall concept. All in all, many individual procedures that tie up human and material resources in several places are launched.
- ◆ When approving a plant, the most demanding component in terms of approval defines the scope of the approval process. This makes approval procedures more complicated overall and subcomponents and projects may be subject to unnecessary reviews, which delays the overall process.
- ◆ Regional and municipal authorities are not sufficiently prepared for this increase in complexity. There is a particular lack of trained personnel who are prepared for the new regulations in the H₂ value chain. This results in long processing times and sometimes exaggerated project requirements that are not always economically and technically feasible.

4. THE NATIONAL HYDROGEN COUNCIL (NWR) SEES A NEED FOR ACTION TO REALISE THE POTENTIAL OF SYSTEMIC H₂ CLUSTERS

Regional H₂ clusters are an important component of the domestic value chain and can make a relevant contribution to achieving the goals of Germany's National Hydrogen Strategy. The NWR recommends the following measures to create the conditions for realising the potential of regional clusters in Germany as quickly as possible. The NWR believes that the following measures are necessary to achieve this:

4.1 CREATION OF A REGULATORY AND ORGANISATIONAL FRAMEWORK FOR REGIONAL PROJECTS

The merger of regional market participants into H₂ clusters requires an organisational and regulatory framework for the (often) cross-sectoral interaction of the various partners – from generation to utilisation. The focus here is on local value creation and the achievement of climate targets. The transformation paths and speeds will vary greatly depending on local conditions and require the corresponding leeway. A mix of instruments is needed to ensure economic efficiency, limit risks and fairly distribute the burden. The legal and regulatory framework required for this still needs to be developed to a large extent.

4.2 ENABLE THE FORMATION OF REGIONAL AND LOCAL PROJECT COMPANIES WITH A PARTY HAVING THE MAIN RESPONSIBILITY AND SUPPORT THE TRADING OF ENERGY AND MATERIAL FLOWS

A party with the main responsibility should be able to be the central point of contact for all questions and concerns relating to the H₂ cluster. For political and official representatives and funding organisations, this main party is the first point of contact for applications and communication measures. In addition, the main party acts on behalf of the players in the cluster to acquire potential suppliers and customers and to initiate long-term supply/purchase contracts. The interfaces between the project partners must be defined for all relevant aspects and legally formulated accordingly in order to enable the transfer of material flows to other market participants, such as trading in hydrogen and its derivatives as well as electrical and thermal energy (CHP, waste heat) from local generation. Energy cooperatives could provide experience here and should be involved in the process.

4.3 SUPPORTING THE EXCHANGE OF INFORMATION AND FURTHER TRAINING IN PUBLIC OFFICES AND AUTHORITIES

The existing training needs of building authorities and other relevant approval authorities must be identified and appropriate measures for the further education and training of experts must be developed in order to provide the necessary expertise. Planning security for applicants should also be ensured through the (further) development of standards and guidelines for approval processes. Cooperation between federal ministries, state ministries and authorities at regional and municipal level also plays an important role here. In particular, the exchange of experience (guidelines, best practice) should be strengthened and the implementation of laws at state level should be supported.

4.4 FACILITATE AND SPEED UP THE IMPLEMENTATION OF APPROVAL PROCEDURES

The NWR suggests that the approval procedures for regional and smaller projects should be simplified and made less bureaucratic. Currently, all hydrogen production plants must undergo an authorisation procedure in accordance with Art. 4. of the Federal Emissions Control Directive. The NWR welcomes the current discussion on staggered facilitation and the possibility of transferring this to the building permit. In the course of this discussion, the NWR recommends raising the limit for approvals under Art. 4. Federal Emissions Control Directive to over 20 MW for the size of the installation. Enabling a normal building permit procedure without public participation below this threshold, while maintaining public participation and effective legal protection, reduces complexity and speeds up processes. It is also recommended that a standardised approval practice be established in all states in Germany in order to facilitate the transferability of successful concepts.

4.5 CREATION OF SUITABLE FINANCIAL FRAMEWORK CONDITIONS – GENERATION AND UTILISATION

Operational utilisation should be supported financially and the economic efficiency gap between fossil and climate-neutral processes should be closed. The German Renewable Energy Sources Act should be adapted to the regional expansion and financing of electrolysers and local renewable energies should be subsidised. We also recommend examining a full tax exemption for the hydrogen produced and its derivatives, particularly for own use. In a further instance, long-term purchase contracts between municipalities and regional producers should be made possible in order to guarantee the financing of the projects. In addition, the terms of funding programmes should be adapted to time conditions with regard to the amortisation of investments. Established mechanisms and instruments in the industrial sector such as H2Global and climate protection contracts should be opened up or transferred and adapted for regional players and for SMEs and all sectors (term of at least ten years), for example, to close the profitability gap via incentives (e.g. CO₂ credits). As a possible funding instrument for closing the cost gap along the entire value chain, the NWR recommends examining the H₂Regional concept of the Association of German Hydrogen Regions, which addresses the discrepancy between the generation costs and the willingness of customers to pay.⁷

4.6 CREATION OF SUITABLE FINANCIAL FRAMEWORK CONDITIONS – DISTRIBUTION OF HYDROGEN

Sustainable financing must be made possible for the economic operation of hydrogen networks outside the hydrogen core network. The funding framework should be designed in such a way as to ensure competitiveness with existing solutions based on fossil fuels and thus enable the transition to a viable business model. There are comparable challenges in the distribution of hydrogen in the regions and to customers, similar to the situation in the hydrogen core network. It is essential for hydrogen network operators, but also for grid users and thus for the ramp-up of the hydrogen economy that costs and default risks can be allocated appropriately.

The regulations for integrated grid development planning for gas and hydrogen that recently came into force are an important first step towards a planning-based transformation of the gas grids, which must be taken into account as part of heat planning. In addition, it must be ensured that the processes for

⁷ BdWR (2024): Anschub der regionalen Wasserstoffwirtschaft. Positionspapier des Bund der Wasserstoffregionen (BdWR) (Boosting the regional hydrogen economy. Position paper of the Association of Hydrogen Regions (BdWR)).

integrated grid development planning and the processes relating to municipal heating planning are interlinked. It is now important to define an orderly process for the transition of consumers to climate-neutral options, in addition to introducing a framework for transformation planning at distribution grid level. To this end, it is necessary to create binding guidelines in a timely manner that can guarantee planning and investment security for all players.

4.7 STRENGTHENING THE DOMESTIC SHARE OF VALUE ADDED

The global trend towards protectionist measures and local content provisions in funding programmes such as the US Inflation Reduction Act (IRA) or comparable approaches in the design of the European Net Zero Industry Act (NZIA) should be viewed critically by local technology providers, as they generally benefit from global free trade. Nevertheless, the risk of one-sided dependencies in strategic technology fields and the associated value chains on technologies and companies from non-EU countries that are not friends should not be underestimated. It must therefore be prevented that public tenders are decided solely on the basis of price and that companies from countries that support their industrial position with measures distorting competition, partly for strategic reasons, are awarded contracts. In this respect, further decision criteria such as efficiency, carbon footprint, safety issues and other aspects with an influence on achieving targets (CO₂ reduction), which are to be evaluated using transparent instruments (e.g., LCA analysis) and promote technological competition, are conceivable. The issues of resilience and technological sovereignty must be considered at EU level.

4.8 CREATION OF SUITABLE FRAMEWORK CONDITIONS FOR REGIONAL STORAGE OF HYDROGEN AND ITS DERIVATIVES

Storage systems will also be necessary where hydrogen supply and value chains are created, in order to harmonise fluctuating energy generation with energy consumption and to achieve a resilient supply and safeguard electricity and heat generation. Storage facilities in regional clusters can be located close to both generation and utilisation. The conversion of existing oil caverns and the testing and prospective conversion of pore storage facilities may also offer potential, in addition to above-ground buffer storage facilities, such as spherical storage facilities, and the utilisation of cavern storage facilities. In order to enable this variety of necessary conversions, conversions of use and extensions, the procedural and approval steps need to be accelerated. Tenders issued by the Federal Network Agency for hydrogen-based electricity storage in accordance with Sect. 390 of the German Renewable Energy Sources Act should also take regional clusters into account. Furthermore, waste heat utilisation concepts in regional clusters are worth supporting, as they favour local value creation via integrated circular chains.

5. THE COMPANIES ARE READY FOR THE REGIONAL HYDROGEN RAMP-UP

The NWR emphasises that the scaling of technologies and systems can only be achieved on the basis of experience and the resulting broad industrialisation. Enabling hydrogen production within the framework of regional H₂ clusters has a high strategic benefit in this sense and is essential for the development and safeguarding of German industry and SMEs in times of structural change. This opens up economic prospects for structurally weak regions in particular, especially if accompanied by educational initiatives and training programmes that keep skilled workers in the region and release additional innovation potential.



THE GERMAN NATIONAL HYDROGEN COUNCIL

On 10 June 2020, the German Federal Government adopted the National Hydrogen Strategy and appointed the German National Hydrogen Council. The Council consists of 26 high-ranking experts in the fields of economy, science and civil society. These experts are not part of public administration. The members of the National Hydrogen Council are experts in the fields of production, research and innovation, industrial decarbonisation, transportation and buildings/heating, infrastructure, international partnerships as well as climate and sustainability. The National Hydrogen Council is chaired by former Parliamentary State Secretary Katherina Reiche.

The task of the National Hydrogen Council is to advise and support the State Secretary's Committee for Hydrogen with proposals and recommendations for action in the implementation and further development of Germany's National Hydrogen Strategy.

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