

Responsible regulation of PFAS – Securing the functioning of the energy transition

THE GERMAN NATIONAL HYDROGEN COUNCIL CALLS FOR RESPONSIBLE AND RISK-BASED PFAS REGULATION WITH CLEAR ESSENTIAL USE EXEMPTIONS FOR ENERGY AND HYDROGEN TECHNOLOGIES

Perfluorinated and polyfluorinated alkyl substances (PFAS) are indispensable for key energy and hydrogen technologies. However, their release into the environment poses a serious problem for humans and nature. With the publication of the Background Document¹ by the European Chemicals Agency (ECHA) in August 2025, a significantly more advanced state of knowledge is now available. The comprehensive evaluation of the consultation submissions, together with the work of ECHA's Scientific Committees for Risk Assessment (RAC) and for Socio-Economic Analysis (SEAC), enables for the first time a sector- and application-specific assessment of emissions, risks and substitution potential.

In this context, the National Hydrogen Council (NWR) underlines the call for differentiated, risk-based regulation with clear essential use exemptions expressed in its statements of 1 February and 15 September 2023. At the same time, the NWR considers it necessary to further develop its previous positions in the light of the new technical findings and to reaffirm and differentiate the categorisation of selected central energy and hydrogen applications as functionally essential. This assessment is made against the background that the term "essential use" is not yet legally anchored in European chemicals legislation², but is currently only used as a political-strategic guiding concept of the European Commission.

1. RESULTS OF THE REACH RESTRICTION PROCESS: DIFFERENTIATION IS ESSENTIAL

The evaluation of the more than 5,600 responses to the public consultation and the work of RAC and SEAC make it clear that different PFAS uses contribute very differently to the overall impact of PFAS in the environment. The current background document shows that a few sectors are responsible for the majority of PFAS emissions, while others – including the energy sector – currently only result in very low emissions to the environment.

¹ <https://echa.europa.eu/de/registry-of-restriction-intentions/-/dislist/details/Ob0236e18663449b>.

² Communication from the Commission – Guiding criteria and principles for the essential use concept in EU legislation dealing with chemicals (OJ C, C/2024/2894, 26.04.2024, ELI: <http://data.europa.eu/eli/C/2024/2894/oj>).

The regulatory options discussed as part of the REACH-process provide evidence of this:

- ◆ A complete ban on all PFAS uses (RO1) would achieve high emission reductions, but would be disproportionate for key industrial and energy technologies.
- ◆ A restriction with application-specific, time-limited exemptions (RO2) represents a balanced approach that combines environmental and health protection with security of supply, innovative capacity and climate protection goals.
- ◆ Controlled utilisation approaches (RO3) can be useful as a supplement, but require robust waste and disposal concepts.

The NWR is clearly in favour of the further development of the RO2 approach. The NWR believes that a regulatory framework based on a differentiated risk assessment is essential in order to ensure environmental and health protection as well as the necessary investment and planning certainty for the ramp-up of the hydrogen economy.

2. REALISTICALLY CATEGORISE EMISSIONS, EXPOSURE AND ENVIRONMENTAL IMPACT

In the field of hydrogen applications, current analyses show that the relevant PFAS emissions mainly occur in the production and end-of-life phase, while the use phase generally takes place in closed systems with very low exposure. In contrast, consumer-related, open applications and certain industrial processes contribute significantly more to overall pollution.

Against this background, the NWR sees a concrete need for action to align regulation even more closely with actual emission and exposure pathways in future. This requires in particular

- ◆ a clear distinction between closed and open applications,
- ◆ a source-related and risk-based assessment along the entire life cycle and
- ◆ prioritising regulatory measures where there are real environmental and health risks today or in the future.

The NWR reiterates its demand that effective PFAS regulation in the application of essential uses must not be based solely on the substance classification, but must be orientated towards risk, extent of exposure and actual environmental relevance. Furthermore, the newly created sectors should not be treated in a generalised manner, but on the basis of their respective risk characteristics. The new data provided in the course of the consultation and other research results now make it possible for the first time to systematically implement this requirement.

3. PFAS IN ENERGY AND HYDROGEN TECHNOLOGIES: FUNCTIONALLY ESSENTIAL

PFAS-based materials are currently essential for the functioning of central systems in the energy transition in selected, technologically critical applications. This applies in particular to the interaction of components and assemblies in lithium-ion batteries, fuel cell systems, electrolyzers and along the entire associated hydrogen value chain.

Regulatory restrictions without suitable, systemically defined exceptions and without a reliable legal framework would not only affect individual components, but would also restrict the functionality of entire technologies and systems. This would jeopardise the ramp-up of the hydrogen economy, industrial scaling and the implementation of the EU hydrogen strategy and REPowerEU as a whole.

ELECTROLYSERS

PFAS-based materials are currently of key functional importance for central electrolysis technologies. This applies in particular to PEM and AEM electrolyzers, where membranes, electrode materials and stack-internal sealing and functional elements have a decisive influence on efficiency, operational stability and service life. Technically equivalent, industrially available alternatives are currently not available for these applications.

This applies in particular to the PEM membrane system (MEA). PFAS-based materials, in particular fluoropolymers, are also used in selected sealing and functional components in alkaline electrolyzers. Their use is not always systemically necessary, but in many cases they represent the state of the art and can only be substituted to a limited extent with regard to chemical resistance, service life and operational safety.

During the operational phase, PFAS-containing materials are an integral part of the electrolyser. A proper assessment of its environmental relevance therefore requires a life cycle approach, focussing on the manufacturing and end-of-life phases.

The NWR confirms that electrolyzers are to be categorised as functionally essential applications under the REACH procedure and require long-term, legally secure exemptions.

FUEL CELLS

PFAS-based membranes, electrode materials and stack-internal functional elements are key to the performance, efficiency and service life of PEM fuel cells. There are currently no technically equivalent alternatives with comparable long-term stability for these applications.

Scientific studies show that ionomers containing PFAS can be chemically degraded under the typical operating conditions of fuel cells. This produces fluorinated degradation products that can potentially escape from the system via product water or gas flows. Although the underlying degradation mechanism has been partially investigated, the actual level and environmental relevance of these emissions in real operation have so far only been insufficiently quantified statistically and are the subject of ongoing research.

Against this background, the environmental and health relevance of PFAS applications in fuel cells must be properly categorised within the framework of a holistic life cycle assessment, with a particular focus on realistic emission paths and on manufacturing, operating and end-of-life phases. The NWR therefore calls for fuel cells to be recognised as functionally essential applications and to be treated in a risk-based and differentiated manner in the REACH procedure. The NWR also believes that substitution testing should be prioritised. At the same time, research and development efforts should be intensified to replace PFAS-containing materials in the near future.

PRODUCTION, SYSTEM TECHNOLOGY AND INFRASTRUCTURE OF THE HYDROGEN ECONOMY

PFAS-based materials are used not only in electrochemically active units, but along the entire industrial value chain of the hydrogen economy. This applies in particular to manufacturing processes (e.g., printing and coating applications), system-relevant sealing and waterproofing applications, corrosion-resistant material solutions as well as machine and system technology.

In industrial series production, functional materials containing PFAS enable stable, reproducible and high-quality manufacturing processes. At the same time, it can be seen that individual process steps can already be implemented PFAS-free, while others are still dependent on PFAS-based materials. Printing applications are therefore not a homogeneous field of application and require a differentiated, process-specific assessment.

At system and infrastructure level, fluoropolymers fulfil key functions in seals, valves, pipelines, compressors and other system components. Due to the high requirements for chemical resistance, temperature stability, sealing efficiency and service life, the options for substitution have so far been limited at best.

These applications are an integral part of closed technical systems with limited exposure during the operational phase. Relevant environmental aspects must be assessed in particular during the manufacturing, maintenance and end-of-life phases. Controlled utilisation approaches can be a suitable regulatory instrument for this.

Against the background of the extended sector logic of the REACH procedure, the NWR demands that, in addition to electrochemical core components, printing applications, sealing applications and machine and plant technology be systematically and coherently taken into account in order to ensure a functional and legally secure regulation of hydrogen and energy technologies.

4. CIRCULAR ECONOMY, RECYCLING AND END-OF-LIFE MANAGEMENT

The present background analyses show that for PFAS-containing components in energy and hydrogen applications, there are currently only very limited recycling, recovery or destruction paths in Europe, most of which are not application-specific. In many cases, industrially established, standardised processes for a closed material cycle are still at an early stage of development or are completely lacking.

Against this background, the NWR recommends

- ◆ the targeted development and establishment of suitable recycling, recovery and disposal processes for PFAS-containing components from energy and hydrogen systems,
- ◆ the further development of clear end-of-life concepts focussing on emission avoidance, safe treatment and traceable material flows, and
- ◆ strengthening design-for-recycling approaches as early as the development and design phase of new technologies.

Until a circular economy is up and running, Europe-wide, harmonised disposal and destruction procedures for PFAS-containing components from energy and hydrogen systems must be ensured. However, the goal remains a functioning closed-loop system for the responsible handling of PFAS.

The establishment of appropriate structures and regulatory frameworks is therefore a necessary prerequisite for practicable and risk-based PFAS regulation.

5. INTENSIFY RESEARCH, DEVELOPMENT AND KNOWLEDGE TRANSFER

The aim remains to replace PFAS where this is technically possible, ecologically necessary and safe to implement. However, the available findings show that PFAS-free alternatives for the named energy and hydrogen applications currently have predominantly low levels of technological maturity and are not available on an industrial scale in the short term.

The NWR therefore recommends that research and development activities be focussed on transferring promising alternatives to higher technology maturity levels. Funding programmes should be designed to be application-oriented and enable new materials to be tested under realistic operating conditions, including long-term and safety aspects.

In addition, uniform testing and evaluation standards as well as certification and authorisation procedures coordinated at an early stage are required to ensure the objective comparability of PFAS-containing and PFAS-free solutions. A structured transfer of knowledge and the expansion of neutral data platforms should provide a reliable and transparent data basis for regulatory decisions.

6. RECOMMENDATION

The NWR supports the goal of effectively protecting the environment and health from the harmful effects of perfluorinated and polyfluorinated alkyl substances (PFAS). At the same time, it must be ensured that the functionality, scalability and investment security of key energy and hydrogen technologies as the main pillars of the energy transition are not impaired by blanket or non-systemic regulatory approaches.

In its opinions of 1 February and 15 September 2023, the NWR already called for differentiated, risk-based PFAS regulation with clear exceptions for functionally essential applications. The sector- and application-specific findings now available as part of the advanced REACH restriction procedure confirm this position and allow it to be further clarified.

The NWR therefore recommends:

- ◆ **A consistently risk-based design of PFAS regulation for essential uses in applications in the hydrogen sector** that is orientated towards actual emission and exposure pathways.
- ◆ **A clear, transparent and predictable exemption and evaluation framework**, with binding criteria and transition and validity periods that take account of real industrial development, investment and specific life cycles of systems and components.
- ◆ **Liability for environmental damage must be established on a polluter-pays basis.**
- ◆ **The legally secure recognition of designated energy and hydrogen technologies** under REACH. Exceptions must be defined on a system-specific basis and must not be limited to individual components.
- ◆ **A coherent view of the entire supply and value chain** in order to avoid regulatory breaks and secure industrial value creation in the EU.

- ◆ **Linking exemptions with emission reduction, circular economy and responsible end-of-life concepts** along the entire life cycle.
- ◆ **The targeted strengthening of research, development and knowledge transfer** in order to replace PFAS with adequate technologies where this is ecologically necessary.

Such an approach combines effective environmental and health protection with investment and planning security and creates the conditions for the successful ramp-up of the energy and hydrogen economy in Europe. However, it is particularly important that reliable decisions are made in a timely manner to ensure investment security for the ramp-up of the hydrogen economy.



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 22 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 Felix Chr. Matthes.

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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