BRIEFING
STOA Options Brief

European Parliament

The potential of hydrogen for decarbonising EU industry

In 2020, the European Commission published its hydrogen strategy, with the aim of boosting hydrogen use in the industry and transport sectors, while fostering the uptake of renewable hydrogen production. The main objective of the study on 'The potential of hydrogen for decarbonising EU industry' is to take stock of the current situation with respect to the realisation of the European Union (EU) hydrogen strategy and to identify policy options that address gaps in its five policy action fields. In this policy brief, both the main policy gaps and the options to overcome them are summarised.

Policy gaps

Recent activities, such as the launch of the European Clean Hydrogen Alliance and the Innovation Fund, the formation of hydrogen valleys and the promotion of important projects of common European interest (IPCEIs) are promising first steps towards a European hydrogen economy. Nonetheless, important policy gaps with respect to the hydrogen strategy's targets remain:

- Hydrogen is and will remain an energy carrier with high costs. Therefore, it should be used predominantly in applications without more cost-effective routes for decarbonisation (such as direct electrification). Clear guidelines for preferred hydrogen use cases including a hierarchy of priority uses are missing, which results in high uncertainty for investors.
- For a roll-out of hydrogen production and use in line with the EU hydrogen strategy, there is a need for additional support schemes, as current support schemes are mainly tailored to individual demonstration projects.
- Currently, there is no European-wide hydrogen network and, accordingly, European legislation on hydrogen infrastructure does not exist. This leads to high uncertainty for both market participants and operators of hydrogen infrastructure. It is therefore important to clarify at least the general rules for future market and infrastructure legislation.
- The trading of hydrogen both within the EU and beyond requires an exact specification of the traded products, in particular renewable and low-carbon hydrogen. Relevant certification schemes are under development, but the specific criteria to be applied have not yet been agreed upon. Also, acceptance issues and civil society involvement have not been addressed to a sufficient extent. Future policies therefore need to support participation of additional stakeholder groups across all European regions and also foster a sustainable approach to international hydrogen partnerships.

Policy options

Under each of the policy action fields under the EU hydrogen strategy, three different options have been developed and compared on the basis of their performance against similar criteria.

Options to foster investments

The considerations of the investment requirements in hydrogen technologies, renewable electricity production and hydrogen infrastructures have demonstrated a need for large investments, in particular in the longer term, but to a certain extent also up to 2030. An important measure to stabilise investors' expectations of future investment conditions is the implementation of a dedicated target system.

The study discusses the following three options:

A. **Compulsory targets for the EU**: In a joint consultation, the European Commission, European Council and European Parliament could define a compulsory target system for the EU with no binding agreements for each Member State.
B. **Compulsory targets for each Member State**: In a joint consultation, the European Commission, European Council and European Parliament could define binding targets for each Member State, with non-compliance sanctions. The Member States would be responsible for achieving the targets.
C. **Indicative targets at EU level**: The EU hydrogen strategy could be updated at EU level, but the decision **whether** a compulsory target system is implemented would be left to each Member State.

In summary, Option B should show the highest effectiveness, but the lowest feasibility and the lowest chance to deal with possible risks. However, Option B may result in intensive bargaining before the implementation of the national target systems, affecting the feasibility of (ambitious) targets. Option A performs better with regard to feasibility and dealing with risks, since it provides Member States and the European Commission with higher flexibility. The main disadvantage could be seen in the additional burden for the EU budget. Also, the effectiveness of Option A could be lower compared to Option B. The effectiveness of Option A could be increased if the European Commission could initiate the financing mechanism independently of available voluntary national contributions. From the EU perspective, Option C seems to be the least desirable option. Although feasibility and dealing with risks are the highest of all considered options, Option C performs worst with respect to benefits, effectiveness, ecological sustainability and coherence with other EU objectives.

Measures for boosting demand and scaling up production

The stocktaking of supporting measures for boosting demand and fostering production showed that there is a particular need to compensate for the high operating expenses, both in the production of renewable hydrogen and its use. Carbon contracts for difference (CCfDs) are identified as a key option to overcome the funding gap for large-scale application of renewable hydrogen in industry. The following three basic principles are compared:

A. **Full regulation at EU level***:* CCfD programmes are being developed at EU level that exceed the scope of the existing Innovation Fund, both in terms of funding scope and existing funding budget.
B. **EU directive to be developed at Member State level***:* A directive would provide Member States with a framework for the design of CCfDs. If the directive is correctly transposed into national law, a State aid assessment is no longer necessary. Alternatively, a regulation could be drafted that determines how CCfDs should be specifically designed if the Member States introduce them.
C. **Full control of CCfD programmes at Member State level***:* The EU would make no harmonisation efforts.

In summary, Option A offers the greatest benefits, in particular with respect to harmonisation and access to CCfDs across all Member States, but also involves high costs, which hampers feasibility. Option C does not incur costs but does not change current policy design and therefore does not deliver benefits compared to the current situation. Option B may provide harmonisation benefits at comparatively low cost, but whether the benefits can indeed be realised depends on the compatibility with national circumstances. In particular, harmonisation issues may occur with respect to award criteria as well as eligibility of certain technologies and costs.

How to design a supportive framework (market rules and infrastructure)

The synthesis of the scientific literature has revealed that the legislation governing hydrogen infrastructure and markets needs to ensure a swift expansion while being flexible with respect to the exact infrastructure needs. Although currently there is no immediate need for an overarching regulation, clarification is needed as to what the overarching principles would be and which concrete set-ups seem favourable. In principle, the EU has the following three over-arching options:

A. **Full regulation at EU level***:* The proposed hydrogen and gas market decarbonisation package would establish an EU-wide regulatory framework comparable to the existing gas infrastructure legislation, with EU-wide fixed rules on unbundling, third-party access, roles of system operators, network codes and remuneration of costs.

B. **EU directive to be developed at Member State level**: The proposed hydrogen and gas market decarbonisation package would establish EU-wide principles, in particular on unbundling and third-party access. It could also announce thresholds for key indicators triggering further regulatory steps, but leave room for experimentation at Member State level during a certain pre-defined period, in particular with respect to the role of system operators, network codes and remuneration of costs.
C. **Maintain control at Member State level until further notice**: The EU could announce thresholds for key indicators triggering regulatory steps at the EU level but could leave it to the Member States to decide if and how to set up a regulation for hydrogen during a certain pre-defined period.

All options may include a step-wise approach, for instance requiring third-party access only after a certain period. Option A shows advantages with respect to fostering an integration of regional networks into a hydrogen backbone and environmental sustainability. In turn, it could also turn out not to be politically feasible in the near future and ineffective in finding the best regulatory setup, due to a lack of experience with the regulation of hydrogen networks and markets. The more flexible approach of Option B should lead to higher political feasibility and effectiveness in finding the best regulatory set-ups. However, this comes with moderate disadvantages, due to less certainty about later integration and environmental stringency, as well as for investors. Finally, Option C leads to the lowest administrative efforts and the highest flexibility for the Member States, but comes with high risks for the later integration of regional networks into a European backbone and the resulting uncertainty for investors and about its effectiveness.

Options for promoting research and innovation in hydrogen technologies

Hydrogen technologies exemplify EU strengths in fundamental and applied research. However, in the past, Europe often lagged behind other global regions in the conversion of scientific insight into economic success. The study specifies the following policy options to enhance the EU position in hydrogen technology implementation:

A. **Establish a dedicated R&D framework**: Beyond Horizon Europe, the EU could create a designated research and innovation framework for critical hydrogen technology to combine leading research groups in a single, long-term funding programme that could enable effective division and coordination of research tasks, systematic exchange of present results and future directions, as well as combined innovation support initiatives by industrial spin-off projects and unified support activities.
B. **Enhance support for hydrogen research and innovation across existing programmes**: Including the option of dedicated calls on key technologies in the Innovation Fund Regulation could offer the opportunity to address the commercialisation of hydrogen technologies more explicitly. Similarly, dedicated calls on hydrogen could be launched under the European Innovation Council (EIC). As both allow explicitly for blending with other national and EU funds, this could trigger substantial additional innovation activities.
C. **Enable Member State action**: After approval by the European Commission's Directorate-General for Competition, the hydrogen IPCEIs could grant Member States individual permission to support their beneficiaries on the costs of first industrial deployment of hydrogen technologies. The systematic continuation of this policy would enable further hydrogen IPCEI initiatives in the future and further streamline their implementation process.

Option A would require additional funding and changes to current policies, but promises substantial benefits in ensuring best utilisation of funds and resources and promoting exchange across borders and disciplines, and between relevant industries and researchers. By contrast, Option B would limit organisational and budgetary burdens, except binding funds that would not therefore benefit other goals within these programmes. Option C could constitute a powerful measure to enhance first industrial use of hydrogen technologies and would not require major budgets at EU level. However, encouraging Member States to primarily support their own national industries, may lead to sub-optimal overall funding allocation at EU scale (building redundant capacities in certain areas, while others might experience funding gaps).

Measures for fostering international cooperation

To achieve a credible transition towards extended use of hydrogen, imported hydrogen should be subject to the same classification and criteria as hydrogen produced within the EU. However, a standardised

nomenclature does not yet exist at the EU level. The study considers the following options for establishing a hydrogen nomenclature within the EU:

A. **Fully harmonised regulation at EU level**: A fully harmonised hydrogen classification scheme could cover different sectors and harmonise the approaches of the Renewable Energy Directive Recast (RED II), the Emissions Trading System (ETS), and the CertifHy project aiming to develop a European-wide definition of green hydrogen. A trading and certification system would be implemented, which would incorporate the related regulations in a stringent manner.
B. **Fully harmonised EU regulation with sustainability criteria**: A fully harmonised regulation could be established at EU level, which, in addition to Option A, would establish a coherent set of sustainability criteria to define sustainable hydrogen. This would include provisions for the supply of water and land use as well as human rights and the sustainable development goals (SDGs).
C. **No further action at EU level**: The RED II provisions would define criteria for transport sector fuels and CertifHy would remain a non-binding project. With no unified nomenclature at EU level, some Member States may fill the gap and set up a separate regulation.

Options A and B would both establish a clearly defined certification scheme at EU level. Option A would be easier to implement and would also be more likely replicated by other countries, which should be considered a benefit. Option B may take longer to establish and an additional sustainable hydrogen class is not necessarily beneficial to the overall classification. By design, Option B outweighs Option A in terms of ecological sustainability, which can be particularly important for regulating imported hydrogen. The status quo defined by Option C is not effective in providing sufficient clarity for market participants and provides no headway for EU leadership in global hydrogen regulation.

Outlook in relation to upcoming policy packages

Some of the policy gaps identified are at least partially addressed by the revised regulations proposed with the Commission's Fit for 55 package, in particular the draft revisions of the RED and the ETS, where the details remain to be negotiated. Others are expected to be addressed with the proposed hydrogen and gas market decarbonisation package scheduled for the end of 2021. The opportunity provided by the negotiation of these two packages should be used to ensure that the EU is well on track to realising the benefits of hydrogen for decarbonising industry, while limiting undesired side-effects. The STOA study discusses the relevant issues emerging here. When dealing with the concrete design of the policies, more detailed analyses (going beyond the scope of this study) will be needed, among other things on reasonable levels of sectoral hydrogen use and production targets, suitable eligibility and award criteria, as well as investment volumes for CCfDs, the concrete design of infrastructure regulations and research and innovation programmes and the detailed criteria for certification of hydrogen.

This document is based on the STOA study 'The potential of hydrogen for decarbonising EU industry'. The study was written by Jakob Wachsmuth, Ali Aydemir, Henning Döscher and Johannes Eckstein (Fraunhofer Institute for Systems and Innovation Research ISI), Witold-Roger Poganietz, Davi Ezequiel François and Dirk Scheer (Karlsruhe Institute for Technology), at the request of the Panel for the Future of Science and Technology (STOA), and managed by the Scientific Foresight Unit, within the Directorate-General for Parliamentary Research Services (EPRS), European Parliament. STOA administrator responsible: Andres Garcia Higuera.

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