
H2GLOBAL – IDEA, INSTRUMENT AND INTENTIONS

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Abstract

H2Global is an innovative instrument to promote a timely and effective technology and market ramp-up of green hydrogen and hydrogen derivatives. The German Federal Ministry for Economic Affairs and Climate Protection (BMWK) provides funding of EUR 900 million for the first ‘funding window’ of the auction based instrument. This first ‘funding window’ is dedicated to the procurement of green products from partner countries outside the European Union (EU) and the European Free Trade Association (EFTA). Future customised ‘funding windows’, equipped with additional funds, should increasingly focus on the market ramp-up in Germany and the EU, and thus combine climate protection and an improvement in energy security. The implementation and further development of H2Global is carried out by the non-profit H2Global Foundation, whose subsidiary, HINT.CO GmbH (Hintco), uses the funding provided to compensate for the difference between supply and demand prices. H2Global is designed to promote and accelerate the green transformation of our society and economy in a market-based way.

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I. Challenges for the ‘hydrogen ramp-up’

H2Global was developed to support the technology and market ramp-up of green hydrogen and hydrogen derivatives and to initiate imports to Germany and the EU as quickly as possible.¹

Green and climate-neutral hydrogen is not an end in itself, but serves above all to protect the climate and the environment. Along with improved energy efficiency and electrification, hydrogen acts as an important pillar of the energy transition. Introducing this new energy carrier and hydrogen derivatives under competitive conditions and high time pressure represents an enormous challenge for both politics and business and is historically unprecedented.²

Substantial effort is required to reach the installed electrolysis capacity target by 2030, which was doubled by the German Federal Government to 10 gigawatts (GW) from the original 5 GW³, and to meet the European Union (EU) targets from the REPowerEU plan⁴ for local production and imports of over 20 million tonnes (Mt) per year by 2030.⁵ Van Wijk et al. calculate that around 350 GW of electrolyser capacity would need to be installed in the EU and its neighbouring countries to meet the European targets.⁶ This would be more than a thousand times the current global installed capacity.⁷

Unlike the EU, Germany has not yet defined an explicit import target. Based on data put forward by van Wijk et al., imports would amount to approximately 2.3 Mt per year. The EU also differentiates between imports of 6 Mt of hydrogen and 4 Mt of

¹ The team of authors would like to thank Jan-Hendrik Behrendsen, Martin Erdmann, Emanuel Henrich, Fynn Hoffmann and Clara Klages for their support in preparing this policy brief.

² See also: Westphal, Kirsten (February 2021): Global Energy Governance: Meeting the Challenge of the Energy Transition. in: The Geopolitics of Energy: Out with the old, in with the new? Oxford Energy Forum 126. pp. 9-12. <https://www.oxfordenergy.org/wpcms/wpcontent/uploads/2021/02/OEF-126.pdf>

³ Press and Information Office of the Federal Government. (2021). Mehr Fortschritt wagen - Bündnis für Freiheit, Gleichheit und Nachhaltigkeit. Coalition agreement between SPD, Bündnis 90/ Die Grünen and FDP. https://www.bundesregierung.de/resource/blob/974430/1990812/04221173_eef9a6720059cc353d759a2b/2021-12-10-koav2021-data.pdf?download=1

⁴ European Commission. (Strasbourg, 8 March 2022). REPowerEU: Joint European Action for more affordable, secure and sustainable energy. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1511

⁵ van Hulst, Noé / Westphal, Kirsten (2022): Now is the time to get hydrogen off the ground in Europe. <https://illuminem.com/illuminemvoices/a08ea94d-6b64-4008-ae4d-657b5117d337>

⁶ van Wijk, Ad/ Westphal, Kirsten/ Braun, Jan Frederik (2022): How to deliver on the Hydrogen Accelerator. <https://www.h2-global.de/post/how-to-deliver-on-the-eu-hydrogen-accelerator>

⁷ IEA (2021). Could the green hydrogen boom lead to additional renewable capacity by 2026? IEA, Paris. <https://www.iea.org/articles/could-the-green-hydrogen-boom-lead-to-additional-renewable-capacity-by-2026>

ammonia annually.⁸ The annually imported volumes are high and also vary with regard to the proportion of hydrogen and hydrogen derivatives. Calculations from the National Hydrogen Council assume a demand of about 138 terawatt hours (TWh) annually.⁹

A triad of supply, demand and infrastructure is needed. This represents a case of the proverbial ‘chicken-egg problem’ – in this case we could even speak of a ‘chicken-cock-egg problem’ – whereby the simultaneous implementation of the aforementioned dimensions is a crucial precondition for the ramp-up of a hydrogen economy. Supply and demand must be promoted and matched. The necessary transport and storage infrastructure is either completely lacking or represents a bottleneck. In the case of hydrogen derivatives, important interfaces in the logistics chain are unclear.

In addition, the necessary technologies have different degrees of maturity. These technologies, which include electrolyzers, must be scaled up, further developed and transferred from manual/low-scale production to industrial mass production. This is to be accomplished by progressively scaling up from today's one to 10 MW¹⁰ to 100 MW, and then from 500 MW into the GW range. However, this must happen at unprecedented speed. Such dynamic developments in generation and increasing demand present a great opportunity and challenge for the economy; coming with cost reductions and increasing production not necessarily developing in a linear fashion during the initial stages. This may mean that investment costs showcase increased volatility. In this context, the exponential growth of photovoltaics at the beginning of this century serves as a good example. In order to successively use hydrogen and hydrogen derivatives, a massive scaling of production, a conversion of the demand side and a cost degression similar to that of renewable energies are also necessary for electrolyzers. ‘First movers’ are at a disadvantage as compared to actors who enter during the next wave of scaling and innovation.

The need for investment at all stages of the value chain is high. While marginal costs are expected to fall, this will only occur once the technologies are scaled up. In addition, many technologies still need to be (further) developed. Technical standards and norms are needed. There is a lack of

⁸ European Commission. (2022). Commission Staff Working Document - Implementing the repower EU action plan: Investment needs, hydrogen accelerator and achieving the bio-methane targets. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022SC0230&from=EN>. S.9.

⁹ Thereby, the reported bandwidths of studies until 2030 are already large before the Russian war of aggression against Ukraine, with a calculated minimum demand of 92TWh and a maximum demand of up to 202TWh, see quantity framework in the National Hydrogen Council. (2021). Hydrogen Action Plan Germany 2021-2025. https://www.wasserstoffrat.de/fileadmin/wasserstoffrat/media/Dokumente/2021-07-02_NWR-Wasserstoff-Aktionsplan.pdf

¹⁰ IEA. (2021). Could the green hydrogen boom lead to additional renewable capacity by 2026? IEA, Paris. <https://www.iea.org/articles/could-the-green-hydrogen-boom-lead-to-additional-renewable-capacity-by-2026>

incentives and green lead markets. Investors face high regulatory uncertainty, making calculations on projects' profitability almost impossible. Reliable business models are hard to develop when the regulatory frameworks are in flux. As a result, investments in production capacities fail to materialise and hence climate-neutral hydrogen and hydrogen derivatives are lacking, preventing the large and economically important CO₂ emitters from decarbonising in a quick and consistent manner.

A market for climate-neutral and green hydrogen does not yet exist. Regulations concerning the definitions of climate-neutral and green products are also unclear.¹¹ Climate-neutral and green hydrogen has been identified politically as an indispensable element for the energy transition. Yet, a market can only emerge once the product – that is to be produced, traded and consumed – is clearly defined. Consistent and internationally compatible criteria are still lacking. The drafts¹² for the delegated acts published by the EU Commission in May 2022 are under revision and initially only define the criteria for renewable fuels of non-biological origin for the mobility sector. Uncertainties also exist with regard to the creditability of the green product and thus its economic added value. As long as the molecule with its green attributes cannot be reliably put into value, there is a lack of investment security – making it difficult to develop economically attractive business models along the entire value chain. These uncertainties extend across the entire supply and logistics chain to the technological transformation on the application side. As a result, final investment decisions are largely absent, while the industry already signs large-volume declarations of intent.¹³

The challenges concerning the ramp-up of climate-neutral hydrogen technologies and the creation of a market are therefore highly complex and can be identified on several levels. Uncertainties about future regulatory frameworks are a significant barrier to investment in what is already a completely new and dynamic environment. Russia's war of aggression against Ukraine

¹¹ This point is also made by the International Energy Agency: IEA. (2021). Global Hydrogen Review 2021. <https://www.iea.org/reports/global-hydrogen-review-2021>.

¹² European Commission. Production of renewable transport fuels - share of renewable electricity (requirements). https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/7046068-Production-of-renewable-transport-fuels-share-of-renewable-electricity-requirements-_en;

European Commission. Renewable energy - method for assessing greenhouse gas emission saving for certain fuels. https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12713-Renewable-energy-method-for-assessing-greenhouse-gas-emission-savings-for-certain-fuels_en

¹³ Steitz, Christoph. (2022). E.ON and Australia's FFI to explore green hydrogen shipments to Europe. <https://www.reuters.com/business/sustainable-business/eon-australias-ffi-explore-green-hydrogen-transport-europe-2022-03-29/> and Uniper SE. (2022). EverWind Secures Offtake from Key German Partner Uniper for Canada's First Green Hydrogen Hub in Nova Scotia. <https://www.uniper.energy/news/everwind-secures-offtake-from-key-german-partner-uniper-for-canadas-first-green-hydrogen-hub-in-nova-scotia>

has further exacerbated the situation by bringing security of supply and substitution of Russian fossil fuels into focus. The urgency of transforming energy supply and industry is becoming clear, but its implementation is not getting any easier. High prices for fossil energy sources reduce the opportunity costs for renewable energies. Yet, the volatility in the price environment and paradoxical electricity price signals counteract this effect. The ongoing investment crisis in the energy sector is exacerbated by the supply crisis, as investments in fossil infrastructure, such as floating terminals for liquefied natural gas (LNG FSRU), become necessary in the short term. However, this was not foreseeable in 2020 when H2Global was developed.

II. Idea and institutionalisation

The H2Global instrument was developed by Timo Bollerhey and Markus Exenberger in 2020, who at the time were working for the *Gesellschaft für Internationale Zusammenarbeit (GIZ)* as consultants on innovative market models for a sustainable energy transformation in Brazil. The goal was to address the described challenges in such a way that final investment decisions concerning scalable hydrogen projects could be made without delay. The aim was to develop an instrument that catalyses market ramp-up of green hydrogen. H2Global aims to reduce the price, market, and regulatory risks hindering the early-stage ramp-up of green hydrogen, by bridging regulatory gaps and creating business models as well as investment certainty across the entire supply chain.

The H2Global concept was first presented to the *German Federal Ministry for Economic Affairs and Energy (BMWi)* after the implementation of the National Hydrogen Strategy in June 2020. The German government approved grants for the ramp-up of a hydrogen economy in its Covid-19 stimulus package 2020 (hereafter referred to as 'stimulus package'). After a positive initial review by the BMWi, H2Global was further developed in an extended team including Florian Geyer, Joachim Schnurr and Wolfram Klein, and elaborated with a view to questions of state aid law by the law firm Redeker/Sellner/Dahs. Prof. Michael Sterner (OTH Regensburg) and Prof. Eichhammer (Fraunhofer ISI) modelled and reviewed the basic economic assumptions underlying the concept. In addition, company surveys were conducted. In this way, the products green ammonia, green methanol and electricity-based Sustainable Aviation Fuel (SAF) were identified for first auctions.

At the end of 2020, the BMWi asked to further develop the concept to the point where it could be implemented as part of a close consultation process with the industry. This process took place under the auspices of the German Hydrogen Association (DWV).

In April 2021, the German Federal Parliament provided EUR 900 million as part of the stimulus package for a first ‘funding window’ under the H2Global model. The team led by Timo Bollerhey and Markus Exenberger was then commissioned to implement the concept within the framework of the foundation model that had been developed.

The purpose of the non-profit H2Global Foundation (hereafter referred to as the ‘Foundation’) is climate and environmental protection. Its activities include measures designed to promote the production and use of green hydrogen and other climate-neutral energy sources at national and international level. The Foundation is based in Hamburg.¹⁴ *Donors* (Stifter) are well-known German, European and international companies.¹⁵ The Foundation's activities include the promotion of dialogue and the analysis of issues surrounding the ramp-up of climate-friendly technologies, especially hydrogen. Since H2Global is a public-private initiative, the *Board of Trustees* (Kuratorium) consists of members elected by the Donor’s Conference as well as members delegated by public bodies which support projects of the Foundation or an enterprise affiliated with the Foundation on the basis of formal grant decisions from public funds. The Foundation offers a platform for exchange and knowledge transfer between politics, business and the public. To this end, it maintains working groups currently dedicated in particular to the ramp-up and scaling of green hydrogen technologies, and the development of market mechanisms for hydrogen and hydrogen derivatives at national, European and global level. The ‘analysis work’ places a special focus on the early, rapid and sustainable integration of developing and emerging countries into the global hydrogen ramp-up and trade.

The central instrument is the *Hydrogen Intermediary Company (HINT.CO GmbH, hereafter Hintco)*, a subsidiary of the H2Global Foundation. It acts as an intermediary and is designed to stimulate market development. Hintco is not a ‘classical trader’ or midstream business (importer and onward transporter) and neither has the financial resources, nor the institutional design to absorb supply chain risks associated with trade of hydrogen and hydrogen derivatives. This concerns in particular risks along the supply chain that a normal midstreamer would cover. Hintco does not have the financial resources to bear such risks. Although a certain risk buffer is built up at Hintco via a specific ‘fee model’, Hintco's creditworthiness essentially results from the Federal Government's *grant decision* (Zuwendungsbescheid). Therefore, when designing the tender procedure, Hintco must be careful to transfer the risks to the supply or offtake side and to keep the remaining residual risks at the Hintco level to a minimum. Ideally, Hintco will become redundant after the end of the funding period – once the market has sufficiently developed and

¹⁴ H2Global Foundation. Statutes of H2Global Foundation. <https://www.h2global-stiftung.com/project/statute>

¹⁵ H2Global Foundation. Shaping the global energy transition. <https://www.h2global-stiftung.org>

trading in hydrogen and hydrogen derivatives can take place via conventional market participants and platforms.

Originally, the intermediary was planned as a state-owned company, which would have facilitated organisational implementation at various points. However, as early as mid-2020, the Federal Government signalled that it explicitly wanted a private-sector implementation. The industry was to carry out and partially finance the implementation of the instrument, while the Federal Government would provide the grant to compensate for the differential costs. A construct like Hintco could not be anchored in the existing tax and finance law as a non-profit, even though it works on the provision of public goods such as climate protection and market building. Thus, Hintco was established as a non-profit limited liability company in November 2021, financed by fees on the purchasing and sales side of the trading contracts.

The design of the instrument and the first tender procedures were notified by the EU Commission on 18 December 2021.¹⁶ On 23 December 2021, the newly formed *Federal Ministry for Economic Affairs and Climate Action (BMWK)* issued the EUR 900 million grant to Hintco.¹⁷

III. The instrument – ratio and functioning

H2Global is an innovative instrument to promote a timely and effective technology and market ramp-up of green hydrogen and hydrogen derivatives based on *competitive bidding processes* (wettbewerbsbasierte Bieterverfahren).¹⁸ Hintco acts as a contractual partner between the supply and demand side at an interface in the supply chain. It compensates for the differential costs between the foreseeable higher purchase and lower sales prices. The differential costs are covered by public grants. The tender procedure ensures that Hintco achieves the most favourable prices in the long-term supply of green products on the supply side. On the demand side, a tender procedure is also carried out, which should reduce the expected differential costs to a minimum.

Hintco acts as a reliable and solvent contractual partner for all relevant actors on both the demand and supply sides. On the supply side, it offers long-term purchase contracts and thus minimises the price,

¹⁶ Commission of the European Union. (2021): State aid: Commission approves €900 million German scheme to support investments in production of renewable hydrogen.

https://ec.europa.eu/commission/presscorner/detail/en/ip_21_7022

¹⁷Federal Ministry for Economic Affairs and Climate Action (BMWK). (2021). Zuwendungsbescheid, Anlage 2: Weitere Nebenbestimmungen und Hinweise (WNUH). Microsoft Word - 211222_ZuWB_Anlage_2_final_clean (bmwk.de) (The grant decision was updated on 26 October 2022)

¹⁸ Federal Ministry for Economic Affairs and Climate Protection. (2022): Hydrogen: Key elements for the energy transition. <https://www.bmwi.de/Redaktion/DE/Dossier/wasserstoff.html>

market, regulatory and contractual risk for the first industrially scalable green PtX projects. This provides the required investment security to the bidding consortia with regard to establishing the first supply and value chains.



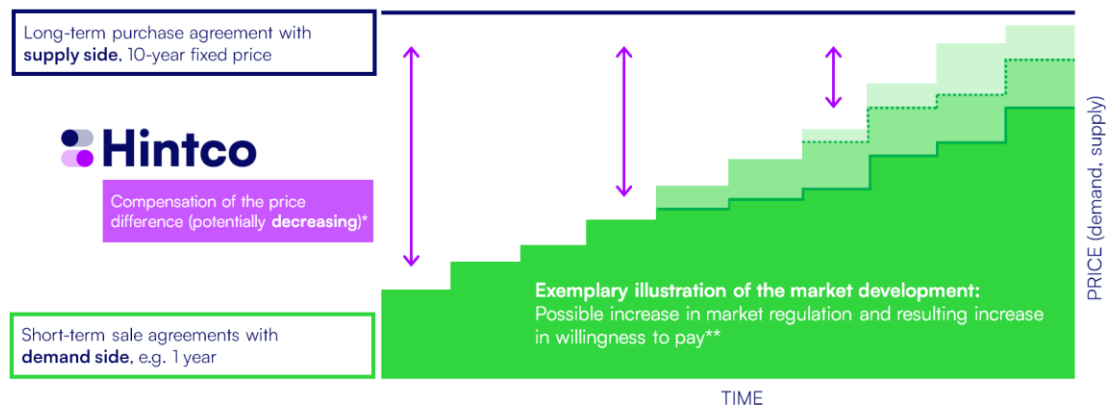
Figure 1: Competitive bidding process

On the supply side, H2Global is intended to give companies and bidding consortia the planning and investment security they need to build large-scale electrolysis capacities and transport them to the EU. H2Global enables investors to base business and financing models on long-term off-take contracts with a solvent contract partner at cost-reflective prices. This is intended to accelerate the implementation of concrete and scalable projects. As H2Global acts at the interface between producers and buyers, the risk of default on the part of the contract partners is minimised. On the demand side, H2Global enables the integration of hydrogen derivatives into the economic cycle at market-reflective prices.

The traded molecules only gain value through their green attributes. The value-enhancing green attributes are based on the fulfilment of regulatory requirements. As stated above, these are currently being developed and will potentially evolve. The H2Global instrument significantly reduces regulatory risks for the industry through long-term purchase contracts, as the requirements for the product are fixed for the duration of the contract. To ensure investment security at this point, criteria for the product to be purchased are defined in advance. The *funding body* (Zuwendungsgeber) is responsible for setting the criteria. Hintco thus bears the risk if the products lose their eligibility for the climate targets and thus their value as a green product.

The different contract durations represent one key element of the H2Global instrument: Long-term contracts on the supply side are opposed by short-term sales contracts on the demand side. This allows the difference between supply prices (generation and transport) and demand prices (transmission and consumption) to decrease over time, if prices for green products continue to

increase due to regulatory incentives and changing consumer behaviour. If revenues on the sales side increase, the differential costs to be covered by the public sector between supply and demand prices are reduced accordingly over time.



*The actual amount of the price difference at the time of the auction depends on the real H2 price development. The capital requirements of the HINT.CO GmbH are accordingly linked to the purchase quantities actually guaranteed in the HPA and the H2 price development.
 **Exemplary illustration

Figure 2 ‘Dynamic component’ due to different contract durations

H2Global, will allow for the first time to appraise realistically the costs for the industrial production of green hydrogen derivatives. In addition, the different contract durations will help to obtain price signals on the demand side dynamically over time. This provides references for the market: transparent prices as well as a transparent catalogue of criteria that ensures the sustainability of the products supplied. The ‘dynamic’ component of the H2Global instrument also aims to ensure that the limited public grant is used as efficiently as possible. This distinguishes the H2Global instrument from conventional and ‘rigid’ funding instruments, which usually focus on direct, project-related subsidisation of capital expenditure (CAPEX costs).

IV. Implementation of the first tender procedure

The first tender procedure aims to procure green hydrogen derivatives on the global market for the European market. The grant comes from the funds of the stimulus package dedicated to international cooperation. This means that projects from countries outside the EU and the European Free Trade Association (EFTA) can apply in this first tender procedure. The grant decision from BMWK in December 2021 provides for the import of green ammonia, green methanol and electricity-based SAF to Europe. The grant decision defines a supply triangle that

includes northern German, Dutch and Belgian ports.¹⁹ Here, among other things, the consuming industry is concentrated and the necessary logistics infrastructure exist.²⁰

The three products ammonia, methanol and electricity based SAF were chosen, as rapid implementation of the hydrogen derivatives and transport vectors is technically and logistically possible. Specifically, the EUR 900 million will be used to purchase these three products over a ten-year period.²¹ The EUR 900 million is the financial ceiling at which Hintco can enter into purchase contracts. This ensures that the non-state-owned Hintco does not have to rely on the proceeds from the sales to meet its contractual obligations on the purchase side, strengthening its creditworthiness. Being a solvent contractual partner for both producers and the demand side is one of the essential elements of the H2Global instrument. This also means that Hintco is expected to draw down only part of the public grant allocated to compensate for the cost difference, as the expected sales revenues will reduce the subsidy requirement or differential cost compensation accordingly.

The product specifications and additional sustainability requirements defined in the grant decision were transferred into commercial contract details and tender documents. On 13 July 2022, the BMWK organised a market consultation²² where a draft of the commercial contract details prepared by Hintco were shared for feedback from relevant stakeholders. Accordingly, a two-stage selection process of bidders and bidding consortia is envisaged. In a first stage, a pre-qualification of candidates for participation in the further tender procedure takes place according to the criteria defined in Art. 58 Directive 2014/24/EU/§§ 45,46 Vergabeverordnung (VgV). In a second stage, the actual tender procedure takes place with the candidates being selected in accordance with Art. 65 Directive 2014/24/ EU/ §51 Procurement Regulation. The product requirements will be based on RED II and Delegated Acts 27(3) and 28(5), published by the EU

¹⁹ Federal Ministry for Economic Affairs and Climate Protection. (2021). Annex 2: Further ancillary provisions and information (WNUH). https://www.bmwk.de/Redaktion/DE/Downloads/XYZ/anlage-2-weitere-nebenbestimmungen-und-hinweise-wnuh.pdf?__blob=publicationFile&v=4

²⁰ IEA. (2021). Hydrogen in North-Western Europe. IEA, Paris. <https://www.iea.org/reports/hydrogen-in-north-western-europe>

²¹ Federal Ministry for Economic Affairs and Climate Protection. (2021). Zuwendungsbescheid - Zuwendung aus dem Bundeshaushalt, Einzelplan 09, Kapitel 0904, Titel 896 02 (Wasserstoffstrategie Außenwirtschaft - Internationale Kooperation Wasserstoff) im Haushaltsjahr 2021 mit Wirkung für die Jahre 2024 bis 2033 für das Vorhaben "H2Global". https://www.bmwk.de/Redaktion/DE/Downloads/XYZ/zuwendung-aus-dem-bundeshaushalt-einzelplan-09-kapitel-0904.pdf?__blob=publicationFile&v=6

²² Federal Ministry for Economic Affairs and Climate Protection, H2Global Foundation, Hydrogen Intermediary Company GmbH. (13 July 2022). International Market Consultation on the 1st H2Global tender procedure. https://www.bmwk.de/Redaktion/DE/Downloads/h2global/international-market-consultation-on-the-1st-h2global-tender.pdf?__blob=publicationFile&v=6

Commission on 20 May 2022 for the consultation process. Should legally binding versions of the delegated acts be published by the end of the tender procedure, these will be adopted unchanged as the basis for the requirements. However, it is expected that the tender procedure will start before their actual adoption. In addition to the green attributes of the products, additional sustainability criteria are placed on the projects. For example, comprehensive documentation must be prepared with regard to the support of the UN Sustainable Development Goals in the respective project country.

After the end of the market consultation, the BMWK has revised the grant decision in consultation with the EU Commission's Directorate-General for Competition. Once Hintco has been notified, the criteria were finalised. The actual tender documents were released in December 2022.²³ The first contracts are expected to be concluded in quarter 3 of 2023. First deliveries are expected two years later, in late 2024/early 2025.

V. Opportunities and limits of the instrument

The institutional set-up of the H2Global instrument is designed to support the technology and market ramp-up of green and climate-neutral hydrogen and hydrogen derivatives. It is both a modular and sequential instrument, enabling it to adapt to changing demands in a rapidly evolving market. H2Global opens up a range of possibilities to promote the technology and market ramp-up in a targeted manner, because it is a controllable funding instrument for government institutions and public funding bodies. It is limited in time and implements a predefined, maximum volume of funding. H2Global is often perceived as an import instrument for hydrogen derivatives because of the first tender procedure. However, its design allows it to promote the ramp-up in Germany, the EU, the European Economic Area and partner countries as well. It can thus also contribute to diversification.

Given its mode of operation, the H2Global instrument can be used according to the specifications and objectives set by the respective funding body. The funding objectives can be of an energy, industrial, technological, innovation or foreign policy nature.

²³ Tenders Electronic Daily. (2022). Germany-Leipzig: Ammonia. Supplies - 675894-2022 - TED Tenders Electronic Daily (europa.eu) (German version only)

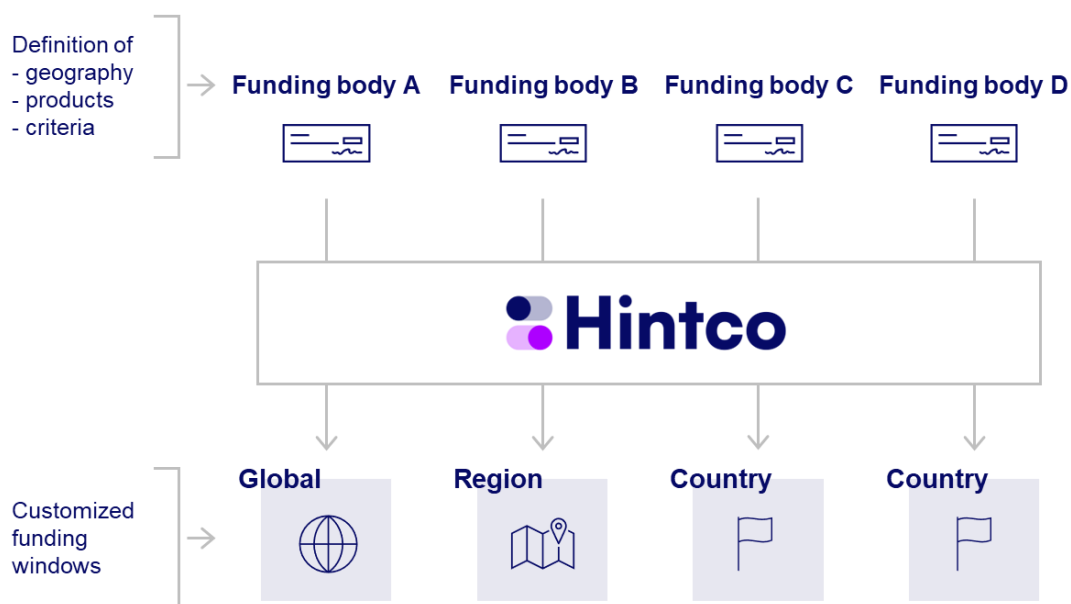


Figure 3 Parallel implementation of several individualised ‘funding windows’

Thanks to the instrument’s flexibility and modular design, funding bodies can react to changing framework conditions and political objectives without major delays in implementation. The time and financial constraints constitute ‘stop and control points’ at which an adjustment and improvement is possible. This allows policy-makers as funding bodies to fine-tune operations with each successive grant.

The opportunities and limitations of the instrument can be summarised in terms of time, quantities, prices, products and market mechanisms.

Time. The timely implementation of the H2Global instrument aims to provide an impetus to the consortia of companies selected from the tender procedure. They can take an initial final investment decision based on their awarded long-term contracts under H2Global. The tender procedure foresees that projects to be selected are scalable and can be launched in the short term. The goal of H2Global is to initiate projects with electrolysis capacities on an industrial scale. During implementation, H2Global offers participating companies both learning experiences and experimental spaces. It also reduces search and transaction costs, which increases the likelihood that cost reductions and efficiency gains will take effect in the second expansion stage and in follow-up projects, and that projects will be scaled up significantly. From today's perspective, the tool helps to address cost and scaling challenges and to offer ‘first movers’ a jump start into a first innovation cycle.

Quantities. The provided amount of EUR 900 million is limited in its impact. The public grant is divided among three products. It is expected that for each product one contract over ten years

will be concluded. The procured quantities are thus, too small to make a significant contribution to security of supply. H2Global can neither stimulate international market ramp-up, nor provide sufficient certainty for the industry to invest into the decarbonization of its processes and plants. Critics have therefore claimed that the instrument is blind on the application side as it neither provides sufficient quantities to the industry, nor can it be counted towards quotas. In fact, the first funding window aims to start production and build up the supply chain to Germany and Europe.

When the H2Global instrument was developed, it was considered that Hintco would purchase quantities of green hydrogen derivatives over and above the public grant provided. In this case, Hintco would have had to estimate the differential costs and, at the same time, the Federal Government would have had to issue corresponding guarantees in the event that the differential costs actually incurred exceeded the range expected. Since issuing such a guarantee would have entailed considerable delays, this was dispensed with to bring the instrument into implementation quickly. It was decided, to give the bidder the opportunity to offer an optional additional delivery quantity, in addition to a minimum delivery quantity. The drawing of this option is subject to Hintco and could be financed from revenues on the sales side. The resulting maximum delivery quantity, together with the minimum delivery quantity and the volume-weighted contract price (euros per ton), forms the award criterion. For future ‘funding windows’, however, it cannot be ruled out that a differential cost approach could be pursued to increase the quantities of green products purchased, implying a more targeted, efficient use of funds and a higher impact on climate protection. Likewise, greater risk sharing by the supply side can be considered in the future, after the instrument has proven its worth in implementation. On the purchase side, the quantities will also be too small and the delivery contract periods too short to cover the needs of large industrial customers steadily and in sufficient quantities.

Prices. In today's market situation, on the one hand green products appear marketable faster compared to grey products, as the price relations have shifted in favour of electrolysis from renewable energies compared to steam reforming of natural gas to blue hydrogen. On the other hand, the price paradox also affects electricity-based electrolysis, as electricity has generally become more expensive. H2Global simulates a functioning market and thus offers initial price signals. Hydrogen derivatives are initially traded in separate markets, but can also be merged into a hydrogen market in future. H2Global could provide important price signals for other instruments and thus allow a more tailored design.

Products. With Russia's invasion of Ukraine, the initial situation has changed significantly. The looming energy supply crisis, the high price level and rising inflation increase uncertainties, and pressure to transform the energy system. In addition to climate protection, the fastest possible substitution of Russian fossil fuels is now also on the agenda. In the medium and long term,

hydrogen derivatives in particular can play a sustainable role, which is why greater needs are emerging – earlier and in more sectors than originally envisaged.

H2Global's provision of green ammonia in the market is viewed as competition for grey ammonia production in Germany. However, the pressure on grey ammonia production is currently already high due to high natural gas prices; moreover, the consumption of ammonia in Germany is far higher than annually sourced through H2Global. The discussion about jobs shows that this has to be seen through the lens of industrial policy, too. For industry, which is under pressure from the price, energy and looming supply crisis, the production of and access to green and climate-neutral hydrogen plays a role in both location-based investment decisions and technology leadership. The importance of hydrogen and hydrogen derivatives thus goes far beyond energy transformation; they are substitutes for fossil energy sources, but also part of the industrial transformation on the demand side and thus of Europe's future economic and growth model. It is necessary to scale up existing technologies from today's manufacturing to industrial scale to enable German and European companies to maintain their pioneering role and remain technology leaders. Priority must now be given to the rapid expansion of generation capacities at home and abroad.²⁴ Moreover, the faster green hydrogen (also via transport vectors such as ammonia) or green 'crude' comes to Germany and the EU for further processing, the sooner there is also the chance to maintain value creation or build up 'green' locational advantages. This presupposes that hydrogen and hydrogen derivatives can be obtained relatively cheaply, safely and reliably. H2Global is one missing part of the jigsaw, albeit a very small one in its current volume.

Market mechanisms. The H2Global instrument is designed to jump-start and make a leap into the market. The first tender procedure will set standards for the definition of green product attributes as well as sustainability criteria for deliveries. Standards and price signals based on criteria and evidence are in turn fundamental prerequisites for a liquid market. On the one hand, there is a need for large long-term contracts, for example for the steel industry, which will be based on similar contract arrangements as for the gas industry. Large-volume bilateral contracts come with the problems known today: they lead to recurring scaling, market concentration and congestion risks also in infrastructure. As a rule, the contracts and especially the pricing formulas remain business secrets.

Long-term contracts will target the large energy-intensive and hard-to-decarbonise sectors that also need large, stable and permanent (baseload) deliveries. On the other hand, neither the technology nor the market ramp-up can be realised without intermediate steps and economies

²⁴ National Hydrogen Council. (2022). Statement: Russia's war of aggression against Ukraine - possible impact on hydrogen ramp-up. https://www.wasserstoffrat.de/fileadmin/wasserstoffrat/media/Dokumente/2022/2022-04-01_NWR-Stellungnahme_Ukraine.pdf. S.5

of scale. In order to have the required quantities ready for delivery at an early stage, for example for the steel industry, it is not only necessary to install the plants at home and abroad, but in practice also to quickly purchase small, steadily growing quantities in order to build up the logistics chain between producers and buyers. H2Global aims at the efficiency and effectiveness of market mechanisms and at cost degression effects through a step change in market and trading places. Here, H2Global can contribute to a level playing field by offering general and transparent criteria and providing important price signals, on the one hand for industrial-scale production, and on the other hand by reducing market entry barriers for small and decentralised projects. A liquid market needs many diverse participants with different interests and risk diversification.

The advantage of H2Global is therefore that it not only provides a competitive interface for supply and demand, but also contributes to market and structure building. The major challenges of a hopefully soon exponentially growing market for green hydrogen and hydrogen derivatives lie in a fair and sustainable distribution of values and risks. This goes hand in hand with the definition of responsibilities, market roles, liability issues and risk mitigation. In this context, the areas of storage and transport are particularly challenging in terms of business models. Transport and storage options are already indispensable for the initial establishment of supply chains. H2Global acts on interfaces along the supply chain that no other instrument addresses. It aims to stimulate the market over time and creates the conditions for a functioning, liquid market with exchange and over-the-counter trading. Indeed, the products purchased by Hintco will be delivered to ports in the Netherlands, Germany and Belgium at intervals during the first ‘funding window’. On the demand side, however, demand could be timed differently, require constant stable baseload deliveries, fluctuate seasonally and rely on different ‘last mile’ transport solutions regionally. Bridging these ‘mismatches’ will be a major challenge for the first phases of ramp-up and infrastructure conversion. In this respect, buffers will have to be built up early on. In order to quickly advance a market ramp-up, an exchange and cooperation with regard to necessary mechanisms and structures is necessary at an early stage. This includes the availability of balancing and control energy as well as commercial and strategic storage facilities. In this respect, the H2Global Foundation is working with the German market area manager THE²⁵ on the necessary requirements for a functioning market, for which energy exchanges such as EEX can and should quickly assume an important role. In the long term, the H2Global instrument can be useful for developing clusters or physical ‘hydrogen valleys’ into ‘island markets’ that are successively interconnected on a pipeline grid basis and also gain liquidity through market-based system services. These ‘island markets’ could also fulfil an early interconnection function of hydrogen and hydrogen derivatives.

²⁵ H2Global entered into a Memorandum of Understanding with Trading Hub Europe (THE) in May 2022.

In summary, the flexibility of the instrument opens up wide scope. In a world characterised by a reorganisation of partnerships and of existing value and supply chains, an instrument that aims at diversified supply relationships potentially brings great added value. Diversification, sovereignty and minimising vulnerability to shocks are a guiding principle²⁶ – not to be equated with autarky – in view of which economic interdependence should not only be oriented towards economic efficiency, but also towards common norms, standards and values. This is where H2Global can come in; on the one hand to diversify hydrogen supplies, and on the other hand to establish targeted bilateral technology and trade relations with strategic partner countries. In particular, forming trade partnerships with developing and emerging economies is an important goal to promote energy transformation, energy supply, and sustainable economic development that takes environmental and climate protection into account.

VI. Outlook

H2Global will have to demonstrate its utility much faster than other instruments of a similar nature. In December 2022, the first supply-sided tender procedure has started.²⁷ Lessons learned from the first tender procedures will provide important insights into the status and costs of technologies, feasibility, implementation and scalability, also in terms of integration into existing supply chains. The outcome will provide more clarity on ‘first movers’ and insight into which players are willing and able to meet strict criteria. Ideally, price signals and criteria will be set as guiding references. The conclusion of contracts by Hintco would only be a first step, but if successful, an important milestone.

While policy makers will make final decisions regarding the future usage of the flexible H2Global instrument, the availability of funds depends on future grants. The most critical factor is to work on synergies, the interplay and a ‘stacking’ of funding instruments and incentives across the entire supply chain. This is also ground-breaking considering a European response to the *Inflation Reduction Act* in the US, and to initiate and accompany the necessary transformation processes. H2Global’s flexibility and modular orientation allow adapting to new ‘funding windows’ according to the latest findings and market developments. Thus, in the 2023 budget, an additional EUR 3.53

²⁶ Westphal, Kirsten (2020): Strategic Sovereignty in Energy Matters. Reflections on Germany's ability to shape and act in the EU. SWP Aktuell 2020/ A46. <https://www.swp-berlin.org/publikation/strategische-souveraenitaet-in-energiefragen>

²⁷ At the time of publication, the tender procedure for ammonia, methanol and SAF are in the phase of *application in the call for competition* (Teilnahmewettbewerb).

billion has been earmarked for the instrument.²⁸ This will enable the implementation of additional tender procedures taking previous learnings into account.

While H2Global was primarily designed as a bridging and catalysing instrument, it could in future transitionally take on an important aggregator role for Europe in international competition, and thus contribute to the realisation of the energy platform envisaged by the REPowerEU communication. It is obvious to use the instrument also for the establishment of supply chains in Germany, in the EU and in its neighbourhood. The further development of the instrument in relation to green hydrogen imports via pipelines will also be of particular importance. This means that the EU will have to focus its 'Global Gateway' strategy not just on interconnectivity with energy-rich neighbouring regions in order to establish corridors for green electrons, molecules and products, but also to build targeted strategic partnerships with a shared value chain. Germany and the EU could therefore use the instrument, if it proves successful, to underpin their own position in the emerging global hydrogen economy by incorporating industrial and technology policy objectives.²⁹

Climate and environmental protection is a global responsibility. Therefore, H2Global can also be used to promote the market ramp-up in developing and emerging countries. It can help to expand countries' existing potentials – both locally and for export – in order to compete against 'first movers' and 'fast followers' on the global market.

²⁸ Federal Ministry of Finance. (01.07.2022). Stabilise public finances, expand future investments, strengthen fiscal resilience. https://www.bundesfinanzministerium.de/Content/DE/Downloads/Oeffentliche-Finanzen/Bundeshaushalt/kabinetttvorlage-regierungsentwurf-2023.pdf?__blob=publicationFile&v=7

²⁹Grinschgl, Julian/ Pepe, Jacopo M./ Westphal, Kirsten (2021). A New Hydrogen World. Geotechnological, economic and political implications for Europe. SWP Aktuell 2021/A 78. <https://www.swp-berlin.org/publikation/eine-neue-wasserstoffwelt>

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