

# HYDROGEN AUCTION SCHEME: DESIGN AND IMPLICATIONS

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## Abbreviation index

<b>AURES II</b>	Auctions for Renewable Energy Support II
<b>CCS</b>	Carbon Capture and Storage
<b>CCfD</b>	Carbon Contracts for Difference
<b>CfD</b>	Contracts for Difference
<b>CO<sub>2</sub></b>	Carbon Dioxide
<b>CINEA</b>	The European Climate, Infrastructure, and Environment Executive Agency
<b>EEA</b>	European Economic Area
<b>EEG</b>	Erneuerbare-Energien-Gesetz (Renewable Energy Sources Act)
<b>ECC</b>	European Commodity Clearing AG
<b>EEX</b>	European Energy Exchange
<b>ESIA</b>	Environmental and Social Impact Assessment
<b>EPEX</b>	European Power Exchange
<b>EU</b>	European Union
<b>EHB</b>	European Hydrogen Bank
<b>RFNBO</b>	Renewable Fuels of Non-Biological Origin
<b>GHPA</b>	Green Hydrogen Purchase Agreements
<b>GW</b>	Gigawatt
<b>H<sub>2</sub></b>	Dihydrogen (here: Hydrogen)
<b>IRENA</b>	International Renewable Energy Agency
<b>kg</b>	kilogramme
<b>MWh</b>	Megawatt-hour
<b>NHS</b>	National hydrogen Strategy
<b>RES</b>	Renewable Energy Sources
<b>THE</b>	Trading Hub Europe

# 1 CONTEXT & THEORETICAL BACKGROUND

## Hydrogen as industrial feedstock and an energy commodity

Almost half of global hydrogen production today comes from natural gas and the rest from coal and oil, with electrolysis accounting for only about 4%<sup>1</sup>. Most of it is produced on-site or relatively close to its legacy demand applications such as refining, fertilizer production and chemical industry, and transported via pipeline, rail or road. Hydrogen is generally inconvenient for handling, transporting and storing. Compared to natural gas, it has about a third of the volumetric energy density at pressures typical for transport and storage. It also causes embrittlement and is more difficult to protect against leaking than natural gas. For liquefaction, relevant especially for long-distance transport, hydrogen needs to be cooled to a lower temperature than natural gas, imposing a significantly higher energy penalty. The logistics and relatively low demand compared to energy commodities like oil, natural gas or electricity mean that the hydrogen market today much more resembles one for an industrial feedstock rather than a globally traded energy commodity. Hydrogen trade has traditionally taken place over the counter, with first trading platforms such as the one developed by the European Energy Exchange (EEX) in Germany only recently coming into existence<sup>2</sup>.

In order for renewable, electrolytic hydrogen to replace hydrogen produced from fossil fuels, production will at least in part need to be located on sites with exceptional renewable energy potentials and away from legacy demand centers. Hydrogen demand structure, and with it, its geographical distribution, will potentially change as well in order to include new applications such as steelmaking and power generation. This shift in geographical patterns would require greater infrastructure capacity to transport hydrogen – or its derivatives such as ammonia or methanol – over larger distances and to more offtakers than before.

1 <https://www.irena.org/Energy-Transition/Technology/Hydrogen>

2 <https://www.eex.com/en/markets/hydrogen>

# 1. Green Hydrogen Framework in the EU and Korea

In July 2020, the European Commission introduced the European Green Deal for a climate-neutral Europe, accompanied by the development of the EU's Energy System Integration Strategy. The latter laid out a set of 38 actions to achieve climate neutrality, including promoting cleaner fuels such as hydrogen and biofuels<sup>3</sup>. The EU Hydrogen Strategy, released the same year, identified hydrogen as key approach for decarbonising what are known as hard-to-abate sectors like steel, chemicals and heavy transport, and for integrating renewable energies into the energy system. It further highlighted auctions as suitable support allocation mechanism which ensures cost-effectiveness and competition, reflecting the requirements of EU's State Aid Guidelines.<sup>4</sup> The REPowerEU plan, introduced in May 2022 primarily in response to the Russian full-scale attack on Ukraine, raised the level of EU's hydrogen ambition and introduced the European Hydrogen Bank (EHB) as the main funding instrument. It doubled the renewable electrolytic (also called "green") hydrogen target by 2030 to 20 million tonnes per year, comprised of 10 million tonnes from domestic production and 10 million tonnes of imports.<sup>5</sup>

The cost of green hydrogen is significantly higher than that for fossil fuels-based one. Currently, grey hydrogen price indices for Europe stand at approximately €2.5 to €3 per kilogram<sup>6,7</sup>. In comparison, bids for RFNBO hydrogen in the 2023 and 2024 Innovation Fund auctions indicated a levelized cost ranging from €5.5 to €13.5 per kilogram<sup>8,9</sup>. To increase the off-takers' willingness to pay the green premium and reduce the need for financial support, the EU has introduced a set of regulatory measures to create market demand. The following provisions have the most direct impact on creating the market pull:

- Renewable Energy Directive (RED) III mandates a share of renewable hydrogen in final energy hydrogen demand in industry of 42% by 2030, and

3 <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2020:299:FIN>

4 <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52020DC0301>

5 [https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en)

6 <https://businessanalytiq.com/procurementanalytics/index/grey-hydrogen-price-index/>

7 <https://e-bridge.com/competencies/energy-markets/hydex/>

8 [https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/calls-proposals/if23-auction-renewable-hydrogen-production\\_en](https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/calls-proposals/if23-auction-renewable-hydrogen-production_en)

9 [https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/calls-proposals/if24-auction\\_en](https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/calls-proposals/if24-auction_en)

60% by 2035; as well as a 1% (together with advanced biofuels and biogas) in 2025 in transport sector, and 1% for RFNBO alone (5.5% together with advanced biofuels and biogas) in 2030

- FuelEU Maritime Regulation mandates a 2% share of RFNBOs in the final energy consumption of on-board fuel by 2034
- ReFuelEU Aviation Regulation sets out a RFNBO subtarget blending mandate within a general SAF blending mandate of 1.2% RFNBOs (2% SAF) by 2025, 2% (6%) by 2032, 5% (20%) by 2035, 10% (34%) by 2040, 15% (42%) by 2045, and 35% (70%) by 2050

The above direct RFNBO market uptake measures are flanked by indirect measures such as EU-ETS, which has recently been extended to cover the maritime sector.

As for South Korea, it began building a comprehensive hydrogen ecosystem in 2019 with the Hydrogen Economy Roadmap and the Hydrogen Technology Development Roadmap. In 2020, the government enacted the Hydrogen Economy Promotion and Hydrogen Safety Management Act and launched the Hydrogen Economy Committee. These initiatives established the foundation for systematic hydrogen development.

The existing Renewable Portfolio Standard (RPS) system supported fuel cells alongside solar and wind power. However, it struggled to ensure stable profitability. Fuel price volatility and Renewable Energy Certificate (REC) price fluctuations created uncertainty for investors. The government recognized the need for a dedicated support mechanism. Initially, the government pursued a Hydrogen Power Portfolio Standard (HPS). This effort eventually expanded into the Clean Hydrogen Power System (CHPS). The 2022 amendment of the Hydrogen Act established CHPS to include both green and blue hydrogen. CHPS launched as the world's first clean hydrogen power auction market. It now serves as a key mechanism for advancing the hydrogen economy and achieving national carbon neutrality goals.

CHPS has multiple objectives. It aims to expand clean hydrogen utilization and lower early market-entry barriers. The system seeks to strengthen the domestic hydrogen power industry. It also contributes to national emissions

reduction targets. The market structure includes power producers use green or blue hydrogen or ammonia to generate electricity. They sell this electricity in the wholesale power market. Producers receive compensation that reflects the higher cost of clean hydrogen power generation. The Korea Power Exchange (KPX) mediates these transactions. KPX pays producers based on market prices. Korea Electric Power Corporation (KEPCO) serves as the obligated buyer. KEPCO purchases all electricity generated from clean hydrogen and ammonia. This arrangement secures stable demand and supports economic viability for producers. CHPS is linked with the clean hydrogen certification system to track carbon emissions. The system is designed to stimulate long-term investment and infrastructure expansion. It also aims to enhance energy security through the integration of hydrogen with renewable energy systems.

## 2. Support types, auction design and their implications

This chapter focuses on support types and on the key auction design elements, and their implications. Both can influence the market participants' behaviour and auction outcomes.

### **1** Support types

Among other things, the type of support is key for risk allocation. Figure 1 provides an overview of risk allocation for four different types of support typically used in the context of renewable energies.

The fixed premium, in contrast to some other support modes, does not directly help facilitating a producer-offtaker-match but instead leaves

this to the bidders. This entails several advantages, including leveraging existing business relationships as well as the producer and the off-taker vetting each other before assuming the counterparty risk. Assuming the most basic contract structure, the parties agree to guaranteed hydrogen price and volume. Assuming no explicit hedging strategies, the producer takes on symmetric risks associated with electricity price and/or volume, meaning swings in these can lead to both gains or losses. Hydrogen price risk and CO<sub>2</sub> coupon price risks do not exist beyond opportunity costs or gains for both off-taker and producer. Both parties are fully exposed to the counterparty risk. As implemented by the EHB, the fixed premium can be viewed to be technically allocated via a supply-side auction since the financial support is paid to the producer. However, the off-taker is equally involved in the formation the bid price since their willingness to pay (expressed as the take-off price) has a direct effect on the bid price, and is incentivised to reveal their true marginal utility (see section 0). This makes tis support type effectively more akin to a double-sided auction.

With one-way Contracts for Difference (CfD), the risks are not allocated symmetrically. Assuming a fixed hydrogen price between the producer and the off-taker (except when the underlying is the hydrogen price itself) and that financial support is awarded to the producer, the producer is put in an advantageous position where they are only exposed to upside risk with respect to the underlying (e.g. power price), and to symmetric risks with respect to all other cost and revenue factors not covered by the financial support contract. The intermediary – the entity providing the financial support – is only exposed to the downside risk with respect to the underlying. The off-taker does not assume risks beyond opportunity costs or gains, except when the underlying is the hydrogen price itself. Then, the off-taker assumes the symmetric risk of having to pay more (less) for the hydrogen in case its price rises (falls). This is analogous to the German electricity market where producers are often protected against low wholesale power prices while the off-takers are fully exposed to high prices. For hydrogen price itself to be the underlying would however require the existence of a liquid market for renewable hydrogen, which at present does

not exist. This makes this approach challenging, as already noted in ...<sup>10</sup>. The same holds true if the underlying is the volume of generated wind or solar power (or a price index fully or partially based on it). In case of a Carbon Contract for Difference (CCfD) where the underlying is the CO<sub>2</sub> coupon price and support is paid to the off-taker, the off-taker assumes the upside risk while the intermediary assumes the downside risk associated with CO<sub>2</sub> coupon price swings. CO<sub>2</sub> price swings, representing neither a direct cost nor revenue factor for either the off-taker or the producer, only represent opportunity risks for both parties. Both the producer and the off-taker assume the counterparty risk. One-way CfD financial support can in principle be allocated via both a supply-side and a demand-side auction auction. Typically, the former is the case, except when the underlying is the price of the emissions certificate (CCfD).

With a two-way CfD where the financial support is paid to the producer, the intermediary assumes the symmetric risk with regard to the underlying, while both the producer and the off-taker are protected from it unless the underlying is the hydrogen price itself, in which case the off-taker is exposed to the symmetric risk associated with its price swings (same as for one-way CfDs). Both parties are also exposed to opportunity risks associated with the CO<sub>2</sub> coupon price. The producer remains exposed to all other symmetric cost and revenue risks not covered by the CfD.

In double-sided auctions, the intermediary holds separate auctions for hydrogen producers and off-takers, committing to a pre-determined volume of hydrogen and/or financial support. As the buying price is typically lower than the selling price, the intermediary covers the difference. The supplier assumes power supply and volume risks, while the intermediary assumes the counterparty risk (it is assumed that the intermediary represents no counterparty risk to producers and off-takers). Both parties are also exposed to opportunity risks associated with the CO<sub>2</sub> coupon price (except when this is the underlying).

Further risks such as regulatory, currency exchange, capital cost, and operational risks are not considered in this simplified analysis.

<sup>10</sup> [https://climate.ec.europa.eu/system/files/2023-08/innovationfund\\_inputpaperforworkshop\\_en.pdf](https://climate.ec.europa.eu/system/files/2023-08/innovationfund_inputpaperforworkshop_en.pdf)

Legend	
<b>S</b>	Supplier
<b>I</b>	Intermediary
<b>O</b>	Off-taker
-----	
<span style="background-color: #d9ead3; border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>	Upside risk only
<span style="background-color: #d9ead3; background-color: #f4cccc; border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>	Both upside and downside risk
<span style="background-color: #f4cccc; border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>	Downside risk only

**FIGURE 1** Risk sharing for different types of support schemes (Source: Own elaboration)

Risks***	Fixed premium*			One-sided CfD**			Two-sided CfD**			Double-sided auctions		
	S	I	O	S <sup>1</sup> S <sup>2,3</sup>	I <sup>1</sup>	O	S <sup>2,3</sup>	I <sup>1</sup>	O	S	I	O
Power price risk <sup>a</sup>	S	I	O	S <sup>1</sup> S <sup>2,3</sup>	I <sup>1</sup>	O	S <sup>2,3</sup>	I <sup>1</sup>	O	S	I	O
Power volume risk <sup>b</sup>	S	I	O	S	I	O	S	I	O	S	I	O
Hydrogen price risk <sup>c</sup>	S	I	O	S <sup>2</sup> S <sup>1,3</sup>	I <sup>2</sup>	O <sup>2</sup>	S <sup>1,3</sup>	I <sup>2</sup>	O <sup>2</sup>	S	I	O
CO <sub>2</sub> coupon price risk <sup>d</sup>	S	I	O	S <sup>1,2</sup>	I <sup>3</sup>	O <sup>3</sup>	S <sup>1,2</sup>	I <sup>3</sup>	O	S	I	O
Counterparty risk <sup>e</sup>	S	I	O	S	I	O	S	I	O	S	I	O

Challenges			
Underlying		Reference power volume determination	Reference power volume determination
Underlying		Reference hydrogen price determination	Reference hydrogen price determination

- \* Assumes fixed price of hydrogen between Supplier and Off-taker (except for **c**) and that support is paid to the Seller (except for **d**)
- \*\* Assumes that support is paid to the Supplier (except for **d**)
- \*\*\* Further risks such as regulatory, currency, capital cost, and operational risk are not considered; Opportunity costs are not considered; Assumes no automatic correlations (e.g. higher power price → higher hydrogen price)
- a** Assumes no explicit power price hedging strategies by the Seller (e.g. own RES-E generation assets or fixed-price PPA)
- b** Assumes that the Supplier assumes the power volume generation risk (e.g. when sourcing the power from own RES generation assets), and does not enter hedging strategies (e.g. via financial instruments)
- c** Assumes that hydrogen price is not fixed; Assumes no possibility for the Off-taker to arbitrage between hydrogen and power price
- d** Assumes a reference CO<sub>2</sub> price path is used only for determining the support level
- e** Assumes that the intermediary, i.e. the subsidy provider, represents no counterparty risk

**FIGURE 1** display the risk allocation for the above four support types (fixed premium, one-way CfD, two-way CfD, and two-sided auctions). For each of these, risk allocation is differentiated by the underlying (power price, power volume, hydrogen price, CO<sub>2</sub> emissions price). The risks considered are power price, power volume (relevant e.g. when the supplier sources electricity from own variable renewable energy power plants), hydrogen

price, CO<sub>2</sub> emissions price, and the counterparty risk. The combination of field colour (indicating upside/symmetric/downside risk) and superscripted number(s) (indicating the choice of the underlying) indicates how the risk is allocated for a specific combination of support type and the underlying. For example, for one-way CfD, upside (green) power price risk is assumed by the supplier (S) if the underlying is the power price (1), while the downside risk (red) is assumed by the intermediary (I). A symmetric (orange) power volume risk for one-ways CfDs is assumed entirely by the supplier regardless of the underlying (no subscripted number).

The REPowerEU plan also focusses primarily on hard-to-abate sectors and advocates a phased approach to scaling up hydrogen production and infrastructure development. However, the EU Hydrogen Strategy is the strategy that communicates support for competitive auctions as a tool to promote the production of renewable hydrogen and drive cost reductions. The graphic below explains the logic of the renewable hydrogen premium and public subsidy model:

## **2 Price formation mechanism**

Besides risk allocation (see above), another key public financing support system feature is the price formation mechanism, including but not limited to when auctions are employed. As already mentioned in section 1.1.1, the European Commission identified auctions as a suitable tool for allocating public support to hydrogen ramp-up which ensures competition and cost effectiveness.

Two price formation mechanisms most commonly used in auctions, each with their own set of advantages and disadvantages, are pay-as-bid (also called “discriminatory price”) and pay-as-clear (also called “uniform price”). In principle, both can be used in combination with any support type and any type of underlying discussed in section 1.2.1, with varying degrees of practicality. The choice of the price formation mechanism will also depend on the characteristics of the market for the commodity in question and the goals of the auction.

Pay-as-clear setup awards all successful bidders the same market-clearing price, determined by the highest accepted bid for the sales auction, which is equivalent to the lowest price for the purchase auction. The advantages of a pay-as-clear setup is that sellers (buyers) reveal their true marginal costs (marginal utility) which contributes to efficiency, that it provides a higher degree of market signals transparency to the bidders, that it lowers entry barriers for participation for smaller bidders, and that there is a clear reference price after the auction has concluded. The downside of pay-as-clear pricing is that in the short term, average prices achieved in the auctions might be higher. With heterogenous goods, pay-as-clear can also lead to distortions in cost-to-value matching due to treating bids as interchangeable while their quality generally differs, which leads to inefficiencies in allocation of support. Low levels of competition, especially in one-off/single shot auctions, generally increase the chances that the total payout for the same amount of auctioned good will be higher.

Pay-as-bid means each that each successful bidder receives the price submitted and prices vary by bidder. The auctioneer selects the lowest bids until the required quantity is reached, or until the supply and demand are matched. This setup is often touted as leading to lower short-run average prices achieved in the auctions, but at least in the context of power markets, not all research supports that conclusion.<sup>11</sup> In addition, this setup decreases the transparency of market signals, disadvantaging the smaller bidders and increasing inefficiencies resulting from bid markups and resources invested by the bidders into acquiring information on their competitors' strategies.

As BDEW explains in its discussion paper on long-term power market design for Germany and Europe, both mechanisms should in theory lead to the same long-term outcome, assuming 1) a homogeneous product, 2) sufficient competition in the market and 3) perfect availability of information.

<sup>11</sup> <https://www.tse-fr.eu/sites/default/files/TSE/documents/conf/2022/energy/you.pdf>

# 2 COMPARISON OF EU'S & KOREA'S HYDROGEN SUPPORT SCHEMES AND AUCTION DESIGN

Following is a high-level comparison of EU's and Korea's hydrogen support scheme and auction design, based on the key elements and features discussed in section 1, with details on each design provided in the Annex 1. Before elements and features are discussed, it must be noted that both support schemes along with their auctions are vastly different in terms of their policy background, stated goals, scope and basic design elements. This makes a direct comparison along the list of individual design elements an approach of questionable expedience. Instead, in the table ... below, first an overview of key features is provided, followed by a comparison of the most important overarching implications for the bidders. In **TABLE 1**, information gathered in the interviews is also incorporated.

**TABLE 1** Comparison of EU's and Korea's hydrogen support schemes and auction design

KEY ELEMENTS AND FEATURES		
RFNBO hydrogen, kg	<b>Auctioned good, unit</b>	Electric power generated from co-firing, MWh
Fixed premium; Tied to production volume	<b>Support type and basis</b>	CfD; Tied to production volume
Double-sided	<b>Support side</b>	Supply-side
Price, volume	<b>Bid components</b>	Price, volume
Price only	<b>Bid ranking</b>	Price and non-price criteria
Pay-as-bid	<b>Price formation mechanism</b>	Pay-as-bid
10 years	<b>Grant duration</b>	15 years
IMPLICATIONS		
<ul style="list-style-type: none"> <li>• Producer: Power price (cost), power production volume, counterparty</li> <li>• Intermediary: /</li> <li>• Off-taker: Counterparty</li> </ul>	<b>Risk allocation</b>	<ul style="list-style-type: none"> <li>• Producer: Hydrogen price (cost), currency (partial)</li> <li>• Intermediary: n. a.</li> <li>• Off-taker: Power price (revenue), currency (partial)</li> </ul>
High	<b>CAPEX Intensity</b>	Low
Up-, mid-, and down-stream	<b>Value chain scope</b>	Mid- and down-stream
<ul style="list-style-type: none"> <li>• Domestic: High</li> <li>• Foreign: Moderate</li> </ul>	<b>Supply Chains Impact</b>	<ul style="list-style-type: none"> <li>• Domestic: Moderate</li> <li>• Foreign: Moderate</li> </ul>

**Legend**

- EU
- Korea

EU's choice of RFNBO hydrogen with the unit of kilograms (kg) as the auctioned good is in accord with the basic hierarchy of its policy framework where hydrogen and its derivatives are understood to come after energy efficiency and direct electrification in combination with decarbonisation of power supply, typically targeting hard-to-abate applications.

A unit of RFNBO hydrogen will generally have a different utility to different bidders depending on their unique combination of intended use, location, sector- and application-specific policies and regulations it is subject to, the markets in which it operates, their business strategies and other factors. The support scheme design offers a high degree of technological openness by forcing the bidders—consisting of a combination of a hydrogen producer and at least one off-taker—to express the individual price gap between the hydrogen's production cost and off-taker's unique marginal utility.

In contrast, Korea's support scheme with power generated from low-carbon ammonia with the unit of megawatt hours (MWh) as the auctioned good reflects the much narrower focus that low-carbon fuels are to play in its climate, energy, industrial and trade policies at this stage. While co-firing of ammonia can be achieved with more than one technology—e.g. coal as well as open and closed cycle gas thermal power plants—such a policy choice has consequences in terms of narrower scope for innovation on the one hand but a higher concentration of public support on the selected applications on the other. Some of the advantages for Korean participants are the opportunity to contribute to auction design improvements based on operational experience, and policy framework signalling sustained commitment to the hydrogen-based power generation. Disadvantages of the scheme on the policy level include the risk associated with a “picking winners” strategy, i.e. of inefficiently allocating public support in case these applications do not achieve expected breakthroughs such as scale, cost and timelines on the low-carbon ammonia supply side, and R&D efforts on co-firing power turbines on the demand side. There is additional concern of lock-in effects, i.e. that focusing on co-firing in existing plants will not sufficiently incentivise Korean manufacturers to develop next-generation hydrogen turbines or large-scale fuel cell power plants. If auction criteria

do not require increasingly higher hydrogen ratios or dedicated hydrogen-fuel equipment, Korean manufacturers may defer investment in advanced hydrogen technologies, effectively locking themselves into sub-optimal or transitional technologies rather than driving bold innovations such as 100% hydrogen combustion or novel power cycles.

With no local content rules in the CHPS, major international turbine and fuel cell manufacturers can in practice also outcompete domestic equipment manufacturers. Companies such as General Electric, Siemens, and Mitsubishi are developing hydrogen-compatible power generation systems. If their technologies prove superior or achieve faster market penetration, Korean power companies might select them to meet CHPS targets, disadvantaging domestic manufacturers. In a worst case, Korean firms could become primarily assemblers or operators of foreign technology and fuel, capturing only a small fraction of total value. This external dominance threat means Korean companies cannot assume a protected market and must continuously improve competitiveness. The initial auction results revealed design flaws where auction parameters, particularly price caps and cost assumptions, misaligned with market realities. Korean companies faced a system too restrictive to accommodate the actual costs of clean hydrogen generation, preventing full participation and potentially excluding viable projects, including those proposing more innovative approaches. This constrains the system's ability to stimulate innovation rather than catalyse it, though ongoing government adjustments to auction rules demonstrate recognition of these limitations.

The choice of fixed premium as the support type by the EHB in combination with the requirement to have already matched the producer with the off-taker(s) and pay-as-bid price formation mechanism are in line with theory since the auction good targeted is heterogenous due to it being produced at different locations, and since the expected level of competition is medium to low, along with a one-off/single shot setting of the auction. As discussed above in section 1.2.1, a fixed premium awarded to bidders consisting of the hydrogen producer and at least one off-taker has the advantage of better matching of cost to value, as well as of a low-complexity risk

structure for all parties involved (the bidder, the intermediary and the off-taker). In Korea, the choice of supply-side CfD in combination with pay-as-bid price formation mechanism is also in line with the fact that the expected level of competition is low and occurs in a one-off/single shot setting, and that the auction good is heterogeneous. Here too, the choice of pay-as-clear as the pricing mechanism can be expected to result in higher prices.

Another central difference with relation to the auctioned good are the criteria governing the type of low-carbon fuels eligible for support and its geographical origin. With EHB's exclusive focus on hydrogen fulfilling the RFNBO criteria, only electrolytic low-carbon hydrogen is entitled to potential subsidies. Furthermore, the first two EHB auctions have been limited to domestic hydrogen, i.e. hydrogen produced in the European economic area (EEA). Korea's auctions allow for more flexibility in that low-carbon, fossil fuels-derived ammonia of foreign origin can also be bid in the auctions. Blue hydrogen currently tends to be cheaper than green, and South Korea only has very limited natural gas resources.<sup>13</sup> It follows that the expected result of the Korean auction is that winning bids will at least partly be based on imported blue ammonia. In fact, the only successful bid from Korea's first auction is based on blue ammonia supplied from Aramco of Saudi Arabia<sup>14</sup>. Should this also be the case in the following auction rounds, it could create an import dependence. It also has a direct negative effect on Korea's capture of the value created partially through public financial support. Korean firms primarily acting as importers or fuel purchasers may not develop significant proprietary technology in hydrogen and ammonia production itself. Further, the operational risks extend beyond supply chain logistics. Failure by a Korean power company to secure contracted ammonia fuel on time could result in missed auction obligations, financial penalties, or subsidy loss. These risks can inflict financial damage on early market participants and, if unmanaged, sour industry-wide attitudes toward ammonia-based power generation.

This choice of the type of hydrogen or ammonia eligible for public support has further far-reaching implications. First, the production of green hydrogen is more capital expenditure (CAPEX)-intensive than for blue

<sup>13</sup> 2024\_H<sub>2</sub>E\_CleanH<sub>2</sub>  
ProductionPathways  
Report.pdf  
(hydrogeneurope.eu)

<sup>14</sup> <https://www.electimes.com/news/articleView.html?idxno=347406>

hydrogen, both in relative and in absolute terms, driven mostly by the costs of electrolyser and its balance of plant.<sup>15</sup> This translates into greater financial risks associated with stranded assets should the project underperform (e.g. due to power price or volume risks, technical performance risks such as downtime or increased maintenance costs, etc), or if counterparty risks materialize. In contrast, blue hydrogen production cost is dominated by operational expenditure (OPEX), first and foremost the cost of natural gas, as well the costs associated with intercontinental shipping of low-carbon ammonia. OPEX does not have to be committed in its entirety at an early stage of the project. In addition, the EHB scheme in principle exposes the producer to potential contractual penalties in the case of non-fulfilment of the contract. In the Korean auction system, the bidders are also exposed to the risks associated with R&D efforts in the field of co-firing, as power turbine technology has not yet achieved full commercial maturity. At the same time, it partially or fully transfers different risks from the bidders to the producers of ammonia (assuming bidders are power generators and not necessarily simultaneously ammonia producers), particularly exchange rate volatility in the first auction, international fuel supply chain dependencies, and commodity price fluctuations.

Another implication resulting from the choice of the type of fuels and their geographical origin eligible under the respective schemes is how much value added as well as innovation and learning effects are captured domestically. It can be argued that the EU's scheme captures significantly more of the upside not only in the mid- and downstream sector like Korea, but also in the upstream where most of the value added and learning and innovation takes place. First, Europe stands to benefit from the fact that the projects for green hydrogen production themselves must be located in EEA. Second, projects must limit the sourcing of electrolysers from China to not more than 25% (see Annex 1), and many of the non-Chinese electrolyser producers are European. Indeed, the results from the EHB 2024 auction show that winning bids intend to source electrolysers from European and US manufacturers.<sup>16</sup> Third, Europe profits from the build-out of additional renewable power generation capacities, mostly wind and solar photovoltaic,

15 2024\_H<sub>2</sub>E\_CleanH<sub>2</sub>  
ProductionPathways  
Report.pdf  
(hydrogeneurope.eu)

16 [https://climate.ec.europa.eu/document/download/4ee6ff31-2dea-41e1-a057-892b86934156\\_en?filename=if24\\_preliminary\\_information\\_auction\\_en.pdf](https://climate.ec.europa.eu/document/download/4ee6ff31-2dea-41e1-a057-892b86934156_en?filename=if24_preliminary_information_auction_en.pdf)

where components can also be expected to at least in part be sourced from European manufacturers. In contrast, the Korean scheme cannot be expected to capture a significant share of value added or learning and innovation effects in the upstream, as it is in blue ammonia exporting countries' interest to keep these benefits to themselves and establish a foothold in what can potentially be a lucrative future market.

# 3 CONCLUSIONS

**EU**

The analysis of the European Hydrogen Bank's (EHB) auction scheme validates the EU's choice for the support system and auction design and show that they fit the facts on the ground at this early stage of hydrogen ramp-up support, first and foremost the lack of comprehensive infrastructure coverage and emerging but still limited competition on the production side. The combination of a fixed premium awarded to a pre matched producer-off taker pair and a pay as bid price formation mechanism for a single shot setting with a heterogeneous product is broadly consistent with auction theory. The EU's apparent focus on price discovery as key element of its design also appears a sound choice.

The EHB design maximises domestic value creation. By focusing exclusively on RFNBO hydrogen produced in the EEA and introducing local content rules, the scheme directly targets upstream green hydrogen production and its deployment across a heterogeneous set of end uses and locations, accounting for the commodity's location-specific production costs and application and infrastructure-specific value to its end-users while keeping most of the economic upside inside the EEA.

At the same time, this configuration places a large share of risks on the bidder, such as power price and volume risk, as well as counterparty risk and potential contractual penalties for non delivery. The bidder's risk profile is further exacerbated by the CAPEX intensive projects where the upfront investment in electrolyzers and associated balance of plant plays a considerable role in their total cost and makes abandoning an underperforming project more costly.

Against this backdrop, there is a strong case for de-risking within the EHB framework and for reducing some of the downside faced by first mover projects if the EU wishes to accelerate project realisation at scale while preserving the scheme's ability to reveal information about costs and off takers' willingness to pay. Extending the support duration beyond the

current ten years would allow a larger portion of asset depreciation to be covered within the support period and so improve bankability without fundamentally changing the allocation of technological and market risks.

In addition, early experience with matched producer–off taker consortia suggests that flexibility around off taker identity and technical configuration after contract award should be increased, in order to account for early, still fluid market where the relevant technologies are evolving fast, changing market conditions are constantly shifting the implicit value of RFNBO hydrogen, infrastructure is still being built and the regulatory uncertainty persists. Greater clarity ex ante on which bid elements can be adapted post award, and under which conditions, could reduce the bidders’ real and perceived risk and help more projects off the ground. Especially relaxing the rigid requirements on locking in specific off takers or detailed technical layouts could shift the focus of the scheme more clearly towards actual decarbonisation outcomes rather than early design choices.

Overall, the EHB auctions appear well aligned with the EU’s broader strategy of using hydrogen primarily for hard to abate applications and of leveraging public support to build a globally competitive manufacturing and project ecosystem; the next step is to calibrate de-risking instruments so that this strategic upside is not constrained by avoidable finance and implementation barriers.

## Korea



Korea's Clean Hydrogen Power System (CHPS) has established the world's first dedicated clean hydrogen power auction market and provides an integrated framework linking auctions, power market participation and a clean hydrogen certification system.

By focusing on electricity generated from low carbon hydrogen or ammonia, with contracts for difference (CfDs) allocated via pay as bid, supply side auctions and a long support duration of fifteen years, the scheme offers power producers a relatively predictable revenue stream while seeking to lower early barriers to market entry and support national carbon neutrality goals.

However, this design embodies a conscious narrowing of scope. Expanding scope to allow for more innovation is critical for the system's long-term effectiveness. The current focus on ammonia co-firing at 20% ratios in existing coal plants, while pragmatic as a transitional approach, does not create sufficient pressure for breakthrough innovations in hydrogen power generation. The first auction's failure to attract the targeted volume, only 79 MW awarded against a 6.5 TWh target, stems partly from constraints on available technologies and business models within the narrow scope. Future rounds should explicitly incentivize higher hydrogen/ammonia ratios, dedicated 100% hydrogen combustion systems, and novel power generation cycles such as advanced fuel cells. The non-price criteria structure, which already allocates 40% weighting to factors beyond price, provides a ready mechanism to reward technological ambition without abandoning cost-effectiveness objectives.

Capturing more value-added and hedging against "picking winners" risks are interconnected challenges. The current system's focus on power generation from imported blue ammonia means Korea captures only downstream value while upstream activities including hydrogen production, catalyst development, and electrolyser innovation occur elsewhere. This

creates both economic opportunity costs and strategic vulnerabilities. The successful bid in Korea's first auction relies on Saudi Arabian blue ammonia, exemplifying this dependency. Diversifying eligible fuel pathways and production locations would distribute risks across multiple technology trajectories and supply sources, reducing the impact if any single pathway underperforms. Incorporating domestic green hydrogen production pathways, even if currently more expensive, would create option value and stimulate domestic innovation in electrolysis, renewable integration, and hydrogen logistics.

Reducing dependency on imported fuels and capturing upstream value-added should become explicit policy objectives in subsequent auction designs. The structural import dependency transfers economic benefits abroad and creates supply chain vulnerabilities, exchange rate risks, and geopolitical exposure. The 2025 indexation mechanism partially addresses exchange rate risks. Establishing separate auction categories or reserved volumes for domestic green hydrogen production would stimulate investment across the full value chain. This approach mirrors the EHB's geographic restrictions but is adapted to Korea's resource constraints and industrial policy objectives. Supporting domestic hydrogen production infrastructure would position Korean firms not merely as fuel purchasers but as technology developers capable of exporting expertise to other hydrogen-importing nations.

Korea's clean hydrogen certification system deserves particular recognition for its explicit 4-grade structure integrated directly into CHPS. This system differentiates hydrogen based on lifecycle carbon intensity with a threshold of 4 kg CO<sub>2</sub>e per kg H<sub>2</sub> or less, creating a transparent quality hierarchy that incentivizes continuous emissions reductions. The use of clean hydrogen grade as a tiebreaker criterion in auction evaluation embeds this environmental differentiation into market mechanisms. This approach is more sophisticated than binary "green" or "clean" categorizations and could inform refinements to international hydrogen certification systems, including potential future iterations of the EU's RFNBO criteria.

The 2024 and 2025 CHPS iterations maintained the core framework

while improving practical stability through exchange rate-linked settlement, volume carryover provisions, and tightened eligibility criteria. However, on October 17, 2025 on the bid submission deadline itself, the Korea Power Exchange cancelled the auction. It mentioned inconsistency between the national commitment to phase out coal power by 2040 and CHPS support for coal-ammonia co-firing operations extending up to 15 years. Industry characterized the deadline-day cancellation as a fundamental expansion of policy uncertainty. Project developers now face directional uncertainty and sunk cost exposure on investments made based on established policy frameworks. The CHPS experience demonstrates that policy stability is essential for market function in capital-intensive energy transitions. The Hydrogen Act was enacted in 2021 and the auction market opened in 2024, yet organizational restructuring that transferred authority from the Ministry of Trade, Industry and Energy to the Ministry of Climate and Environment resulted in abrupt suspension. For CHPS to fulfill its institutional potential, policy design must achieve greater durability through robust inter-ministerial coordination, clearer decarbonization pathway mapping that reconciles near-term deployment with medium-term coal phase-out commitments, and formal stakeholder consultation processes to strengthen credibility and catalyze private investment at scale.

	EU: Round 1 (2023)	EU: Round 2 (2024)	Korea: 2024	Korea: 2025
<b>1 General information &amp; auction design</b>				
1. Objective of the auction	Cost efficient support for RFNBO hydrogen production in the EEA	Cost efficient support for RFNBO hydrogen production in the EEA, [New, additional] incl. as contribution to security of supply, industrial leadership and competitiveness	Reducing greenhouse gas emissions through the use of clean hydrogen in power generation Fostering the hydrogen ecosystem, kick-starting the hydrogen economy as a new power market segment.	No changes
2. Auctioned good	RFNBO hydrogen, unit: kg The hydrogen must fulfill criteria as defined in the Delegated Act C(2023) 1086 supplementing Directive (EU) 2018/2001; the producer must provide certification for the produced hydrogen; the GHG reduction is calculated over the entire payment duration	No changes	Power generated from clean hydrogen or ammonia, delivered to the Korean power grid. Unit: MWh Any hydrogen produced via low-carbon pathways so long as its emissions have a lifecycle carbon intensity of $\leq$ 4 kg CO <sub>2</sub> e per 1 kg H <sub>2</sub>	No changes
3. Total auction volume	Auctioned good volume: No limit Budget: EUR 800 million: general topic	Hydrogen volume: No limit Budget: [Adjustment] EUR 1.0 billion: general topic EUR 200 mio.: maritime sector	Auctioned good volume: 6.5 TWh per year of clean hydrogen-based power Budget: capped but not publicly announced.	[Adjustment] Auctioned good volume: 3 TWh per year of clean hydrogen-based power Budget: capped but not publicly disclosed
4. Single vs. multiple-item auction	Multiple items	Multiple items	Multiple items	Multiple items
5. One-stage or two-stage auction	One-stage	No changes	One-stage	No changes
6. Auction type	Static auction, sealed bid	No changes	Static auction, sealed bid	No changes
7. Pricing mechanism	Pay-as-bid	No changes	Pay-as-bid	No changes
8. Support type	Output-based, tied to kg of produced hydrogen	No changes	Output-based, tied to MWh of generated power	No changes
9. Support form	Fixed premium	No changes	Fixed component & a flexible (CfD) component <ul style="list-style-type: none"> <li>• <b>Fixed Component:</b> base capacity payment or a guaranteed portion of revenue per kWh</li> <li>• <b>Variable Component:</b> often called the fuel component, CfD with fuel cost as the underlying</li> </ul>	[Adjustment] Exchange rate-linked settlement mechanism introduced to the underlying to account for foreign exchange risk in long-term fuel supply contracts
10. Offtaker	No restriction on off-takers	No changes	Not relevant: no offtaker in the constellation., electricity is fed into the public grid	No changes

11. Bid ranking	Price only	No changes	<p>Combined price J(60% weight) and non-price (40% weight) criteria.                      Non-price criteria:</p> <ul style="list-style-type: none"> <li>• Environmental/GHG reduction/GHG intensity</li> <li>• Industrial/economic</li> <li>• Acceptance/project stage</li> <li>• Grid impact</li> </ul>	No changes
12. Tiebreaker	<p>The following criteria will be used as tie-braker, in the following order:</p> <ol style="list-style-type: none"> <li>1. Lower grant amount</li> <li>2. Country with lower volume of funds awarded</li> <li>3. Earlier entry into operation time</li> </ol>	[New, additional] Conclusive tie-braker in the form of a random draw added	<p>The following criteria will be used as tie-braker, in the following order:</p> <ol style="list-style-type: none"> <li>1. Lower price</li> <li>2. Clean hydrogen grade</li> <li>3. Emissions coefficient</li> <li>4. Fuel supply stability</li> </ol>	No changes
13. Clearing mechanism	<p>The last bid still wholly covered by the total auction budget gets accepted. No partial bids. The next-lowest bid goes into a reserve pool. Non-awarded volume does not get carried over.</p>	No changes	<p>The last bid still wholly covered by the total auction budget gets accepted (the target may be exceeded by 5%). No partial bids. The next-lowest bid goes into a reserve pool. Non-awarded volume does not get carried over.</p>	No changes
14. Safeguards	<ul style="list-style-type: none"> <li>• Between auctions: Based on market testing, budget and feedback on competition</li> <li>• Intra-auction: None (e.g. no clawbacks)</li> <li>• Completion guarantee/ safeguard against speculative bids: 4% of the max grant amount; guarantee must be signed by a bank or financial institution with adequate rating; Lol from a financial institution to issue a completion guarantee needs to be included in the bid</li> </ul>	<ul style="list-style-type: none"> <li>• [Adjustment] Completion guarantee raised to 8%.</li> <li>• [New, additional] Auction schedule based on past participation level</li> </ul>	<ul style="list-style-type: none"> <li>• Between auctions: Based on market testing, budget and feedback on competition</li> <li>• Intra-auction: Anti-collusion and transparency safeguards enforced throughout the bidding process</li> <li>• Completion guarantee/ safeguard against speculative bids: 10% performance bond required, calculated on annual contract volume. Called and/or lost through staged penalties and termination in case of failure to achieve commercial operation.</li> </ul>	No changes

2 Definitions, qualifications, certifications, deadlines, sanctions, reporting				
<p>1. Bids &amp; Project</p>	<p><b>Admissibility (pass/fail):</b></p> <ul style="list-style-type: none"> <li>• Deadlines, documentation, use of EC's portal</li> </ul> <p><b>Eligibility (pass/fail)</b>  <b>Project must be located in EEA</b></p> <ul style="list-style-type: none"> <li>• Project must have a minimum of 5MWe newly installed electrolyser capacity (w/o pooling)</li> <li>• Hydrogen must be made in newly built production facilities (pre-FID and -construction)</li> </ul> <p><b>Relevance and quality (pass/fail):</b></p> <ul style="list-style-type: none"> <li>• RE sourcing strategy: Lots of data to be provided / 60% of lifetime power supply must be covered by Lols/MoUs/ precontracts</li> <li>• Hydrogen offtake strategy: Dito</li> <li>• Electrolyser sourcing: Dito</li> <li>• Evidence of hedging strategy. i.e. „substantial symmetry“ between cost and revenue increase must be credibly demonstrated</li> <li>• Env. permitting: „Credible evidence that a procedure has been started and will be resolved positively in time for meeting a entry-into-service deadline“</li> <li>• Grid connection permits: Dito</li> <li>• Assessments of technical, financial &amp; operational maturity</li> <li>• Lol for a completion guarantee by a bank</li> </ul> <p><b>Support cumulation rules:</b></p> <ul style="list-style-type: none"> <li>• Not allowed: CAPEX/OPEX support, general power price components incl. general levies, CO<sub>2</sub> levy compensation, offtakers with state-subsidised hydrogen consumption if that means their hydrogen demand increases</li> <li>• Additionality req.: power used is generally not allowed to receive state aid (exceptions apply);</li> <li>• Allowed: Support for project dev./feasibility studies, capacity dev. (incl. In electrolyser manufacturing), non-specific transport infrastructure, levies financing energy and environmental policy objectives</li> </ul> <p><b>After evaluation and before grand agreement signing:</b></p> <ul style="list-style-type: none"> <li>• A completion guarantee (see above, under „Safeguards“)</li> <li>• Financial capacity check</li> </ul> <p>No local contact reqs.</p>	<p><b>[New, additional] Criterion under Relevance wrt supply security, industrial leadership and competitiveness:</b></p> <ul style="list-style-type: none"> <li>• Projects must limit the sourcing of electrolyser stacks with surface treatment or cell unit production or stack assembly carried out in China to not more than 25% (in MWe)</li> </ul> <p><b>[New, additional] Criteria wrt to:</b></p> <ul style="list-style-type: none"> <li>• Safety: Compliance with ISO 22734:2019</li> <li>• Cybersecurity: Plan must be in place; Data must be stored inside EEA</li> </ul> <p><b>[New, additional] Obligation to provide information wrt:</b></p> <ul style="list-style-type: none"> <li>• Intended origin of equipment</li> <li>• Critical raw mineral intensity of the equipment</li> <li>• Recycling strategy of the electrolyser OEM</li> <li>• What standards does the equipment comply with</li> <li>• Whether OEM receives foreign financial contribution</li> </ul> <p><b>[New, additional] Rules on foreign subsidies, state aid and trade defence instruments</b></p>	<ul style="list-style-type: none"> <li>• Admissibility (pass/fail)</li> <li>• Submission deadline and required documentation must be met</li> <li>• Bidders must hold or have applied for a power generation business license at the time of bid</li> <li>• Project must not be registered under the Renewable Portfolio Standard (RPS)</li> </ul> <p><b>Eligibility (pass/fail)</b></p> <ul style="list-style-type: none"> <li>• Project types: <ul style="list-style-type: none"> <li>- Co-firing power plants with ≥20% clean hydrogen or clean ammonia (by lower heating value)</li> <li>- 100% hydrogen-fired power plants (e.g. turbines, fuel cells)</li> </ul> </li> <li>• Fuel must be certified as “clean hydrogen” under Korea’s Clean Hydrogen Certification system</li> </ul> <p><b>Relevance and quality (pass/fail)</b></p> <ul style="list-style-type: none"> <li>• Bidders must demonstrate financial soundness (e.g. credit rating)</li> <li>• Viable technical and operational plans must be submitted</li> <li>• Projects must show evidence of technical credibility and delivery capacity</li> </ul>	<ul style="list-style-type: none"> <li>• [New, additional] No change to eligible project types, but continued strict adherence to clean hydrogen certification standard (no relaxation permitted)</li> <li>• [New, additional] Reinforcement of non-overlap rule: Projects fulfilling RPS obligations remain excluded</li> <li>• [Adjustment] Emphasis on operational readiness: compliance with tighter project delivery timelines (linked to 36-month completion rule under safeguards)</li> </ul>

<p>Consortium</p>	<ul style="list-style-type: none"> <li>• Compliance with legal entity checks &amp; "EU exclusion situation limitation"</li> <li>• No limitations on origin of consortium members; no information provided on requirements, checks etc.</li> </ul>	<p>No changes</p>	<p>Consortium participation is permitted. A lead entity must be designated as the contractual counterpart. Roles and responsibilities of each consortium member must be clearly defined in the bid. Financial and technical capability may be assessed at both consortium and member levels. The lead entity holds primary liability for project delivery and contract compliance. The consortium structure may be maintained after award, but contractual obligations rest with the lead bidder.</p>	<p>No changes</p>
<p>2. Deadlines</p>	<ul style="list-style-type: none"> <li>• Completion guarantee issuance: Not later than two months after the dispatch of the evaluation result letter inviting the selected applicants for grant agreement preparation</li> <li>• Project entry into operation (counting from the date of signing of the grant agreement): Not later than 5 years after signing of the grant contract. 100% of the nameplate electrolyser capacity stated in the bid should enter into operation.</li> </ul>	<ul style="list-style-type: none"> <li>• [New, additional] For project entry into operation: Safety and Cybersecurity requirements must also be met</li> <li>• [New, additional] Financial close must be no later than 2.5 years after signing grant agreement</li> </ul>	<p>Contracting &amp; entry into operation: Power purchase agreement (PPA) to be signed by end of 2024. Projects must enter commercial operation within 36 months of contract signing (extended to 48 months with grace period of 12 months) Minimum investment milestone: At least 30% of total project budget must be invested within 18 months of contract signing. Failure to meet this may trigger review and potential contract termination.</p>	<p>[Adjustment] Grace period for delayed commissioning removed; standard 36-month completion timeline enforced</p>
<p>3. Sanctions</p>	<ul style="list-style-type: none"> <li>• Non-compliance with entry-into-operation deadline: Termination of the grant contract and exercise of completion guarantee</li> <li>• Prolonged and severe underproduction (&lt;30% of the yearly grant volume on a 3-year rolling basis): Termination of the grant contract and grant reduction</li> <li>• Not achieving a 70%-GHG-reduction: Grant reduction</li> </ul>	<ul style="list-style-type: none"> <li>• [New, additional] Non-compliance with financial close deadline: Termination of the grant contract and exercise of completion guarantee</li> <li>• [New, additional] entry into operation must be approved by CINEA</li> <li>• [New, additional] Non-fulfillment of security of supply, industrial leadership and competitiveness criteria: Grant reduction or contract termination</li> <li>• [New, additional] For bids in the maritime sector: Non-achieving signed contracts for 60% of the stated volume by offtaker in maritime sector at financial close: Grant reduction</li> </ul>	<ul style="list-style-type: none"> <li>• Non-compliance with entry-into-operation deadline: If commercial operation is not achieved within 48 months, the government may impose penalties or initiate contract adjustment/termination.</li> <li>• Underinvestment / milestone failure: If the project fails to invest <math>\geq 30\%</math> of the total budget within 18 months of contract signing, the contract may be terminated following a government review.</li> <li>• Violation of fuel criteria: Use of hydrogen not certified under the Clean Hydrogen Certification Scheme can lead to ineligibility or contract breach consequences.</li> <li>• Breach of bidding rules (e.g. anti-collusion): Violations may result in bid disqualification, contract revocation, and restriction from future participation.</li> </ul>	<p>[New, additional] Exchange-rate indexed settlement must be applied accurately</p>

3 Bids				
1. Bid components	<ul style="list-style-type: none"> <li>• Bid price: Fixed premium in EUR/kg</li> <li>• Production volume: Expected production volume in kg per year over a 10-year contract period</li> </ul>	No changes	<ul style="list-style-type: none"> <li>• Bid price: Strike price in KRW/kWh</li> <li>• Production volume: Power generation volume in MWh/year over a 15-year contract period</li> </ul>	No changes
2. Bid floor price	None	No changes	None	No changes
3. Bid ceiling price	4.50 EUR/kg		An undisclosed ceiling on the total levelized cost (KRW per MWh) and a ceiling on the fuel cost component of the bid. Any bid exceeding either the total LCOE cap or the indexed fuel-price cap was disqualified.	
4. Minimum and maximum yearly hydrogen production	No upper or lower limits to the expected average yearly production	No changes	No upper or lower limits to the expected average yearly production	No changes
5. Minimum and maximum grant amount	Max grant amount (bid price x expected yearly volume x 10 years) equals 1/3 of the total grant volume per auction Max grant amount: 266,7 mio. EUR	[Adjustment] Maximum grant amount restriction for each bid applies: EUR 250 million in the general topic and EUR 200 million in the maritime topic	There was no fixed monetary grant upfront – support is performance-based over time	No changes
6. Technologies, regions and actors	No special rules for different technologies, regions or actors. Project must be located within the EEA.	[new additional] EUR 200 mio. earmarked for projects with maritime off-taker(s)	Technology-neutral approach: all hydrogen-based power generation technologies are eligible. Power generation projects must be located in Korea. Open to both public and private sector developers.	?
7. CO <sub>2</sub> abatement threshold and calculation methodology	None	None. [new additional] Clarification that CINEA, will use 6.84 tCO <sub>2</sub> -eq./tH <sub>2</sub> for the purpose of calculating the subsidy efficiency.	<ul style="list-style-type: none"> <li>• The baseline CO<sub>2</sub> emission factor for hydrogen energy is linked to the certified “clean hydrogen grade” commonly set around 41.5 gCO<sub>2</sub>/MJ as a threshold for clean hydrogen certification, with system boundary set as Well-to Gate.</li> <li>• CO<sub>2</sub> abatement = (baseline CO<sub>2</sub> per unit energy – clean hydrogen CO<sub>2</sub> per unit energy)*hydrogen energy supplied</li> </ul>	No changes

4 Grant payout				
1. Start of payout	Project's entry into operation	No changes	Project's Commercial Operation Date (COD)	No changes
2. Payment schedule	Every 6 months from entry into service	No changes	Every 12 months from COD	No changes
Grant duration / Max. payout duration	10 years from entry into operation (less if expected production volume is reached earlier)	No changes	15 years from COD	No changes
3. Grant indexation	No indexation.	No changes	No indexation	[new additional] Exchange-rate-linked indexation
5. Max grant payout volume	Max grant amount (less in case of underproduction)	No changes	Max grant amount (less in case of underproduction)	No changes
6. Over- and underproduction limits	<ul style="list-style-type: none"> <li>Overproduction: Semi-annual production beyond 140% of the ½ of contracted yearly production value will not receive support</li> <li>Underproduction: Unclear (sanctions for severe underperformance)</li> </ul>	No changes	<ul style="list-style-type: none"> <li>Overproduction: No support beyond 100% of contracted yearly production</li> <li>Underproduction: Payment reductions, delays, or contract termination may apply</li> </ul>	No changes

# **HYDROGEN AUCTION SCHEME: DESIGN AND IMPLICATIONS**

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