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**Subject: State Aid SA.103648 (2022/N) – Denmark
State aid measure to support the industrialization and upscaling of
the production of PtX**

Excellency,

1. PROCEDURE

- (1) Following pre-notification contacts, on 16 December 2022, Denmark notified a support scheme (the “scheme”) for the promotion of the production of renewable hydrogen through electrolysis for the purpose of reducing greenhouse gas emissions, pursuant to Article 108(3) of the Treaty on the Functioning of the European Union (TFEU).
- (2) By letter dated 6 December 2022, Denmark agreed to exceptionally waive its rights deriving from Article 342 TFEU in conjunction with Article 3 of Regulation 1/1958¹ and to have the present decision notified and adopted in English.

¹ Regulation No 1 determining the languages to be used by the European Economic Community (OJ 17, 6.10.1958, p. 385).

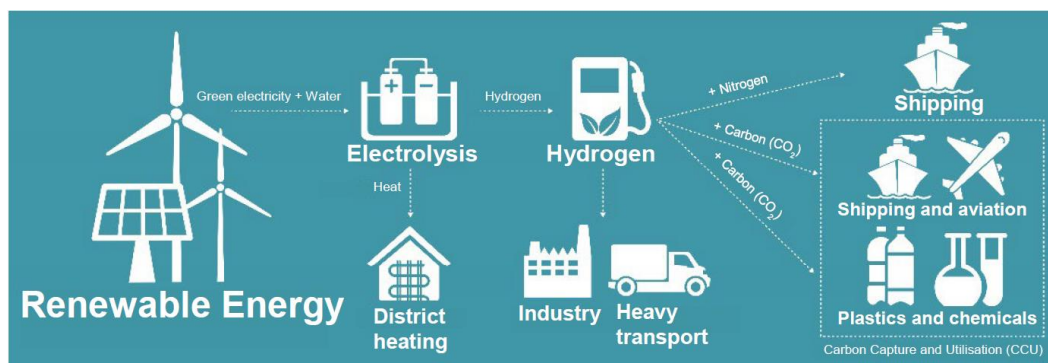
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2. DETAILED DESCRIPTION OF THE MEASURE

2.1. Background and objectives of the scheme

- (3) The EU has set a climate protection target of reducing greenhouse gas (“GHG”) emissions by at least 55% by 2030, with a view to becoming climate neutral by 2050². In order to achieve this, far-reaching changes are required in all sectors of the economy.
- (4) Renewable hydrogen can reduce GHG emissions when this hydrogen, and derivatives of it, displace (chemicals made using) fossil-based fuels and industrial feedstock. Power-to-X (“PtX”) products include hydrogen produced through electrolysis, and more complex derivatives of this hydrogen such as ammonia, methanol and kerosene produced through additional processes beyond electrolysis. PtX products made using renewable electricity are also known as renewable fuels of non-biological origin (“RFNBOs”) in the EU regulatory framework.³

Figure 1: How PtX can be used in Denmark



Source: Danish Energy Agency

- (5) As explained by the Commission in its Hydrogen Strategy for a Climate-Neutral Europe Communication⁴ (the “EU Hydrogen Strategy”), hydrogen can be used as a feedstock, a fuel or an energy carrier and storage, and has many possible applications across the industry, transport, power and buildings sectors. Most importantly, using it does not emit CO₂ and emits almost no air pollution. Hydrogen offers a solution to decarbonise industrial processes and economic sectors where reducing GHG emissions is both urgent and hard to achieve. It can replace fossil fuels as a zero-carbon feedstock in chemicals and fuels production and can help decarbonise transport and store surplus renewable power. To contribute to climate neutrality, hydrogen production needs to achieve a far larger scale and its production must become fully decarbonised.

² Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 (‘European Climate Law’), OJ L 243, 9.7.2021, p. 1.

³ See Article 2(36) of Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (the “Renewable Energy Directive”), OJ L 328, 21.12.2018, p. 82–209.

⁴ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – A hydrogen strategy for a climate-neutral Europe, COM(2020) 301 final.

- (6) Furthermore, the Commission's 2022 REPowerEU Communication⁵, which *inter alia* sets out the goal of phasing out the Union's dependence on fossil fuels from Russia before 2030, outlined the important role that hydrogen could play in diversifying EU gas supplies, proposing to boost renewable hydrogen production and imports to 20 million tonnes by 2030, while also acknowledging that other forms of fossil-free hydrogen, notably nuclear-based hydrogen, may also play a role in substituting natural gas.
- (7) Denmark envisions an important role for renewable hydrogen in the future energy system and the decarbonisation of multiple end users, including users in hard-to-abate sectors where direct electrification is not possible or is associated with very high costs. The Danish Climate Agreement on Energy and Industry 2020⁶ envisages a Danish subsidy scheme in the form of a competitive bidding process for PtX. In addition, the Danish political agreement on development and promotion of hydrogen and green fuels from March 2022⁷ describes the design and construction of such a subsidy scheme for PtX in greater detail.
- (8) Furthermore, in 2021 the Danish government adopted a strategy for PtX⁸ based on the analyses of the Danish Energy Agency (DEA), and continuous dialogue with the PtX industry in Denmark. One of the many elements in that strategy is the establishment of a competitive bidding process for PtX support.
- (9) PtX technologies are currently being developed and demonstrated worldwide, and there is limited experience with large-scale production of hydrogen and other PtX products, as well as associated costs. To estimate the need for State aid, the DEA has therefore estimated the current levelised cost of energy (LCOE) of renewable hydrogen and compared this to its possible value on the market. According to that analysis, hydrogen and other PtX-fuels are costly to produce, and their LCOE exceeds the market price of the fossil alternatives. The DEA estimates a funding gap in the range of 70-120 DKK/GJ (9.40-16.00 EUR/GJ⁹) for renewable hydrogen and 125-230 DKK/GJ (16.80-30.80 EUR/GJ) for other renewable PtX fuels taking into account current costs and revenues. This makes decarbonisation using renewable hydrogen and other renewables-based PtX less competitive at present when compared to more mature technologies such as direct electrification. Nevertheless, electrolyser construction costs have already been reduced by 60% globally in the last 10 years, and are expected to halve in 2030 compared to today with economies of scale¹⁰.
- (10) The main purpose of the scheme is to support the industrialisation and upscaling of the production of PtX in Denmark, and thereby reduce the costs related to the production of renewable hydrogen.

⁵ Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions – REPowerEU: Joint European Action for more affordable, secure and sustainable energy, COM(2022) 108 final.

⁶ <https://www.regeringen.dk/media/9863/aftaletekst-klimaftale-energi-og-industri-1.pdf>.

⁷ <https://www.regeringen.dk/media/11146/aftale-om-udvikling-og-fremme-af-brint-og-groenne-braendstoffer.pdf>.

⁸ https://ens.dk/sites/ens.dk/files/ptx/strategy_ptx.pdf.

⁹ Assuming a DKK/EUR exchange rate of 0.134.

¹⁰ Based on cost assessments of IEA, IRENA and BNEF. Electrolyser costs to decline from €900/kW to €450/kW or less in the period after 2030, and €180/kW after 2040. BNEF (2020) *Hydrogen Economy Outlook*. IRENA, *Global Renewables Outlook, 2020*. IEA, *2019 Hydrogen report*.

- (11) The scheme will also help Denmark achieve a national target of 55% of renewable energy by 2030 and to phase out coal from electricity production in the same year. In the longer term, the scheme will further help to allow Denmark to become completely independent from fossil fuels by 2050. Furthermore, the scheme will contribute to achieving Denmark's target to reduce its carbon emissions by 70% in 2030 compared to 1990 levels and to reach carbon neutrality by 2050. The DEA estimates that the PtX-fuels produced with aid from the scheme will reduce GHG emissions by approximately 0.07 million tonnes CO₂ annually.
- (12) Denmark does not dispute that the scheme constitutes State aid within the meaning of Article 107(1) TFEU.

2.2. National legal basis

- (13) Denmark states that the national legal basis of the scheme will be:
- (a) The Danish act no 923 dated 18 May 2021¹¹, which authorises the Danish Minister for Climate, Energy and Utilities to carry out competitive bidding processes for the granting of aid for the production of chemical fuels or products from electricity in the period 2022-2030;
 - (b) Draft authorisation to carry out competitive bidding processes, which will come into force upon the approval of the scheme by the Commission; and
 - (c) Eventual contracts that will be concluded with the winners of the competitive bidding process conducted under the scheme.
- (14) The Danish authorities have confirmed that aid will only be granted under the scheme after the Commission has adopted a decision authorising it.

2.3. Administration of the measure

- (15) The granting authority for the scheme is the DEA.

2.4. Beneficiaries

- (16) The scheme is open to undertakings of all sizes, regardless of nationality, wishing to build and operate a new electrolysis plant in the national territory of Denmark. The scheme is not open to firms wishing to procure PtX rather than producing it themselves.
- (17) There is no limitation as to the uses of the produced hydrogen, so it can be used both for energy and non-energy purposes (e.g. transport).
- (18) Denmark expects the scheme to benefit up to three projects, including new market entrants.
- (19) Denmark explains that more than 20 PtX potential projects with a capacity of more than 6 GW electrolysis have been announced in Denmark, none of which

¹¹ <https://www.retsinformation.dk/eli/lta/2021/923>

have yet made final investment decisions, even though only 100-200 MW electrolysis is expected to obtain support through the scheme.

2.5. The eligible technology

- (20) The objective of the scheme is to support the production of renewable hydrogen using electrolysis. The eligible technology under the scheme is the production of renewable hydrogen using electrolysis. Whether or not the hydrogen is afterwards converted into other PtX products, or utilised or sold with no further conversion, is not relevant under the scheme. All electrolysis technologies¹² will be able to participate, and there is no limit on the size/capacity of the projects.
- (21) Denmark commits to ensure that projects that benefit from aid under the scheme will produce hydrogen that meets or exceeds the criteria for RFNBOs developed under the EU regulatory framework (see recital (4)).
- (a) Pursuant to Article 25(2) of the Renewable Energy Directive,¹³ the GHG emissions savings from the use of the RFNBO along its lifecycle must be at least 70% compared to a fossil fuel comparator;
 - (b) The ‘additional’ nature of the renewable electricity supplying electrolyzers shall be determined pursuant to Article 27(3) of the Renewable Energy Directive; and
 - (c) Pursuant to Article 28(2) of the Renewable Energy Directive, the supplier must provide buyers with all necessary information and proof of the sustainability characteristics of hydrogen produced.
- (22) If Denmark finds that the hydrogen produced does not meet those standards, the winning bidder is not entitled to the aid. In addition, the GHG emissions savings of any non-RFNBOs produced by beneficiaries in the aided projects, which will not be subsidised under the scheme, must be at least 70% on average over one or more time periods during the lifetime of the scheme¹⁴. According to Denmark, this will ensure that any non-RFNBOs produced by beneficiaries do not undermine the environmental benefits of the support provided under the scheme.
- (23) If any part of the EU regulatory framework for renewable hydrogen under the Renewable Energy Directive is incomplete at the time of the conduct of the auctions, Denmark will use the criteria defined in the draft framework for

¹² Water electrolysis refers to the splitting water into hydrogen and oxygen gas through the use of electricity by an electrochemical process called electrolysis. There are currently three types of electrolysis technologies: Polymer electrolyte membrane (PEM), alkaline electrolysis, and solid oxide electrolysis membrane.

¹³ Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources, OJ L 328, 21.12.2018, p. 82–209.

¹⁴ The methodology for calculating this shall be the methodology set out in the draft Commission Delegated Regulation on establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and specifying a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels, which was published by the Commission for public consultation on 23 May 2022, excluding the methodology set out in the first subparagraph of point 6 of ANNEX A of that draft Commission Delegated Regulation. Available here: https://commission.europa.eu/news/commission-launches-consultations-regulatory-framework-renewable-hydrogen-2022-05-23_en.

renewable hydrogen published by the Commission for public consultation on 23 May 2022¹⁵.

- (24) Denmark has confirmed that, once work to develop the EU regulatory framework for renewable hydrogen under the Renewable Energy Directive or other sources of legislation is complete, the scheme will be amended if necessary to comply with the requirements for renewable hydrogen and other renewable fuels of non-biological origin set out in the EU framework within 10 calendar days from the adoption of the relevant legal acts.
- (25) Denmark expects all aided projects to produce hydrogen that prevents at least 70% of the GHG emissions expected in the counterfactual scenario, as that is the GHG reduction standard for RFNBOs set out in the sectoral legislation (see recital (21)(a)). The eligible projects will thus produce hydrogen that fulfils the GHG reduction ‘do no significant harm’ criterion according to the requirements set out in Taxonomy Regulation¹⁶ for the activity “Manufacture of hydrogen”.
- (26) Denmark commits to ensuring that the scheme complies with Union law, including the principles of free movement and non-discrimination.

2.6. Allocation process

- (27) Aid will exclusively be allocated through a competitive bidding process that is open to all parties with eligible projects. This process aims to ensure that projects compete for the available aid on the basis of objective, open, clear, transparent and non-discriminatory criteria.
- (28) The DEA expects 10-15 undertakings to participate in the competitive bidding process¹⁷, and that the budget of the scheme is set at a level that should ensure that the budget constitutes a binding constraint in a competitive allocation process i.e. not all tenderers will receive aid.
- (29) The aid will preferably be allocated in one bidding round awarding the total budget of the scheme. However, if the total budget of the scheme cannot be awarded to projects that have bid under 70 DKK/GJ (9.40 EUR/GJ) of hydrogen produced, the budget will be divided into two competitive bidding rounds¹⁸, with an expected budget of maximum DKK 750 million (EUR 100 million) for the first competitive bidding round and minimum DKK 500 million (EUR 67 million) for the second round. This feature of the scheme is intended to function as a safety mechanism, promoting greater competition between bidders, and thus reducing the level of aid.

¹⁵ Available here: https://commission.europa.eu/news/commission-launches-consultations-regulatory-framework-renewable-hydrogen-2022-05-23_en.

¹⁶ Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088, OJ L 198, 22.6.2020, p. 13, and the relevant Commission implementing legislation referred to therein.

¹⁷ The DEA has knowledge of more than 20 potential projects in Denmark and many of them are expected to participate.

¹⁸ Estimates from the DEA indicate that this is likely to be the case, as the DEA estimates (with great uncertainty) a funding gap of 70-230 DKK/GJ for potential beneficiaries. See Table 3 for explanation of how the 70 DKK/GJ threshold was set.

- (30) In addition to the safety mechanism described in recital (29), there will also be a general bid cap of 120 DKK/GJ (16 EUR/GJ) for hydrogen produced to ensure proportionality, meaning that no bid above the cap will be accepted.
- (31) Both the level of the safety mechanism and the level of the general bid cap have been derived from the estimated funding gap between the cost of producing PtX products and the expected value the PtX products would generate on the market (see recitals (52) and (53)).
- (32) The documents that describe the conditions for the competitive bidding process, including the selection criteria, will be published on the DEA’s website two months before the deadline for submission of bids.
- (33) Aid under the scheme will be granted solely based on the bids submitted according to the pay-as-bid principle, such that the awarded aid will be equal to the bidder’s bid. No *ex post* adjustments of the bid, or negotiations after the submission of the bid, are possible. Denmark does not expect this to result in a significant risk of strategic bidding in view of the expected strong competition for support (see recital (28)). However, the DEA can give the option of a marginal bid, meaning that the marginal bidder may receive the opportunity to downscale the quantity of renewable hydrogen it proposes to produce such that its funding needs can be met within the funds available in the auction round, but at the bid price it had originally offered.
- (34) The DEA will ensure that the application form for the scheme complies with the minimum requirements necessary for it to constitute an aid application, as foreseen under point 30 of the Guidelines on State aid for climate, environmental protection and energy 2022 (CEEAG)¹⁹.
- (35) In their bids, bidders must state a price in DKK per GJ for the first 10 years of operating the electrolysis plant from the date on which the installation begins operation, as well as the amount of hydrogen to be produced during that period. These figures determine the upper limit for how much aid each project can receive in the aid period. In order to help determine the contractual penalty to be imposed in case the project is not developed (see recital (56)), bidders must also state the capacity of the electrolyser they intend to construct. To ensure the requested aid amount is proportional to the capacity, the stated hydrogen production must be linked to electrolyser capacity according to the following formula.

$$\begin{aligned}
 & \textit{Total GJ hydrogen produced over 10 years} \\
 & = (\textit{GJ hydrogen per hour at full capacity}) \\
 & \times (\textit{number of full load hours per year}) \times 10
 \end{aligned}$$

The number of full load hours may not exceed 5 500 hours per year.

- (36) Bid letters must also include declarations, including that the bidder:

¹⁹ OJ C 80, 18.2.2022, p.1.

- (a) has complied with any and each requirement for repayment of aid which the European Commission, in a previous decision, has declared illegal and incompatible with the internal market²⁰;
 - (b) is not an undertaking in difficulty as defined in point 20 in the Commission Communication on Guidelines on State aid for rescuing and restructuring non-financial undertakings in difficulty²¹;
 - (c) shall not receive any other State aid to cover the same costs as the premium pursuant to the contract for the scheme; and
 - (d) has not started works on the project to construct installations covered by the bid.
- (37) A bidder can submit independent bids for different installations. However, bids cannot be conditional on the award of contracts for other installations not included in the same bid.
- (38) Once the deadline for the submission of the bids had expired, all eligible bids will be ranked based on cost competitiveness. Projects will thus be ranked from lowest to highest based on the bid price in DKK per GJ of renewable hydrogen produced for the first 10 years of operating the electrolysis plant. The projects with the lowest aid per GJ of renewable hydrogen produced are therefore ranked highest²² and will be selected until the budget of the scheme is exhausted, incentivising companies to apply for lower subsidy amounts. The number of winning bidders and the total capacity of the winning projects will not be known until all the contracts have been signed.

2.7. Reference projects

- (39) Denmark has provided the following reference projects, which it deems to be representative of the hydrogen projects in Denmark it has knowledge of:
- (a) A stand-alone offshore, off-grid alkaline electrolysis plant of 100 MW physically connected to a nearby offshore wind farm, producing hydrogen for a maximum of 4 800 full load hours per year.
 - (b) A grid-connected alkaline electrolysis plant of 100 MW, flexibly producing hydrogen for a maximum of 2 500 full load hours when following the production profile of a renewable energy source power purchase agreement (RES PPA) and purchasing electricity on the market

²⁰ See judgment of the Court of First Instance of 13 September 1995, *TWD v Commission*, T-244/93 and T-486/93, ECLI: EU:T:1995:160, paragraph 56. See also Communication from the Commission — Commission Notice on the recovery of unlawful and incompatible State aid (OJ C 247, 23.7.2019, p. 1).

²¹ Communication from the Commission — Guidelines on State aid for rescuing and restructuring non-financial undertakings in difficulty (OJ C 249, 31.7.2014, p. 1).

²² If several bids contain the same offered bid price, the bids in question will be ranked according to the quantity of green hydrogen produced, from the largest to the smallest. If several bids contain the same offered bid price and the same quantity of green hydrogen, the bids in question will be ranked through drawing lots if it is not possible to award all of the bids a contract within the available funds.

when the market price of electricity is below 200 DKK/MWh (26.80 EUR/MWh)²³.

- (40) Denmark has submitted a quantification of all the costs of the two reference projects. This quantification is summarised in the table below. Denmark explains that, as there is little experience and no liquid market for renewable hydrogen or other PtX products in Denmark or in neighbouring countries, the funding gap has been estimated by comparing estimated costs of producing PtX fuels (LCOE) with the value of fossil based equivalents on the market.

Table 1: Quantification of the costs of reference projects²⁴

Reference project	(a)	(b)
MW electrolysis capacity	100	100
Type of project	Physical link to offshore wind (100 MW)	Grid-connected (RES PPA and electricity market)
No of full load hours / year	4 800	2 500
CAPEX, DKK/GJ hydrogen	30	35
Fixed OPEX, DKK/GJ hydrogen	10	11
Electricity, DKK/GJ hydrogen	110	38
Network tariffs, DKK/GJ hydrogen	0	41
Total LCOE, DKK/GJ hydrogen	150	125

Source: Notification

- (41) As for the potential revenues of the reference projects, Denmark assumes that revenues from the sale of renewable hydrogen will be equivalent to those from the sale of hydrogen production by natural gas steam methane reforming (see recital (43)). In addition, Denmark states that the reference projects may obtain additional revenues from green certificates and the provision of ancillary services. Denmark's best estimate of these additional revenues is 30-50 DKK/GJ (4-6.7 EUR/GJ) but this is considered highly uncertain as there are currently no such projects operating in Denmark.
- (42) All assumptions for energy prices and investment costs are based on research by the DEA. Denmark has assumed electricity costs based on the LCOE of renewable energy projects with a pre-tax WACC of 5% rather than based on current market prices. Data on investments, operational costs and efficiencies are based on the DEA energy technology catalogue²⁵, fossil fuel price forecast in the

²³ Based on the electricity price duration curves prepared for the Danish climate and energy forecast and the PtX costs (CAPEX and OPEX) assessed in the technology catalogue, Denmark has estimated the number of full load hours per year that minimise the costs per GJ hydrogen produced by electrolysis. This is a balance between the electricity price and the investment costs, assuming that electrolyzers can be operated fully flexible. With the assumed electricity price curve and investment costs, the minimal costs per produced GJ is reached at approximately 2500 full load hours/year in Denmark when spot prices for electricity are low.

²⁴ For the ten years of operation and assuming a 5% WACC.

²⁵ Energistyrelsen, *Teknologikatalog for fornybare brændstoffer*, <https://ens.dk/service/fremskrivninger-analyser-modeller/teknologikataloger/teknologikatalog-fornybare>.

DEA price catalogue²⁶, and electricity price forecast in the DEA energy and climate forecast²⁷. A pre-tax WACC of 5% is used to discount future cash-flows for the two reference projects²⁸. However, Denmark stresses that these figures are currently subject to significant uncertainty due to Russia's war of aggression against Ukraine. In addition, hydrogen technologies are being developed and demonstrated, and there is limited experience with large-scale production of hydrogen and other PtX products and associated costs. Uncertainty is particularly pronounced regarding the additional revenues that projects could generate from green certificates and the provision of ancillary services, and regarding the transport costs for any hydrogen produced. Furthermore, there is uncertainty about the future costs of electricity, which to a large extent determines the total costs of hydrogen production by electrolysis.

- (43) As a counterfactual scenario for the reference projects, Denmark assumes increased hydrogen production by natural gas steam methane reforming. The DEA estimates the costs of this hydrogen at 90 DKK/GJ (12 EUR/GJ), not including EU Emission Trading System (EU ETS), costs which Denmark estimates could add around 50 DKK/GJ (6.7 EUR/GJ)²⁹.
- (44) In addition to renewable hydrogen, the scheme is also open to projects which produce hydrogen through electrolysis and use it to produce other, more complex PtX fuels, including ammonia, methanol and e-diesel projects. The costs of these have also been assessed by the DEA, and are presented below.

Table 2: Quantification of the costs of other PtX fuels

	Ammonia	Methanol	E-diesel
Hydrogen LCOE, DKK/GJ	125-150	125-150	125-150
Conversion loss DKK/GJ	18	32	52
CAPEX, DKK/GJ	44	19	57
CO2 supply, DKK/GJ		53	70
Total LCOE, DKK/GJ hydrogen	187-212	229-254	304-329

Source: Notification

- (45) Denmark considers that projects producing these alternative PtX fuels would have similar revenues to hydrogen production projects.
- (46) In light of the information presented above in recitals (39) to (45), Denmark estimates (with great uncertainty) a funding gap of 70-230 DKK/GJ (9.40-30.80 EUR/GJ) for potential beneficiaries of the scheme. At the lower bound, this estimate is based on the offshore and off-grid hydrogen reference project (reference project (a) described in recitals (39)(a) and (40)), with an estimated cost of 150 DKK/GJ (20 EUR/GJ), plus costs of 10 DKK/GJ (1.30 EUR/GJ) for transport to a European hydrogen market via a hydrogen pipeline network, to make a total of 160 DKK/GJ (21.40 EUR/GJ), and revenues of 90 DKK/GJ

²⁶ Energistyrelsen, *Samfundsøkonomiske analysemetoder*, <https://ens.dk/service/fremskrivninger-analyser-modeller/samfundsokonomiske-analysemetoder>

²⁷ Energistyrelsen, *Klimastatus og -fremskrivning 2022*, <https://ens.dk/service/fremskrivninger-analyser-modeller/klimastatus-og-fremskrivning-2022>.

²⁸ The real WACC of 5% is based on the assumption that investors finance projects with an equity share of 20-40% with a real cost of equity of 6.3% and a debt share of 60-80% with a real cost of 4.2%.

²⁹ Assuming a natural gas price of 43 DKK/GJ, as per the DEA's price projections from 2022.

(12 EUR/GJ) from the sale of hydrogen (see recital (43))³⁰. Denmark explains that it considers this the most robust reference project as it is not subject to the high and volatile electricity market prices that an on-grid reference project would be subject to.

- (47) There are already policy measures in place to reduce GHG emissions and drive renewable energy deployment, most notably the EU ETS³¹. In addition, Denmark participates in an “important project of common European interest” (IPCEI) regarding hydrogen, which aims to support large, transnational development projects that can benefit the entire EU. Furthermore, Denmark is in dialogue with the Commission on allocating the Just Transition Fund to establish a national investment funding scheme for innovative green key technologies with a particular focus on PtX and hydrogen.
- (48) Nevertheless, Denmark has assessed that these are not sufficient to remove the market failure in relation to the production of renewable hydrogen. Whereas the policy measures are too general to channel funding to promising PtX technologies, the IPCEI does not concern the production of renewable hydrogen, but instead the use of PtX fuels and products.

2.8. Form of aid and level of support

- (49) The scheme provides a subsidy for the construction and operation of renewable hydrogen production installations. The aid will be provided in the form of direct grants. There are no concessions or other benefits granted as part of the aid measure: Bidders are responsible for finding locations for the plants and obtaining all relevant approvals, constructing the plants as well as all aspects linked to their operation including the acquisition of necessary supply of renewable electricity for the production of renewable hydrogen.
- (50) The aid will be paid as a fixed premium per GJ of renewable hydrogen produced. Renewable hydrogen is the precursor to all other renewables-based PtX products, and the award criteria do not exclude projects that carry out additional chemical steps to make other renewables-based PtX products. By choosing a fixed premium, the normal business risks arising from possible price variations will be borne by the beneficiaries rather than the State. Although Denmark had considered the use of a sliding premium, such as a contract-for-difference, it was deemed not to be optimal. In particular, Denmark considered that the use of a sliding premium would likely:

³⁰ Denmark does not factor in possible additional revenues from green certificates and the provision of ancillary services, which it estimates could be in the range of 30-50 DKK/GJ. Denmark has also excluded EU ETS costs (see recital (43)). Including ancillary services and green certificates revenues, and assuming buyers of hydrogen would be prepared to pay extra for the green hydrogen to avoid ETS costs would, if they materialise, reduce the funding gap. However, counterbalancing these potential upsides, Denmark observes that there are cost items that may prove considerably higher than estimated. As an example, Denmark has assumed very low transport costs in part based on the assumption that there will be an affordable hydrogen pipeline network available; however, that pipeline network currently does not exist (and it will also not be built as part of the scheme). Denmark submits that, consequently, the funding gap calculations they have presented are balanced and constitute a best estimate available.

³¹ See recital (94).

- (a) introduce increased uncertainty for prospective beneficiaries, which would be reflected in higher auction clearing prices;
 - (b) be excessively complex from the perspective of the design of the auction in light of the significant uncertainty surrounding the PtX value chain in Denmark at present³²; and
 - (c) reduce the incentive to flexibly operate electrolyzers, depending on the design of the premium.
- (51) As described in Section 2.6, there will be a safety mechanism to induce competition between bidders and to reduce the aid amount, and a general bid cap. The general bid cap is set at 120 DKK/GJ (16 EUR/GJ), meaning that all bids above that price will be rejected and the fixed premium paid to beneficiaries will thus not exceed 120 DKK/GJ amount (recital (30)).
- (52) The estimated funding gap used to set the levels of both the safety mechanism and the bid cap is based on the capital expenditure (CAPEX) and operating expenditure (OPEX) of an offshore, off-grid alkaline electrolysis plant, as well as the expected LCOE of an offshore wind farm in Denmark (reference project (a) described in recitals (39)(a) and (40)). In this case, all the electricity produced on the offshore windfarm is assumed to be used for electrolysis, in average around 4 800 full load hours per year. There will be no or very limited exchange of electricity with the public grid³³.
- (53) Denmark has submitted a quantification of all the costs and revenues of this reference project, which are summarised in Table 3 below, along with how the levels of both the safety mechanism and the bid cap are set in relation to the resulting funding gap.

³² On the revenue side, Denmark states that the market for renewable hydrogen is not developed enough for the identification of any practicable reference price. Therefore, Denmark argues there are currently no relevant prices that could be used for a renewable hydrogen contract for difference scheme in Denmark. Furthermore, Denmark states that there is uncertainty surrounding the costs and revenues of the broad range of PtX projects that are eligible for support under the scheme.

³³ Denmark deems the choice of this reference project to be more robust for the setting of the levels of both the safety mechanism and the bid cap in the current climate when compared with an on-grid reference project, as it is not subject to the high and volatile electricity market prices in part caused by Russia's war of aggression against Ukraine.

Table 3: Estimated funding gaps for assessment of the bid caps³⁴

2030	General bid cap	Safety mechanism bid cap
Full Load Hours per year		4 800
CAPEX, DKK/GJ hydrogen		30
OPEX, DKK/GJ hydrogen		10
Electricity, DKK/GJ hydrogen		110
LCOE, DKK/GJ hydrogen		150
Risk premium	33%	0%
Risk premium, DKK/GJ hydrogen	50	0
Transport by pipeline to Europe, DKK/GJ hydrogen	10	10
Total estimated costs, DKK/GJ hydrogen	210	160
Fuel assumed substituted by green hydrogen: Grey hydrogen, DKK/GJ hydrogen		90 ³⁵
Estimated funding gap, DKK/GJ hydrogen	120	70

Source: Notification

The safety mechanism is set at the estimated funding gap, and the general bid cap is set as the funding gap, including a risk premium of 33% in order to take into account the immaturity of the technology (see Section 3.3.1.2 for further details). While these may appear to be set at low levels, Denmark expects strong competition between bidders (see recital (28)).

- (54) If more than one bidding round is held (see recital (29)), the DEA will also change the bid cap in the subsequent competitive bidding process if necessary in order to ensure that it corresponds to market developments between the first and the second competitive bidding rounds. In this case, this will be done on the basis of a revised funding gap analysis. This analysis will determine whether the projects still have a substantial economic disadvantage, in terms of a net extra cost between the factual and counterfactual scenarios, and draw on experience learned as the industry develops and uncertainties about the initial assumptions are reduced (see footnote 30).
- (55) Should beneficiaries produce more renewable hydrogen than they specified in their bids, premiums will only be paid for the quantity of renewable hydrogen originally specified in their bids.
- (56) To ensure projects are fully developed without delay, and to mitigate the risk of bidders strategically acting to deprive competitors of the support offered under the scheme, the beneficiaries must have constructed the full capacity stated in their bids (see recital (35)) within a four-year time limit (see recital (58)). If a beneficiary has not constructed the full capacity, it will be subject to liquidated damages according to the following formula.

$$\text{Penalty} = \text{Penalty rate} \times (\text{total GJ hydrogen over 10 years}) \times \% \text{ missing capacity}$$

Where:

- *Penalty rate = 40 DKK/GJ;*

³⁴ Assuming a 5% weighted average cost of capital (WACC).

³⁵ Based on of natural gas steam methane reforming, and a natural gas price of 43 DKK/GJ as projected for 2027-2028 in the DEA's price projections from 2022.

- *total GJ hydrogen over 10 years = the total expected production over a 10-year aid period measured in GJ as stated in the contract with the bidder; and*
- *% missing capacity = the remaining capacity not constructed measured as a percentage of the full capacity as stated in the contract with the bidder.*

In order to provide security for payment of the penalty, all bidders must submit a letter of intent to provide a demand guarantee from a financial institution along with their bid, and winning bidders must provide an actual demand guarantee from a financial institution prior to signing the contract. Furthermore, if a beneficiary has not started the production of RFNBOs within the four-year time limit, the ten-year subsidy period will be reduced proportionally with the delay in production. It is Denmark's assessment that this provides beneficiaries with a high incentive to construct and operate the full capacity in accordance with their bid and produce the total amount of green hydrogen as stated in their bid.

2.9. Duration of the scheme

- (57) Denmark states that the competitive bidding process is planned to take place in the period 2023-2025, and that aid under the scheme may be granted until 31 December 2025.
- (58) Selected beneficiaries will have four years to construct the full electrolyser capacity and begin hydrogen production after the signing of the agreement. The DEA may grant exemptions from the four-year limit if the selected beneficiary is able to prove that delays have been caused by pre-defined criteria, including circumstances beyond the control of the winning bidder (war, pandemic, fire, strikes, vandalism, etc.), excessively lengthy waits for permits issued by national authorities, and delays in connecting the project to the network. This extension will be proportional to the actual delay with a maximum extension of one year.
- (59) To ensure swift development, applicants for funding under the scheme will be required to provide proof of the relevant permits for the construction and operation of the projects, including statements from the competent Danish environmental authorities, and for grid-connected projects a screening report from the Danish transmission system operator addressing, *inter alia*, whether connecting the project to the transmission grid will be possible within the four-year time limit described above in recital (58).
- (60) Successful beneficiaries will be granted contracts with a duration of 10 years. Therefore, payments will continue up to around 2040 at the latest, if projects take four years to realise and produce hydrogen for 10 years.

2.10. Budget and financing

- (61) The total budget of the scheme for its entire duration is DKK 1.25 billion (around EUR 168 million at the time of the adoption of this Decision). The total aid paid out under the scheme is capped at that amount. The scheme will be financed through the State budget of Denmark.

2.11. Cumulation

- (62) Projects which receive State aid under the scheme may not receive any other State aid covering the same costs. For this reason, bidders must give a declaration that

they do not receive any other State aid covering the same costs as the premium paid under the scheme.

- (63) If the winning project is an expansion of an existing installation that already receives aid, the beneficiary must install separate metering infrastructure for the PtX fuel production related to the project. In such cases, it will be necessary for the hydrogen production related to the winning project to be measured separately to ensure that the beneficiary only receives aid under the scheme for the hydrogen produced according to the bid.

2.12. Transparency

- (64) Denmark submitted that it will ensure compliance with the transparency requirements laid down in points 58 to 61 of the CEEAG. The relevant data of the scheme will be published on a national website³⁶, as well the Commission's transparency register no later than six months after aid under the scheme has been granted.

3. ASSESSMENT OF THE MEASURE

3.1. Existence of state aid

- (65) Article 107(1) TFEU states that *'any aid granted by a Member State or through State resources in any form whatsoever which distorts or threatens to distort competition by favouring certain undertakings or the production of certain goods, shall, in so far as it affects trade between Member States, be incompatible with the common market'*.
- (66) The support for the producers of hydrogen under the scheme is financed from the general State budget (see Section 2.10). The scheme will therefore be financed from State resources.
- (67) The scheme is established in national law (see Section 2.2) and the Danish Government determines important elements of the scheme, including the beneficiaries, the conditions of eligibility in the scheme, and the scheme's budget. The scheme will be administered by the DEA, a State agency. The scheme is therefore imputable to the State.
- (68) Producers of renewable hydrogen through electrolysis will receive an advantage in the form of a direct grant that covers relevant investment and production costs and a reasonable profit (see Section 2.8), which are not otherwise achievable under normal market conditions.
- (69) In addition, the scheme favours certain types of investments (i.e. in renewable hydrogen production), and will not be available to all potential producers of hydrogen. The scheme is therefore selective.
- (70) The scheme targets renewable hydrogen producers, which are involved in the production of products or services which are widely traded within the European Economic Area (EEA). This may include renewable hydrogen. The notified

³⁶ <https://ens.dk/>.

scheme is therefore likely to distort competition on the hydrogen market and affect trade across the EEA.

- (71) Therefore, the scheme constitutes State aid in the meaning of Article 107(1) TFEU. The Commission notes that Denmark does not dispute that the scheme constitutes State aid (see recital (12)).

3.2. Lawfulness of the aid

- (72) Parts of the national legal basis have not yet been adopted and will only enter force after the notification of the Commission's decision (see recital (14)). Thus, Denmark has complied with the stand-still obligation set out in Article 108(3) TFEU.

3.3. Compatibility of the aid

- (73) The Commission has assessed the compatibility of the scheme on the basis of Article 107(3)(c) TFEU. The scheme aims at promoting economic activities in a manner that reduces GHG emissions and increases the level of environmental protection, as described in Section 2.1. The supported activities fall within the scope of the CEEAG. More specifically they fall under the category of aid for the reduction and removal of GHG emissions, including through support for renewable energy and energy efficiency (see point 16(a) CEEAG).
- (74) The Commission has therefore assessed the scheme as support for the producers of hydrogen through electrolysis under the general compatibility provisions in Section 3 of the CEEAG, as well as the specific compatibility criteria for aid for the reduction and removal of GHG emissions including through support for renewable energy and energy efficiency in Section 4.1 CEEAG.

3.3.1. Positive condition: the aid must facilitate the development of an economic activity

3.3.1.1. Contribution to the development of an economic activity

- (75) Article 107(3)(c) TFEU provides that the Commission may declare compatible '*aid to facilitate the development of certain economic activities or of certain economic areas, where such aid does not adversely affect trading conditions to an extent contrary to the common interest*'. Therefore, compatible aid under that provision of the Treaty must contribute to the development of certain economic activity.³⁷ In accordance with this, point 23 CEEAG states that, when notifying aid, Member States must identify the economic activities that will be facilitated as a result of the aid and how the development of those activities is supported.
- (76) Denmark has explained that the scheme supports, via direct grants, the production of renewable hydrogen through electrolysis, therefore contributing to the development of economic activities in this sector and other related sectors (see recitals (10) and (11)).

³⁷ See judgment in case C-594/18 P, *Austria v Commission*, EU:C:2020:742, paragraphs 20 and 24.

- (77) The Commission therefore considers that the scheme facilitates the development of certain economic activities as required by Article 107(3)(c) TFEU and point 23 CEEAG.

3.3.1.2. Incentive effect

- (78) State aid can only be considered to facilitate an economic activity if it has an incentive effect. An incentive effect occurs when the aid induces the beneficiary to change its behaviour towards the development of an economic activity pursued by the aid, and if this change in behaviour would not otherwise occur without the aid³⁸.
- (79) In order to demonstrate the presence of an incentive effect, point 28 CEEAG requires the factual scenario and the likely counterfactual scenario in the absence of aid to be identified. Furthermore, points 28, 38 and 90 CEEAG require the incentive effect and necessity of the aid to be demonstrated through a quantification for the reference projects supported under the scheme following the description in point 51 CEEAG.
- (80) Since the notified measure is a scheme, the quantification related to the factual scenarios can be provided per reference project³⁹.
- (81) Denmark has submitted a quantification of all the costs and revenues for two reference projects it deems to be representative of the hydrogen projects in Denmark that it has knowledge of (see section 2.7).
- (82) Having examined the information provided by Denmark, the Commission considers that the assumptions informing the quantification are reasonable.
- (83) The Commission notes that were the reference project that is used to define the lower bound of Denmark's estimated funding gap to receive 50 DKK/GJ (6.70 EUR/GJ) additional revenues from ancillary services and green certificates, and an additional 50 DKK/GJ from an increased value of green hydrogen compared to grey hydrogen as a result of the EU ETS, the reference project would appear to have no funding gap⁴⁰. However, Denmark has explained that the project assumes a hydrogen pipeline network which does not exist in Denmark yet. In the absence of a pipeline, such projects would require hydrogen transport by other means (truck or shipping) at significantly higher costs. Developers may also choose to produce more costly PtX products (see Table 2) because of this transport issue.
- (84) The Commission agrees that Denmark has explained that the amount of aid needed by different eligible beneficiaries is highly uncertain at this stage of the deployment of PtX technologies, and notes that the calculations provided by Denmark to demonstrate that only under a series of optimistic assumptions could

³⁸ See in that sense Section 3.1.2 of the CEEAG, as well as the *Hinkley* judgment (C-594/18 P, Austria v Commission, EU:C:2020:742, paragraphs 20 and 24).

³⁹ An example project that is representative of the average project in a category of eligible beneficiaries for an aid scheme.

⁴⁰ This assumes production and transport costs of 150 DKK/GJ (see recital (46)), and revenues of 140 DKK/GJ from the sale of hydrogen (including avoided EU ETS costs) (see recital (43)) and 50 DKK/GJ from green certificates and the provision of ancillary services (see recital (41)).

the projects eligible for support under the scheme be implemented in the absence of State aid. Given the significant uncertainty currently surrounding the costs and revenues of PtX projects, including regarding transport costs, the Commission considers that beneficiaries are in fact likely to face a gap between their costs of producing hydrogen and the revenues they could expect to make (see recital (46)). Therefore, the requirements in point 28 CEEAG are fulfilled.

- (85) Point 29 CEEAG stipulates that aid does not normally present an incentive effect in cases where works on the project started prior to the aid application. Point 30 CEEAG further explains that the aid application may take various forms, including for example a bid in a competitive bidding process.
- (86) The Commission notes that Denmark will require bidders to confirm that work on the project in question has not begun prior to submitting the written bid, and subsidy applications will be rejected if this is not the case (see recital (36)). The Commission also notes that the DEA will also ensure that the application form complies with the minimum requirements set out in point 30 CEEAG such that it constitutes an aid application (see recital (34)). Therefore, the requirements in point 29 CEEAG are fulfilled.
- (87) Finally, point 32 CEEAG stipulates that aid granted merely to cover the cost of adapting to Union standards has, in principle, no incentive effect. However, the Commission notes that there are no Union standards applicable to the hydrogen and other PtX products produced under the scheme. Therefore, the requirements of point 32 CEEAG are fulfilled.
- (88) The Commission therefore considers that the aid granted under the scheme has an incentive effect.

3.3.1.3. No breach of any relevant provision of Union law

- (89) State aid cannot be declared compatible with the internal market if the supported activity, the aid measure, or the conditions attached to it entail a contravention of provisions or general principles of Union law⁴¹.
- (90) As set out in Section 2.5, the Commission notes that aid under the scheme will be granted in compliance with the Renewable Energy Directive. For renewable hydrogen, the Commission notes that installations eligible to receive aid under the scheme have to fulfil the GHG emissions savings criteria and the additionality criteria applicable to RFNBOs under the Renewable Energy Directive. Furthermore, the suppliers will be required to provide buyers with all necessary information and proof of sustainability characteristics of hydrogen, as required by the Renewable Energy Directive (see recital (21)).
- (91) Additionally, the Commission notes that Denmark commits to ensuring that the scheme complies with Union law, including the principles of free movement and non-discrimination (see recital (26)).

⁴¹ CEEAG point 33, and judgment of 22 September 2020, *Austria v. Commission*, C-594/18 P, EU:C:2020:742, paragraph 44.

- (92) Therefore, the Commission considers that the scheme does not infringe relevant Union law, and that the requirements of point 33 CEEAG are fulfilled.

3.3.1.4. Conclusion on the assessment of the positive condition

- (93) The Commission therefore concludes that the scheme fulfils the first (positive) condition of the compatibility assessment i.e. that the aid facilitates the development of an economic activity pursuant to the requirements set out in Sections 3.1, 4.1.1, and 4.1.2 CEEAG.

3.3.2. *Negative condition: the aid cannot unduly affect trading conditions to an extent contrary to the common interest*

3.3.2.1. The positive effects of the aid measure

- (94) As indicated in Section 3.3.1.1, the scheme contributes to the development of certain economic activities, i.e. the production of renewable hydrogen, and progress in the decarbonisation of the industrial, transport and/or energy sectors. The Commission notes that the DEA estimates that the PtX-fuels produced as a result of the scheme will reduce GHG emissions by approximately 0.07 million tonnes of CO₂ annually by 2030 (see recital (11)). Because the scheme supports only renewable hydrogen production and other renewables-based PtX products or the production of hydrogen involving a reduction of at least 70% of emissions compared to steam methane reforming on average (see recitals (21) to (24)), the scheme will contribute to achieving the EU target of at least 32% of renewable energy by 2030, and the EU target of reducing CO₂ emissions by at least 55% by 2030 (relative to 1990 level) (see recital (3)). The Commission notes that the scheme will contribute to the Danish government's long-term goal for Denmark to reduce GHG emissions by 70% by 2030 (relative to 1990 level) and to reach net zero emissions by 2050 at the latest. Finally, by replacing natural gas (products) with renewable hydrogen (products), the Commission notes that the scheme will positively contribute to reducing the Union's dependency on imported fossil fuels from Russia.

3.3.2.2. Necessity of the aid

- (95) Point 34 CEEAG explains that the proposed State aid measure must be targeted towards a situation where it can bring about a material development that the market alone cannot deliver. Point 89 CEEAG states that the Member State must identify the policy measures already in place to reduce GHG emissions. In order to demonstrate the necessity of aid, points 38 and 90 CEEAG explain that the Member State must show that the reference project(s) would not be carried out without the aid, taking into account the counterfactual situation, as well as relevant costs and revenues including those linked to measures identified in point 89. Point 90 CEEAG states that limits to profitability and/or clawbacks may be required where Member States provide support in the form of a guaranteed remuneration to ensure that the private investment takes place in the context of significant uncertainty concerning future market developments related to a large part of the business case. Point 91 CEEAG explains that where the Member State demonstrated that there is a need for aid, the Commission presumes that a residual market failure remains, which can be addressed through aid for decarbonisation, unless it has evidence to the contrary.

- (96) The Commission recalls its conclusion in recitals (83) and (84) that the reference projects would likely not be carried out without the aid given the significant gap between their costs of producing renewable hydrogen and the price achievable on the market. Moreover, in the absence of further regulatory measures incentivising the use of renewable hydrogen, as identified by Denmark, the Commission notes that the market will not deliver a higher production of renewable hydrogen as it would not be profitable (see section 2.7). Points 34, 38, and 89 CEEAG are therefore fulfilled.
- (97) Despite the significant uncertainty surrounding the relevant costs and revenues of renewable hydrogen projects, the aid will be paid as a fixed premium (recital (50)). The Commission accepts the absence of a limit to profitability or clawback mechanism in the scheme in light of:
- (a) The fact that the aid is granted in a competitive bidding process featuring a safety mechanism and a bid cap (see recitals (27) to (31));
 - (b) The strong evidence for competition for support under the scheme (see recital (28)); and
 - (c) The correlation between hydrogen and electricity prices⁴², which means increased revenues for beneficiaries in the form of higher hydrogen prices would tend to be offset at least somewhat by increased electricity purchase costs.

The requirements in point 90 CEEAG are therefore fulfilled, and the Commission considers that a residual market failure remains and that it can be addressed by the scheme, in line with point 91 CEEAG.

- (98) To ensure that aid remains necessary for each eligible category of beneficiary, Member States must update their analysis of relevant costs and revenues at least every 3 years for schemes that run longer than that, as set out in point 92 CEEAG. To fulfil this requirement, the Commission notes that Denmark commits to update its analysis of relevant costs and revenues before a potential second round of competitive bidding under the scheme is carried out (see recitals (29) and (54)).
- (99) The Commission therefore considers that the scheme is necessary to support the targeted economic activity in a manner that increases environmental protection.

3.3.2.3. The appropriateness of the aid

- (100) Point 93 CEEAG states that the Commission presumes the appropriateness of aid for achieving decarbonisation goals, provided all other compatibility conditions are met. It further sets out that, given the scale and urgency of the decarbonisation challenge, a variety of instruments, including direct grants, may be used.
- (101) The Commission therefore considers that, in light of the overall assessment of the compatibility of the scheme presented in this State aid decision, the aid in the form of direct grants to support the production of renewable hydrogen through

⁴² The price of hydrogen made by the steam methane reformation of natural gas is largely determined by the market price of natural gas. Likewise, the market price of natural gas also has a large influence on the market price of electricity.

electrolysis is an appropriate instrument to support the targeted economic activity in a manner that increases environmental protection.

3.3.2.4. Eligibility

- (102) Point 95 CEEAG explains that decarbonisation measures targeting specific activities which compete with other unsubsidised activities can be expected to lead to greater distortions of competition, compared to measures open to all competing activities. As such, Member State should give reasons for measures which do not include all technologies and projects that are in competition.
- (103) In this connection, a non-exhaustive list of permissible restrictions is set out in point 96 CEEAG which provides:
- “....
- (d) a Member State identifies reasons to expect that eligible sectors or innovative technologies have the potential to make an important and cost-effective contribution to environmental protection and deep decarbonisation in the longer term;
-
- (f) a more selective approach can be expected to lead to lower costs of achieving environmental protection (for example through reduced system integration costs as a result of diversification, including between renewables, which could also include demand response and/or storage), and/or result in less distortion of competition;”
- (104) Furthermore, Member States must regularly review eligibility rules and any rules related thereto to ensure that reasons provided to justify a more limited eligibility continue to apply for the lifetime of each scheme, as set out in point 97 CEEAG.
- (105) The Commission notes that the scheme, by its very nature, is not open to all decarbonisation technologies and projects that are in competition contrary to the principle set out in the first sentence of point 95 CEEAG, being restricted only to support for the production of renewable hydrogen. Accordingly, the Commission will examine whether Denmark has provided sufficiently grounded reasons for that restriction.
- (106) In this regard, the Commission notes Denmark’s argument that a support scheme targeted at electrolysis projects is crucial to supporting the industrialisation and upscaling of the production of PtX in Denmark, thereby reducing the costs relating to the production of renewable hydrogen longer term (see recital (10)). In addition, the Commission takes note of Denmark’s views that renewable hydrogen is especially relevant in hard-to-abate sectors where direct electrification is not possible or associated with very high costs (see recital (7)).
- (107) Denmark has demonstrated that although renewable hydrogen is not currently a cost effective form of decarbonisation, it is expected to be needed to decarbonise certain sectors and activities in the longer term and has the potential for significant cost decreases over time (see recital (9)). The Commission therefore considers that the restricted eligibility criteria for the scheme can be justified on

the basis of point 96(d) CEEAG. Furthermore, a targeted support scheme will accelerate the rate of cost reductions and, in turn, enable faster and cheaper decarbonisation of hard to abate sectors in the longer term, and as the scheme does not further differentiate between different projects (recital (20)). Therefore, the Commission considers that the limited eligibility is further justified based on point 96(f) CEEAG.

- (108) To fulfil the requirement in point 97 CEEAG, the Commission notes that the targeted (PtX exclusive) tenders will only continue as long as the projects have a substantial economic disadvantage compared to other abatement technologies. Moreover, the Commission notes that Denmark will review the funding gap of potential PtX projects before a potential second round of competitive bidding under the scheme is carried out (recital (54)), allowing for a comparison with other abatement technologies.

3.3.2.5. Public consultation

- (109) Point 99 CEEAG requires Member States to consult publicly on the competition impacts and proportionality of proposed measures, prior to the notification of aid. The respective requirements apply only to measures approved from 1 July 2023. Therefore, point 99 CEEAG is not applicable to the scheme under assessment.

3.3.2.6. The proportionality of the aid

- (110) Point 47 CEEAG explains that State aid is considered to be proportionate if the aid amount per beneficiary is limited to the minimum needed for carrying out the aided project or activity. Point 103 CEEAG specifies that aid for reducing GHG emissions should in general be granted through a competitive bidding process to ensure that the objectives of the measure can be attained in a proportionate manner which minimises distortions of competition and trade.
- (111) Point 49 CEEAG states that when the aid amounts are determined through a competitive bidding process, the result of that process will provide a reliable estimate of the minimum aid required so that detailed assessments of the net extra costs necessary for carrying out the investment will not be required. It further provides the criteria that must be fulfilled so that the aid is deemed proportionate:
- (a) the bidding process is open, clear, transparent and non-discriminatory, based on objective criteria, defined *ex ante* in accordance with the objective of the scheme and minimising the risk of strategic bidding;
 - (b) the criteria are published sufficiently far in advance of the deadline for submitting applications to enable effective competition;
 - (c) the budget or volume related to the bidding process is a binding constraint in that it can be expected that not all bidders will receive aid, the expected number of bidders is sufficient to ensure effective competition, and the design of undersubscribed bidding processes during the implementation of a scheme is corrected to restore effective competition in the subsequent bidding processes or, failing that, as soon as appropriate; and
 - (d) *ex post* adjustments to the bidding process outcome are avoided as they may undermine the efficiency of the process's outcome.

- (112) Point 104 CEEAG further sets out that the bidding process should, in principle, be open to all eligible beneficiaries to enable a cost effective allocation of aid and reduce competition distortions.
- (113) The Commission notes that the aid under the scheme is allocated exclusively through a competitive bidding process that is open to all parties with eligible projects (see recital (16)), and that projects of all electrolysis technologies and hydrogen uses compete on equal terms (see recital (20)). The Commission notes that the criteria for the participation in the bidding process are defined *ex ante*, in a clear, transparent and non-discriminatory way, and appear justified and proportional in light of the objective of the scheme. In particular, there are no restrictions on the actual electrolysis technology used (as long as it can produce renewable hydrogen), nor on the use of that hydrogen, and eligibility is overall only restricted to the extent necessary to support the industrialisation and upscaling of the production of PtX in Denmark (see recitals (20) to (26) and (107)). Moreover, the Commission notes that the risks of strategic bidding are addressed through the expected strong competition for support (see recital (28)), contractual penalties (see recital (56)), and measures to ensure the maturity of the projects at the time of the submission of the bids (see recital (59)).
- (114) The Commission notes that the selection criteria and bidding process will be published two months before the start of the tender (see recital (32)).
- (115) Furthermore, the Commission notes that the budget of the scheme has been set at a level that is lower than the expected demand for subsidies, and is a binding constraint (see recital (37)). As explained by Denmark in recital (19), more than 20 PtX projects with a capacity of more than 6 GW electrolysis have been announced in Denmark, none of which have yet made final investment decisions, even though only 100-200 MW electrolysis is expected to obtain support through the scheme. Furthermore, whereas Denmark expects 10-15 undertakings to participate in the competitive bidding process (recital (28)), a maximum of three are expected to benefit from the scheme (recital (18)). This indicates that the number of bidders clearly exceeds the potential winners, and therefore a strong competition is expected in the competitive bidding process. Furthermore, the Commission notes that the scheme includes a safety mechanism, intended to promote greater competition should the bidding process not initially result in sufficiently competitive bids (recital (29)), and that the bids are subject to a bid cap (recital (30)).
- (116) The Commission notes that the aid will be granted solely on the basis of the offer submitted by the bidder, and that there will be no *ex post* adjustments of the bid or negotiations of the bids after the bids are submitted (see recital (33)). To that effect, the Commission notes that while there may be a possibility for the marginal bidder to downscale the quantity of renewable hydrogen it proposes to produce to such a level that its funding needs can be met within the funds available in the auction round, no changes to the bid price are allowed (see recital (33)).
- (117) The Commission notes that there are no concessions or other benefits granted as part of the scheme (see recital (49)).
- (118) Therefore, the Commission considers that the requirements in points 47, 49, 103, and 104 CEEAG are fulfilled.

- (119) Point 50 CEEAG explains that the selection criteria used for ranking bids should put the contribution to the main objectives of the measure in relation with the aid amount requested by the applicant.
- (120) The Commission notes that the ranking criterion will be the subsidy price in DKK per GJ of renewable hydrogen produced that is submitted for the competitive bidding process (see recital (38)). The Commission considers this ranking criterion to directly reflect the environmental benefits the scheme aims to achieve, as displacing (chemicals made using) fossil-based fuels and industrial feedstock with (chemicals made using) the renewable hydrogen produced under the scheme will reduce GHG emissions.
- (121) Therefore, the Commission considers that the requirements in point 50 CEEAG are fulfilled.
- (122) Point 106 CEEAG explains that, where the analysis required under point 90 shows there may be a significant deviation between the bid levels of different categories of beneficiaries, the risk of the overcompensation of cheaper technologies should be considered. Furthermore, any bid caps should be justified with reference to the quantification for reference projects.
- (123) The Commission notes that the analysis required under point 90 CEEAG, which is summarised in Table 1, does not reveal a significant deviation between the bid levels of the different renewable hydrogen reference projects with any certainty. Nevertheless, the scheme will also be open to renewables-based ammonia, methanol and e-diesel projects, which may have markedly different funding gaps, as shown in Table 2. Whereas this suggests that there may be a significant deviation between the bid levels that different categories of beneficiaries are expected to offer, the Commission notes that the maximum aid provided by the scheme is limited to the total estimated funding gap of the most robust reference project (assuming a risk premium of 33%) through the scheme's general bid cap⁴³. This bid cap will be reviewed before a potential second round of competitive bidding under the scheme is carried out (see recital (54)). The Commission also notes the strong competition expected in the competitive bidding process (see recital (115)), mitigating the risk of overcompensating cheaper technologies.
- (124) Therefore, the Commission considers that the requirements in point 106 CEEAG are fulfilled.
- (125) Point 56 CEEAG explains that when aid under one measure is cumulated with aid under other measures, Member States must specify the method used to ensure that the total amount of aid for a project or an activity does not lead to overcompensation or exceed the maximum aid amount allowed under the CEEAG.
- (126) The Commission notes that projects which receive State aid under the scheme, may not receive any other State aid covering the same costs as the scheme (Section 2.11), therefore the requirements in point 56 CEEAG do not apply.

⁴³ Recitals (30) and (52), and Table 3.

(127) Therefore, the Commission considers that the aid granted under the scheme is proportionate.

3.3.2.7. The transparency of the aid

(128) Denmark will ensure compliance with the transparency requirements laid down in points 58 to 61 CEEAG. The relevant data of the scheme will be published on a national website⁴⁴ that will link to the Commission's transparency register⁴⁵.

(129) This information will be published no later than six months after the decision to grant the aid has been taken. It will be kept available to the general public without restrictions for at least 10 years.

3.3.2.8. Avoidance of undue negative effects of the aid on competition and trade, and balancing

(130) Point 70 CEEAG explains that the Commission will approve measures under these guidelines for a maximum period of 10 years. As stated in Section 2.7, the aid will be awarded in the period 2023-2025, therefore the requirement in point 70 CEEAG is respected.

(131) Point 116 CEEAG explains that the aid must not merely displace the emissions from one sector to another and must deliver overall GHG emissions reductions. Point 121 CEEAG explains that aid which covers costs mostly linked to operation rather than investment should only be used where the Member State demonstrates that this results in more environmentally-friendly operating decisions. Furthermore, points 127 to 129 CEEAG require Member States to explain how they intend to avoid the risk of aid stimulating or prolonging the consumption of fossil-based fuels and energy.

(132) The Commission notes that all projects will produce hydrogen that meets or exceeds the criteria for RFNBOs (recital (21)). Under the sectoral rules for RFNBOs, the electricity used would either be from additional renewable sources, or be sourced from the grid when the emission intensity of the marginal generator is sufficiently low to avoid significantly increasing demand for fossil fuels or increasing GHG emissions. If beneficiaries also produce non-RFNBOs, the GHG emissions savings of these must be at least 70% on average over one or more time periods during the lifetime of the scheme, and operating aid will not cover the costs of this production (recital (22)). The Commission therefore considers that the projects would not prolong the consumption of fossil-based fuels, nor lead to a mere sectoral displacement of emissions. Although most of the aid of one reference project covers OPEX (see Table 1), the Commission notes that the aforementioned safeguards help ensure that electrolyzers are operated in a manner that minimises environmental harm.

(133) Point 120 CEEAG explains that Member States must demonstrate that reasonable measures will be taken to ensure that projects granted aid will actually be developed.

⁴⁴ <https://ens.dk/>.

⁴⁵ <https://webgate.ec.europa.eu/competition/transparency/public?lang=en>.

- (134) The Commission notes that Denmark aims to prevent non-realisation and minimise delays through a maximum realisation period for projects of four years, with the possibility of a one year extension at maximum if justified (see recital (58)). The winners of the competitive bidding process are subject to a contractual penalty if this time limit is not met (see recital (56)). Applicants for funding under the scheme will be required to provide proof of the relevant permits for the construction and operation of the projects (see recital (59)). Furthermore, aid under the scheme covers the full net extra cost (or funding gap) necessary to realise projects, removing the need for projects to seek additional sources of funding apart from the scheme (see recital (49)).
- (135) Point 122 CEEAG states where aid is primarily required to cover short-term costs that may be variable, Member States should confirm that the production costs on which the aid amount is based will be monitored and the aid amount updated at least once per year. The aid must be designed to prevent any undue distortion to the efficient functioning of markets, and preserve efficient operating incentives and price signals, as set out in point 123 CEEAG.
- (136) As referred to in Section 3.3.1.2, the analysis of the DEA shows that aid under the scheme will likely cover short-term costs that may be variable, namely electricity input costs. Although premiums will not be updated after they have been awarded, the Commission notes that the production costs will be monitored and the level of the bid cap and safety mechanism updated for a potential subsequent bidding process under the scheme, if necessary (see recital (54)). Fixed premiums will maintain the incentive to flexibly operate electrolyzers. The Commission notes that the possibility of negative prices for the production of renewable hydrogen appear vanishingly small in light of the information on costs and revenues provided by Denmark (see Section 2.7), and that the scheme's use of a competitive bidding process (see Section 2.6) does not incentivise the beneficiaries to offer their renewable hydrogen output below marginal cost. Therefore, the requirements of points 122 and 123 CEEAG are fulfilled.
- (137) Points 124 and 125 CEEAG state that the Commission will carry out a case-by-case assessment for measures that include dedicated infrastructure projects, taking into account steps to mitigate the distortive effect of aid to such infrastructure. However, the Commission notes that this requirement is not relevant for the scheme as no aid under this scheme covers dedicated infrastructure.
- (138) Point 131 CEEAG explains that, where risks of additional competition distortions are identified or measures are particularly novel or complex, the Commission may impose conditions, including the obligation to perform an *ex post* evaluation, as set out in point 76 CEEAG. However, the Commission considers that this requirement is not relevant for the scheme in light of its size, design, and the presence of previously adopted State aid decisions for hydrogen support⁴⁶.
- (139) Point 132 CEEAG states that Member States should demonstrate how the proposed measure will not lead to distortions of competition, for example, through increased market power, should the measure be expected to benefit a particularly limited number of beneficiaries.

⁴⁶ SA.53525, SA.62619, SA.102003.

- (140) The Commission notes Denmark’s assessment that the scheme is likely to eventually support one to three beneficiaries (see recital (18)) out of a possible 10-15 that will participate in the competitive bidding process (see recital (28)). While this number is limited, the Commission notes that the risk of distorting competition and trade is kept to a minimum by the aid being granted through a competitive bidding process. As explained by Denmark in recital (18), the Commission notes that the scheme is likely to actually increase competition by supporting the entry of new competitors. While Denmark expects the projects supported by the scheme to add up to 100-200 MW of electrolysis capacity (see recital (19)), the Commission notes that the EU Hydrogen Strategy calls for 40 GW of renewable hydrogen electrolyzers by 2030. The requirements of point 132 CEEAG are therefore fulfilled.
- (141) The Commission therefore considers that aid granted under the scheme avoids undue negative effects on competition and trade.

3.3.3. *Weighing up the positive and negative effects of the aid*

- (142) As indicated in recital (94), the scheme contributes to the development of certain economic activities, i.e. the production of renewable hydrogen, and thus the decarbonisation of the industrial, transport and/or energy sectors. Furthermore, by replacing natural gas (products) with renewable hydrogen (products), the scheme will positively contribute to reducing the Union’s dependency on imported fossil fuels from Russia in line with the REPowerEU Communication. The scheme will therefore contribute to important policy objectives at the EU and national level.
- (143) Point 134 CEEAG explains that, so long as there are no obvious indications of non-compliance with the ‘do no significant harm’ principle and so long as all other compatibility conditions are met, the Commission will typically find the distortions to competition of decarbonisation measures to be offset by their positive effects. In this case there are no obvious indications of non-compliance with the do-no-significant harm principle (see recital (25)) and all other compatibility conditions are met. The Commission thus considers that any negative effects of the aid are offset by its positive effects.
- (144) Therefore, the Commission considers the aid compatible with the internal market under Article 107(3)(c) TFEU.

4. AUTHENTIC LANGUAGE

- (145) As mentioned in recital (2), Denmark has accepted to have the decision adopted and notified in English. The authentic language will therefore be English.

5. CONCLUSION

The Commission has accordingly decided not to raise objections to the aid on the grounds that it is compatible with the internal market pursuant to Article 107(3) of the Treaty on the Functioning of the European Union.

Yours faithfully,

For the Commission

Margrethe VESTAGER
Executive Vice-President