EUROPEAN COMMISSION

Brussels, 21.9.2022
C(2022) 6847 final

In the published version of this decision, some information has been omitted, pursuant to articles 30 and 31 of Council Regulation (EU) 2015/1589 of 13 July 2015 laying down detailed rules for the application of Article 108 of the Treaty on the Functioning of the European Union, concerning non-disclosure of information covered by professional secrecy. The omissions are shown thus […]		PUBLIC VERSION This document is made available for information purposes only.

Subject:

State Aid SA.64631 (2022/N) – Austria
State Aid SA.64641 (2022/N) – Belgium
State Aid SA.64636 (2022/N) – Denmark
State Aid SA.64628 (2022/N) – Finland
State Aid SA.64670 (2022/N) – France
State Aid SA.64654 (2022/N) – Greece
State Aid SA.64645 (2022/N) – Italy
State Aid SA.64650 (2022/N) – Netherlands
State Aid SA.64627 (2022/N) – Poland
State Aid SA.64754 (2022/N) – Portugal
State Aid SA.64634 (2022/N) – Slovakia
State Aid SA.64623 (2022/N) – Spain
State Aid SA.64652 (2022/N) – Sweden

Important Project of Common European Interest on Hydrogen Industry (Hy2Use)

Seiner Exzellenz Herrn
Alexander Schallenberg
Bundesministerium für Europa, Integration und Äußeres
Minoritenplatz 8
A - 1014 Wien

Κύριος Νίκος Δένδιας
Υπουργός Εξωτερικών
Βασιλίσσης Σοφίας 1
Grèce - 10671 Αθήνα

Son Excellence Madame Hadja Lahbib
Ministre des Affaires étrangères, des Affaires européennes et du Commerce extérieur,
et des Institutions culturelles fédérales
Rue des Petits Carmes, 15
B - 1000 Bruxelles

Udenrigsminister Jeppe Kofod
Asiatisk Plads 2
D - 1448 København K

Utrikesminister Ann Linde
Utrikesdepartementet
Arvfurstens palats
Gustav Adolfs torg 1
SE - 111 52 Stockholm

Son Excellence Madame
Catherine Colonna
Ministre de l'Europe et des Affaires étrangères
37, Quai d'Orsay
F - 75351- PARIS

Onorevole Luigi Di Maio
Ministro degli Affari esteri e della Cooperazione Internazionale
P.le della Farnesina 1
I - 00194 Roma

Zijne excellentie meneer Wopke Hoekstra
Minister van Buitenlandse Zaken
Rijnstraat 8
N - 2515 XP Den Haag

Ulkoministeri Pekka HAAVISTO
Laivastokatu 22
FI-00160 Helsinki

Jego Ekscelencja
Zbigniew Rau
Minister Spraw Zagranicznych
Al. . J. Ch. Szucha 23
PL-00 - 580 Warszawa

S. Ex.ª o Ministro dos Negócios Estrangeiros
João Gomes Cravinho
Largo do Rilvas
P - 1399-030 Lisboa

Ivan KORČOK
minister zahraničných vecí a európskych záležitostí Slovenskej republiky
Hlboká cesta 2,
833 36 Bratislava
SLOVENSKÁ REPUBLIKA

Excmo. Sr. José Manuel Albares Bueno
Ministro de Asuntos Exteriores y de Cooperación
Plaza de la Provincia 1
E-28012 MADRID

Excellencies,

1. PROCEDURE

(1) On 17 December 2020, 22 Member States and Norway agreed on a "Manifesto for the development of a European "Hydrogen Technologies and Systems" value chain"[1]. This manifesto recognises the importance of promoting cross-border collaborations and of working on large-scale joint investment projects, in order to support the development and deployment of hydrogen technologies and systems[2], in particular in view of the contribution of this value chain to the creation of sustainable industrial jobs and to the attainment of the European Union's (the "Union") energy and climate targets also in light of the EU Hydrogen Strategy[3]. On this basis, the signatories agreed to promote the realisation of Important Projects of Common European Interest ("IPCEI") on hydrogen.

(2) In this context, several Member States launched national calls for pre-selecting potential projects and, during the period from January 2021 to August 2021, held several technical meetings to prepare and develop a common programme for IPCEI. Given the large interest from stakeholders and the variety of technologies and systems identified within the value chain, Member States decided to design more than one potential IPCEI on hydrogen.

(3) On 15 July 2022, the Commission adopted a decision[4] not to raise objections on the first IPCEI on Hydrogen Technology ("Hy2Tech"), involving 35 undertakings from 15 Member States.

(4) On 31 August 2021, 1 September and 13 September 2021, Austria, Belgium, Denmark, Finland, France, Greece, Italy, the Netherlands, Poland, Portugal, Slovakia, Spain and Sweden pre-notified their plans to participate in an IPCEI on Hydrogen Industry ("Hy2Use") on the basis of a common draft overall descriptive text (so-called "Chapeau" document) prepared taking into account the criteria of the IPCEI Communication[5], as well as detailed information on Hy2Use and its components and individual projects.

---

1 https://www.bmwk.de/Redaktion/DE/Downloads/M-O/manifesto-for-development-of-european-hydrogen-technologies-systems-value-chain.pdf?__blob=publicationFile&v=10

2 Hydrogen systems consist of the integration of different technologies for the generation, storage, transportation, distribution and use of hydrogen. A local hydrogen system could for instance encompass an electrolyser, a hydrogen storage tank, a hydrogen refuelling station, a methanation unit, a fleet of heavy duty vehicles powered by hydrogen, and a pipeline for the distribution of hydrogen. A list of abbreviations is presented in Annex II.

3 Communication from the Commission, to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Region, *A hydrogen strategy for a climate-neutral Europe*, COM(2020)301 final, 8.7.2020.

4 SA.64625 (2022/N) and others - Important Project of Common European Interest on Hydrogen Technology (Hy2Tech) (not yet published).

5 Communication from the Commission, *Criteria for the analysis of the compatibility with the internal market of State aid to promote the execution of important projects of common European interest* (OJ C528/10, 30.12.2021).

(5) The European Commission (the "Commission") requested and received complementary information from all of the participating Member States listed in recital (4) (the "Member States") and the relevant undertakings (the "participating undertakings") during the period between October 2021 and August 2022.

(6) The Commission services organised high-level meetings with senior representatives of the Member States in order to enhance coordination between the Member States and ensure progress. These high-level meetings took place on 19 December 2021 and on 24 August 2022. In addition, during the pre-notification stage, meetings took place between the Commission and the Member States at the technical level.

(7) On the following dates, the Member States notified State aid for the execution of Hy2Use: Belgium on 24 August 2022, Austria, Italy and the Netherlands on 25 August 2022, Finland, France, Poland, Slovakia, Spain and Sweden on 26 August 2022, Denmark on 29 August 2022, Greece on 1 September 2022 and Portugal on 3 September 2022. All of the Member States have individually notified the common Chapeau document and their planned aid measures.

(8) By letters accompanying each notification, the Member States agreed to waive their rights deriving from Article 342 of the Treaty on the Functioning of the European Union ("TFEU") in conjunction with Article 3 of Regulation 1[6] and to have this Decision adopted and notified in English.

(9) Norway is participating in Hy2Use with two individual projects[7], which are mentioned in the Chapeau document and it will collaborate with the participating undertakings in the Member States. Norway notified aid for these projects to the EFTA Surveillance Authority ("ESA") on 26 August 2022. The ESA, pursuant to Article 109(1) of the Agreement on the European Economic Area (the "EEA Agreement") in conjunction with Article 24 of the Agreement between the EFTA States on the Establishment of a Surveillance Authority and a Court of Justice, is competent to assess whether Norway has complied with the provisions of the EEA Agreement. On the basis of Article 109(2) and Protocol 27 to the EEA Agreement, the ESA and the Commission have cooperated throughout the assessment of Hy2Use.

(10) In light of the above, and given the parallel competence of both institutions in the present case, the Commission has cooperated with and consulted the ESA before adopting the present decision.

---

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

7 Norway participates in Hy2Use with two individual projects in TF 2, Barents Blue Ammonia Plant ("Barents Blue") and TiZir Titanium & Iron AS ("TiZir").

2. OBJECTIVES AND DESCRIPTION OF HY2USE

2.1. Objectives of Hy2Use

(11) By participating in Hy2Use, the Member States have agreed to ensure the development of the hydrogen value chain by supporting the construction of hydrogen-related infrastructure, notably large-scale electrolysers and transport infrastructure (see section 2.2.2.1), and by supporting the development of hydrogen technologies to be used in multiple industrial sectors (see section 2.2.2.2). Hy2Use, amongst other things, seeks to contribute to attaining the specific goals of the EU Hydrogen Strategy as well as the Union's general objectives in reaching its decarbonisation targets, in particular the European Green Deal and the REPowerEU Plan (see section 3.3.2.2).

(12) The Member States intend to grant aid to participating undertakings in Hy2Use that aim to establish infrastructure projects of great importance for the energy strategy of the Union or that develop innovative and sustainable technologies for the use of hydrogen in different industrial sectors that go substantially beyond the current state-of-the-art. Hy2Use will thus bring together undertakings operating at different levels of the value chain.

(13) The overall objectives of Hy2Use, established in the Chapeau document, are to:

a. install large-scale electrolysers generating hydrogen in large European industrial centres located along an emerging European hydrogen backbone[8];

b. boost the supply of renewable and low-carbon hydrogen, thereby reducing dependency on the supply of natural gas;

c. research and develop innovative and sustainable technologies for the integration of hydrogen into the industrial processes of multiple sectors;

d. ensure the transfer of knowledge to new or improved applications, as well as to ensure new research, development and innovation ("R&D&I") in the different sectors and disseminate this knowledge across the hydrogen value chain by fostering collaborations between the various stakeholders;

e. support new jobs and growth through the development and strengthening of highly skilled staff, aiming at mitigating the social impact of the transition to clean energy; and

f. contribute to the coordination of hydrogen-related activities across the EEA in order to create an integrated EEA hydrogen ecosystem.

[8] The "European hydrogen backbone" is an initiative jointly developed by European gas infrastructure undertakings to establish a pan-European hydrogen infrastructure by 2040, including hydrogen supply corridors by 2030, as enabler for the development of the hydrogen market. See https://ehb.eu/.

2.2. Description of Hy2Use

(14) This section describes Hy2Use as it has been presented by the Member States in their notifications. Hy2Use is organised along two different technology fields ("TF")

- TF 1: Development of hydrogen generation and transport infrastructure; and
- TF 2: Development of hydrogen technologies for industry applications.

(15) Within TF 1, the participating undertakings will carry out infrastructure projects pursuant to point 25 of the IPCEI Communication, whereas in TF 2 the participating undertakings will conduct R&D&I and first industrial deployment ("FID") activities pursuant to points 22 and 23 of the IPCEI Communication.

2.2.1. Differences between Hy2Use and Hy2Tech

(16) In Hy2Tech, the participating undertakings will carry out R&D&I and FID activities related to the hydrogen value chain, in four areas: development of hydrogen generation technologies; development of fuel cell hydrogen technologies; development of technologies for storage, transportation and distribution of hydrogen; and development of hydrogen technologies for a selection of end-users (in particular the mobility sector).

(17) In this regard, the two IPCEIs are to an extent complementary concerning their general structure and objectives. Both projects address the same value chain, targeting similar general common objectives, which are closely linked to the EU climate and energy strategies (see section 3.3.2.2). However the two IPCEIs are nevertheless distinct.

(18) Unlike Hy2Tech, Hy2Use encompasses a TF (i.e. TF 1) focussed solely on the development of hydrogen generation and transport infrastructure, i.e. the construction of large-scale electrolysers and transport pipelines.

(19) Furthermore, concerning the technology focus of both IPCEIs, Hy2Tech concentrates on the mobility of persons (e.g. railway, buses and maritime) and transport of goods (e.g. heavy duty trucks, railway and maritime applications). Hy2Use, on the other hand, contains a different range of industrial applications, focusing on different sectors that were not covered by Hy2Tech, namely the derivatives of hydrogen, such as ammonia, and the use of hydrogen in the industrial processes to produce metals, chemicals and food, e-fuels and refineries, cement and glass – many of them considered hard-to-abate industrial sectors[9]. For instance, while Hy2Tech aims at developing lightweight material for hydrogen vehicles and combined cycle gas turbine packages for maritime applications, Hy2Use (in TF 2) seeks to develop the use of hydrogen as feedstock (i.e. raw material used as an input for industrial processes), thereby contributing to decarbonising the steel or chemical industries, as well as the use of hydrogen as a fuel for heating applications in the cement and glass industries.

9 Hard-to-abate sectors are those sectors where decarbonisation is a more costly way of reducing emissions than current technologies with a higher carbon content.

2.2.2. *Description of the TF of Hy2Use*

(20) Each TF focuses on key stages of the hydrogen value chain. Along this value chain, within and across each of the TF, the participating undertakings will collaborate in order adequately to meet Hy2Use's objectives and overcome a number if identified challenges during that process (see sections 2.2.2.1 and 2.2.2.2).

2.2.2.1. TF 1 – Development of hydrogen generation and transport infrastructure

(21) TF 1 focuses on the supply of renewable and low-carbon hydrogen by ensuring the construction of large-scale electrolyser capacities within or near several important European industrial centres and in port areas, mainly powered by renewable energy. The projects included in this TF are consistent with the priorities of the Guidelines on Trans-European Networks for Energy (the "TEN-E Guidelines")[10], and will facilitate the emergence of the future integrated hydrogen infrastructure or backbone. The activities considered in TF 1 are expected to contribute towards the following overarching objectives:

- Creating approximately 3.5 gigawatt ("GW") of new electrolyser capacity, located in important Union industrial centres and in port areas, resulting in an output of approximately 340 000 tonnes of renewable and low-carbon hydrogen per year;
- Delivering greenhouse gas ("GHG") emission avoidance, both directly (in the generation of hydrogen via electrolysis[11] compared to the conventional method based on fossil fuels) and indirectly (in the use of the renewable and low-carbon hydrogen by end-users in different industrial, mobility and energy sectors);
- Connecting newly built renewable energy sources ("RES"), especially offshore wind and solar, thereby increasing the overall capacity of renewable energy in the EEA;
- Connecting to and contributing to an emerging integrated hydrogen infrastructure or backbone, in compliance with applicable Union and national law on hydrogen infrastructure; and
- Integrating innovative traceability system for certifying renewable hydrogen in accordance with applicable Union legislation.

(22) In order to achieve these objectives, all of the projects in TF 1 face multiple challenges. A major challenge lies in the substitution of natural gas or other fossil fuels with renewable hydrogen at an unprecedented large-scale. Another major challenge for the projects in this TF is how to achieve competitive prices

---

[10] See Regulation (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on guidelines for trans-European energy infrastructure (OJ L 152, 3.6.2022, p. 45).

[11] The electrolysis consists of different technologies: proton exchange membrane ("PEM") electrolysis alkaline electrolysis ("AEL"), solid oxide electrolysis ("SOE") and anionic exchange membrane ("AEM") electrolysis.

by the large-scale generation of renewable and low-carbon hydrogen, thereby enabling the development of a complete hydrogen ecosystem. Other challenges include the optimisation of renewable hydrogen processes before feeding into the storage and transport infrastructures, as well as the electricity system integration of high amounts of RES, whilst reducing concurrently downstream electricity grid congestion.

2.2.2.2. TF 2 – Development of hydrogen technologies for industry applications

(23) TF 2 focuses on supporting and enabling the creation and deployment of clean and innovative technologies in different industrial end-use sectors replacing carbon-based technologies with renewable and low-carbon hydrogen technologies. These end-use sectors are: ammonia, metals, chemical, food, e-fuels and refineries, and cement and glass.

(24) The activities planned in TF 2 aim to contribute to the following overarching objectives, during both the R&D&I and FID phases, which are common to all sectors concerned.

(25) For R&D&I:

- developing technologies to ensure safe and reliable use and operation of electrolysers and feed-in of renewable and low-carbon hydrogen;
- developing, implementing and applying a cost-efficient electricity procurement strategy;
- reducing the specific power consumption of the electrolysis and increasing the lifetime of the stack; and
- reducing the related CO_2 emissions, due to the fact that the products of the hydrogen-based plants are expected to have better material properties (e.g. chemical and physical properties) compared to the current state-of-the-art.

(26) For FID:

- developing CO_2 emission-free productions under thermodynamic and kinetic process parameters that do not affect the material properties of the products; and
- scaling up the different technology and processes from pilot to industrial scale, thereby facilitating the use of renewable and low-carbon hydrogen.

(27) The main challenge, during both the R&D&I and FID phases, relates to the lack of knowledge and experience in integrating electrolysers and the generated renewable and low-carbon hydrogen into industrial processes. As a result, the task of ensuring safe and reliable use and operation of electrolysers, in order to generate the required hydrogen, without recourse to conventional alternatives is equally challenging. Furthermore, an additional challenge relates to integrating CO_2 capture technologies to reduce global emissions for further processing the hydrogen into industrial products, as well as stabilising and integrating hydrogen streams from fluctuating RES into existing upstream production systems.

(28) In addition, each of the sectors targeted by TF 2 in Hy2Use face its own specific challenges, during both the R&D&I and FID phases. For instance:

- there is currently a lack of knowledge on how to develop a more efficient ammonia production method that would also ensure a renewable ammonia product;

- in the metals sector, the current technologies for decarbonised hydrogen heating are nascent and optimised control schemes for, for instance, hydrogen-based direct reduced ("DR") iron technology, need to be developed further;

- in the chemical and food sectors, one of the main challenges lies in the integration of an appropriate CO_2 source in order to process the hydrogen into a chemical product;

- for e-fuels and refineries, the combination of large-scale electrolysers with carbon capture and utilisation ("CCU") technologies (e.g. for methanation), requires a fully synchronised operation of the integrated plant, due to the fact that each technology is materially interconnected to the others and each technology has separate flexibility constraints; and

- in the cement sector, the development of suitable combustion kilns for the production of different types of materials constitutes one of the main challenges, given that the use of hydrogen as a fuel can lead to different material properties of the product, which need to be avoided.

2.2.3. Description of the participating undertakings in Hy2Use

(29) This section briefly describes the participating undertakings involved in each TF of Hy2Use. The individual projects of each participating undertaking[12] under the different TF are described in more detail under section 2.4.1.

(30) The participating undertakings are:

- <u>Air Liquide Industrie B.V. (with two individual projects "Air Liquide ELYgator" and "Air Liquide CurtHyl") and Air Liquide France Industrie ("Air Liquide FR")</u>

Air Liquide (the Netherlands and France) produce and supply industrial gasses (hydrogen, oxygen, argon, nitrogen, carbon monoxide and syngas). They are subsidiaries of the Air Liquide Group, which has expertise in the entire hydrogen value chain (i.e. production, storage and distribution) and in the development of all industrial applications.

- <u>Bay of Biscay Hydrogen S.L. (Petroleos del Norte S.A.) ("Petronor") and Cartagena Hydrogen NetWork S.L. (Repsol Hidrógeno S.A.) ("Repsol")</u>

[12] These undertakings will participate in Hy2Use with separated individual projects implemented by the different legal entities, bringing the total number of individual projects to 35 (not including the two individual projects notified by Norway to ESA, namely Barents Blue and TiZir).

Repsol (Spain) is an energy supplier, which develops renewable photovoltaic ("PV") and wind energy projects and operates low-emission electricity generation assets. Petronor (Spain), part of Repsol group, refines and commercialises petroleum products and their derivatives.

- BONDALTI Chemicals S.A. ("Bondalti")

Bondalti (Portugal) is active in the Chlor-alkalis ("PCA") productive sectors in the inorganic chemicals segment, and Aniline and by-products ("PAD") in the organic chemicals segment. It produces chlorine, hypochlorite and non-integrated aniline, and sells aniline and mononitrobenzene ("MNB").

- Borealis Agrolinz Melamine GmbH ("Borealis")

1. Borealis (Austria) is active in the mechanical recycling of plastics and produces ammonia, fertilizers and technical nitrogen products. It also provides circular polyolefin solutions and base chemicals.

- ENGIE Electrabel ("ENGIE Electrabel"), ENGIE ("ENGIE BE") and ENGIE Energie Nederland N.V. ("ENGIE NL")

ENGIE (Belgium and the Netherlands) operates in the generation of electricity and supply of energy and energy-related products to households and businesses.

- Enel Green Power España S.L. ("Endesa")

Endesa (Spain), part of the Enel Group active in the power and gas markets, carries out activities in the electricity business (generation, distribution, and sale) and gas, mainly in the Spanish and Portuguese markets.

- Everfuel A/S ("Everfuel")

Everfuel (Denmark) is a small and medium-sized enterprise ("SME")[13] that develops and operates renewable hydrogen supply chains for end-users within industry and mobility.

- Fluxys Hydrogen Transmission Network ("Fluxys")

Fluxys (Belgium) is a gas infrastructure undertaking focusing on gas and liquefied natural gas transmission and storage. It is active in the midstream segment of the gas value chain between production and consumption.

- Hybrit Development A.B. ("HDAB")

HDAB (Sweden) is an undertaking active in the metal industry that performs R&D in the field of fossil-free technologies that can be used in the iron and steelmaking value chain.

- H2 Aboño S.A. ("EDP-A"), H2 Los Barrios S.A. ("EDP-LB")

[13] The Commission applies the term 'SME', as defined in Annex I of Commission Regulation (EU) No 651/2014 of 17 June 2014, declaring certain categories of aid compatible with the internal market in application of Article 107 and 108 of the Treaty, OJ L 187/1, 26.6.2014.

H2 Aboño S.A and H2 Los Barrios S.A. (Spain) are both subsidiaries of the EDP Group, which is a wind energy production undertaking active in the electricity value chain and in gas commercialisation.

- H2ermes B.V. ("HyCC")

H2ermes B.V. (the Netherlands) is a special purpose vehicle 100% owned by HyCC. The latter is a JV owned by Nobian and Macquarie's Green Investment Group ("GIG"), which focusses on water electrolysis to produce renewable hydrogen at an industrial scale.

- H2-Fifty B.V. ("H2-Fifty")

H2-Fifty (the Netherlands) is a JV owned by bp and HyCC to launch a 250 megawatt ("MW") electrolyser using off-shore wind and solar power.

- IAM Caecius S.L. ("Fertinagro")

IAM Caecius S.L. (Spain) is a special purpose vehicle ("SPV") set up by EDP Group and Fertinagro Biotech S.L. The latter is part of Tervalis Group, which is a supplier of fertilizers for agriculture. Fertinagro's focus will be the development of new animal feed solutions.

- IBERDROLA CLIENTES S.A. ("Iberdrola")

Iberdrola (Spain) is an electric utility, producing wind power. It is also active in the design, construction and operation of thermal power plants, combined cycle power plants and heat and power cogeneration plants.

- MassHylia Clean Hydrogen Sas ("MassHylia")[14]

MassHylia (France) is a JV to be established by TotalEnergies SE (France) and ENGIE SA (France), in charge of the investment in renewable hydrogen production equipment (such as electrolyser, hydrogen storage unit) and of the commercialisation of renewable hydrogen supplied to customers.

- NextChem S.p.A. ("NextChem")

NextChem (Italy) is a subsidiary of Maire Tecnimont Group, which is active in research, licensing, engineering and construction of processing plants. NextChem focusses on renewable chemistry and energy transition technologies.

- Ørsted Hydrogen Netherlands Holding B.V. ("Ørsted")

Ørsted (the Netherlands) develops, constructs and operates offshore and onshore wind farms, solar farms, energy storage facilities, bioenergy plants and provides energy products to its customers.

- P2X Solutions Oy ("P2X")

---

[14] This name is subject to the approval of the respective relevant committees within TotalEnergies and ENGIE; the name of the future JV may therefore evolve at a later stage.

P2X (Finland) is an SME that builds and operates renewable hydrogen and synthetic fuel production plants. It distributes the hydrogen to the mobility sector through its Hydrogen Refuelling Stations network.

- PKN Orlen S.A. ("Orlen")

Orlen (Poland), part of the ORLEN Group, is an industrial electricity producer active on the Polish energy market. Its offerings includes petrochemical and refinery products.

- RINA Consulting - Centro Sviluppo Materiali S.p.A. ("RINA-CSM")

RINA-CSM (Italy), part of RINA Group, is active in the steel sector, carrying out R&D projects for steel makers, plant suppliers, and oil and gas undertakings.

- RONA a.s. ("RONA")

RONA (Slovakia) focusses on the development, production, and sale of utility glassware and manufactures lead-free household crystalware.

- SardHy Green Hydrogen S.r.l. ("SardHy")

SardHy (Italy) is a JV set up by EGP and Saras S.p.A ("Saras"). The latter is an energy undertaking with operations in petroleum refining, marketing, oil products distribution and power generation.

- SHELL Nederland B.V. ("Shell")

Shell (the Netherlands) is a global group of energy and petrochemical undertakings with expertise in the exploration, production, refining and marketing of oil and natural gas, and the manufacturing and marketing of chemicals.

- Solar Foods Oy ("Solar Foods")

Solar Foods (Finland) is an SME that develops platform technologies for food ingredients and produces protein for human consumption by using hydrogen and air-captured CO_2.

- South Italy Green Hydrogen S.r.l. ("SIGHy")

SIGHy (Italy) is a joint venture ("JV") set up by Enel Green Power Italy S.r.l. ("EGP") and Eni S.p.A. ("Eni"). EGP is part of the Enel Group, which develops and operates renewable energy power plants. It also develops and manages power generated from renewable resources, including wind, solar, hydro and geothermal. Eni is a global energy undertaking active on the entire value chain: from the exploration, development and extraction of oil and natural gas to the generation of electricity and the development of circular economy processes.

- TECforLime S.A. ("TfL")

TfL (Belgium), part of the Carmeuse group, is a provider of lime, limestone products and related customised engineering solutions.

- <u>TITAN Cement S.A. ("TITAN")</u>

TITAN (Greece) is a cement and building materials producer, operating quarries, ready-mix plants, terminals, and other production and distribution facilities.

- <u>Uniper Benelux N.V. ("Uniper")</u>

Uniper (the Netherlands) is an undertaking in the energy sector that is active along the entire hydrogen value chain. Its core activities include power generation, energy trading and a gas portfolio.

- <u>VERBUND A.G. ("VERBUND")</u>

VERBUND (Austria) produces hydro-electricity and operates the Austrian electricity and gas transmission grids. It is also active in energy transmission and international trading and sales.

2.3. Governance of Hy2Use

(31) For the implementation and monitoring of Hy2Use a governance structure will be set up. This structure of Hy2Use is summarized in the table below:

IPCEI Supervisory Board ("SB")		
Public Authority Board ("PAB")	IPCEI Facilitation Group ("FG")	Commission (guest status)
IPCEI General Assembly ("GA")		

Table 1: Hy2Use governance structure

(32) Hy2Use's Supervisory Board ("SB") consists of:

- The PAB, with representatives appointed by the Member States participating in Hy2Use, each having one vote;
- Hy2Use's FG; and
- Representatives of the Commission, as observers and advisers without voting rights, appointed by the Commission.

(33) The role of the SB will be to supervise, monitor and ensure the implementation of Hy2Use at large. This concerns, in particular, the monitoring of the progress of the participating undertakings' individual projects, as well as Hy2Use as a whole. The focus of the implementation of Hy2Use is on both, technological advances and the spillover activities to disseminate these advances that the participating undertakings have committed to undertake. The SB will be also responsible for the annual reporting to the Commission on the basis of information provided by the FG.

(34) In principle, the SB will meet twice a year, by means of teleconferencing or videoconferencing. In addition, the SB may meet in extraordinary session to discuss any event relating to Hy2Use, in particular regarding the potential entry

of a new participating undertaking or the exit of an existing participating undertaking.

(35) To demonstrate the effectiveness of Hy2Use's functioning, key performance indicators ("KPIs") will be agreed upon at the SB's first meeting and monitored accordingly during the course of Hy2Use.

(36) The GA will be organised once a year, gathering all participating undertakings and the representatives of the Member States (and the Commission as observer). At its first meeting, within six months after the Commission's decision approving Hy2Use, the GA will elect the members of the FG, and it will be responsible of adopting decisions on any changes of the FG's composition. In particular, the GA elects the Hy2Use's chair and deputy Hy2Use and the coordinators (including their substitutes) of each TF, who will be members of the SB. It will also designate a participating undertaking that is a member of the FG, as key contact for the implementation of the spillover commitments. The GA will moreover take note of any exit decision from Hy2Use either at the next ordinary GA meeting or by written consultation, teleconferencing or videoconferencing. As from its second meeting onwards, the GA shall be organised alongside an annual public Hy2Use conference.

(37) The FG is composed of the chair, the deputy of Hy2Use, the coordinators of the TF (and their substitutes) and any additional undertaking's representatives or advisors who have assumed related duties. It will be in charge of TF coordination, annual reporting, communication, preparation of events, etc. It will drive the overall progress of the TF on a non-confidential basis and establish a permanent interface between private and public stakeholders with the goal of highlighting Hy2Use's role and impact.

(38) The FG will also be responsible for organising and fostering collaboration and communication within Hy2Use and vis-à-vis third parties who can potentially benefit from the results of Hy2Use but who are not participating undertakings. For this, the FG will implement two instruments: the annual Hy2Use meeting and Hy2Use website.

(39) A Hy2Use meeting will take place once a year. The first meeting will take place at the latest one year following the Commission's decision approving Hy2Use. The meeting will consist of a dedicated session for Member States, the Commission and the participating undertakings and a public conference open to any interested party, during which the participating undertakings will present the main results of their work.

(40) The website will host public information about Hy2Use and the participating undertakings. The website will also serve as the dissemination and interaction channel of Hy2Use engaging thus entities other than the participating undertakings. For this, the website will list all spillover activities to which the participating undertakings have committed (see section 2.5). This information will be presented in the form of an "Events Calendar" with the concrete dates and a brief description of the activity. The interested community will have the opportunity to register to participate in the activities directly with the participating undertaking who will be in charge of the specific activity. The website will thus also serve as a basis for the annual reporting on the delivery of the committed activities. The FG will collect qualitative and quantitative

information on each activity. It may also foresee a restricted area for the participating undertakings to organise the implementation of Hy2Use.

(41) The members of the FG will change over time to take into consideration the end of participation of the participating undertakings according to their respective individual projects.

(42) As regards national governance, the participating undertakings' individual projects are governed by funding agreements to be concluded with the relevant funding authority within each Member State. Such funding agreements impose requirements and obligations towards the administration of any individual project according to the rules set up by the funding authority. The national funding authorities are in possession of the commitments of all participating undertakings. As such, the PAB will be responsible for monitoring the completeness of the listings and announcements of the committed spillover activities and knowledge dissemination.

2.4. Hy2Use as an Integrated Project

(43) The Member States submit that Hy2Use is an integrated project within the meaning of point 13 of the IPCEI Communication. The Member States explain that Hy2Use is based on a common programme aiming at the same objective and is based on a coherent systemic approach, as laid down in the common Chapeau document.

(44) The Member States also explain that the two TF of Hy2Use are both complementary and significantly add value in order to meet the objectives of each TF separately and of Hy2Use as a whole. The figure below presents the overall structure of Hy2Use, including the individual projects by the participating undertakings in the two TF.

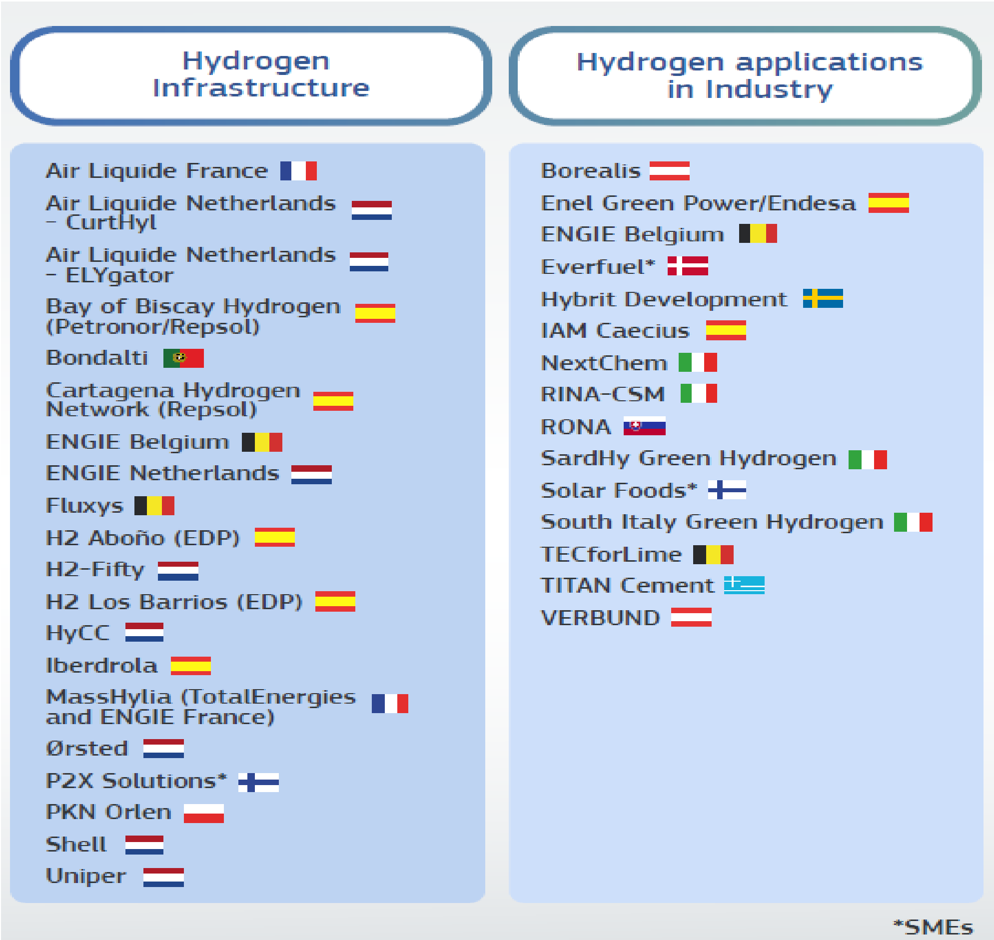

Figure 1: Overall structure of Hy2Use

(45) The Member States further explain and describe in the common Chapeau document that the individual projects composing Hy2Use, are organised in two TF, which are complementary and significantly add value in order to achieve the common objectives of Hy2Use. According to the Member States, the supply of renewable and low-carbon hydrogen will be facilitated by large-scale electrolysers and related infrastructure for its storage and distribution (scope of TF 1), which is complementary to the demand for renewable and low-carbon hydrogen that is expected to increase by technological innovations in different industrial end-use sectors (scope of TF 2).

(46) Sections 2.4.1 and 2.4.1.2 describe such added value and complementarity in each TF. Section 2.4.2 describes in which way, according to the Member States, each of the two TF significantly adds value to and is complementary with each other in order to meet the objectives of Hy2Use. Furthermore, multiple collaborations amongst the participating undertakings within the same TF (see section 2.4.3.1) or across TF (see section 2.4.3.2) corroborate the integrated nature of Hy2Use.

2.4.1. Description of the significant added value and complementarity of the individual projects within each TF for the achievement of the objective of Hy2Use

(47) The individual projects of the participating undertakings are outlined below in the two TF. Each project is one constituent part of Hy2Use.

2.4.1.1. Description related to the significant added value and the complementarity of the individual projects for the achievement of the goals of TF 1

(48) TF 1 involves 20 individual projects by the participating undertakings: Air Liquide FR, Air Liquide CurtHyl, Air Liquide ELYgator, Bondalti, EDP-A, EDP-LB, ENGIE Electrabel, ENGIE NL, Fluxys, HyCC, H2-Fifty, Iberdrola, MassHylia, Orlen, Ørsted, Petronor, P2X, Repsol, Shell, and Uniper.

(49) According to the Member States, the significant added value of all of the individual projects in TF 1 lies in the common objective to establish renewable and low-carbon hydrogen capacity that can be safely transported, stored and used in multiple sectors within the EEA, in line with the objectives of the EU Hydrogen Strategy and with the TEN-E Guidelines, and also to facilitate the emergence of a future integrated hydrogen infrastructure or backbone. The implementation of all of the individual projects is also expected to save thousands of tonnes of CO_2 emission per year, thereby facilitating the decarbonisation of the EEA in line with the objectives of the European Green Deal.

(50) In order to facilitate attaining the common objective, the TF is divided into four main tasks, each one containing specific components. The Member States submit that all of these tasks with their components are equally important and significantly add value for the achievement of the TF's goals, as they enable a proper division of the different work packages of the participating undertakings, thereby ensuring completion of the individual projects in a timely manner.

(51) Task one concerns the installation of large-scale electrolysis capacity to enable the generation of renewable and low-carbon hydrogen. This requires the building of highly flexible electrolysers using exclusively or predominantly electricity from RES, and the scaling up of hydrogen generation.

(52) Task two concerns the connection of the newly built-up renewable and low-carbon hydrogen generation capacity to different transport and storage infrastructures. This task contains the following components:

a) supplying renewable and low-carbon hydrogen to a broad spectrum of applications and to different types of end-users;

b) expanding and constructing the pipeline network, where necessary; and

c) constructing storage infrastructure.

(53) Task three relates to the integration of renewable and low-carbon hydrogen, thereby ensuring the functionality of the energy system. This task contains the following components:

a) ensuring, subject to the agreement of the Member States concerned, the installation of adequate pipeline transport capacity for future import of hydrogen, in addition to the self-generated renewable and low-carbon hydrogen;

b) developing cost- and energy optimised systems;

c) connecting hydrogen producers with off-takers for a flexible and reliable hydrogen market; and

d) improving efficiency and lowering maintenance costs of the electrolysers.

(54) Finally, task four concerns the investigation of regulations, standards and safety issues for the use of hydrogen in large-scale electrolysers. This in particular means:

a) contributing to the definition of an appropriate regulatory framework or considering alternative design solutions based on risk assessment;

b) setting a new reference standard for the use of hydrogen, taking into account safety constraints; and

c) integrating a traceability system for certifying renewable and low-carbon hydrogen.

2.4.1.1.1. <u>Description related to the significant added value of the individual projects</u>

1. <u>Air Liquide FR</u>

This project will contribute to the goals of TF 1 by building a 200 MW PEM electrolyser in order to generate renewable hydrogen for industry and heavy mobility uses. The project will generate approximatively 20 000 tonnes of renewable hydrogen per year and should save the equivalent of approximately 3.8 million tonnes of CO_2 over 15 years of operation (including both direct and indirect decarbonisation effects).

2. <u>Air Liquide CurtHyl</u>

Air Liquide CurtHyl will contribute to the goals of TF 1 with the construction of a 200 MW PEM electrolyser in Maasvlakte (Rotterdam) that will generate on average [10 000-20 000] *(*)*[15] tonnes of hydrogen yearly. The electrolyser will operate solely on dedicated RES (wind farm) and should save [900 000-1 000 000] tonnes of CO_2 emissions over 15 years of operation. The renewable hydrogen will be marketed to customers in the Rotterdam area and to undertakings in the refinery, chemical and mobility sectors. In a later phase, the project is expected to further scale up, interconnect with and support the emergence of an EEA-wide network for hydrogen.

3. <u>Air Liquide ELYgator</u>

This project will contribute to the goals of TF 1 with the construction of a hybrid 200 MW AEL/PEM electrolyser to enable renewable hydrogen generation of approximately [10 000-20 000] tonnes per year, […] to industrial and mobility

[15] *_Confidential information_.

customers. The electrolyser will operate solely on renewable power, sourced from a dedicated wind farm and a dedicated directly connected solar farm. The project should lead to [100 000-200 000] tonnes per year of CO_2 being saved and, furthermore should develop a carbon footprint tracking solution to certify the carbon content of hydrogen and ensure traceability from the power source to end-customers.

4. Bondalti

Bondalti's project will deploy the required infrastructure to generate renewable hydrogen for the chemical, gas and mobility sectors. Off-takers will be able to acquire the hydrogen either through a connection to the national gas network, or through direct hydrogen supply in the form of high-pressure tanks or liquefied hydrogen. The project involves the installation of an electrolyser with envisaged capacity of up to 355 MW by 2030, generating approximately 40 000 tonnes of hydrogen per year. The project will make use of the complementarity between solar and wind sources and achieve high electrolysis capacity factors […]. By 2030 the project will require more than 1 GW of renewable electricity generation. This will be achieved by partnering with energy suppliers from the power sector for achieving additional dedicated generation of approximately [300-400] MW solar PV and [700-800] MW on-shore wind.

5. EDP-A

The project consists in the construction of an electrolyser with a capacity of 100 MW that is expected to save more than 100 000 tonnes of CO_2 emissions per year and generate renewable hydrogen of approximately 12 000 tonnes per year for customers in the steel, cement, chemical, fertilisers and glass sectors. The EDP Group will be responsible for installing 200-300 MW of renewable capacity that is required for supplying the renewable energy for the electrolyser. The project is located close to the planned European hydrogen backbone, and envisages a potential scale up in the medium-long term to more than 500 MW electrolyser capacity.

6. EDP-LB

The project consists of the construction of an electrolyser with a capacity of 100 MW to generate renewable hydrogen. The envisaged generation of renewable hydrogen is 12 000 tonnes per year, which should save more than 100 000 tonnes of CO_2 emissions per year. The project plans to source exclusively renewable electricity for the operation of the electrolyser. The site is in the proximity of the port of Algeciras with potential for exporting hydrogen and with a large industrial area with potential off-takers in the steel, chemical, refinery and gas sectors.

7. ENGIE Electrabel

ENGIE Electrabel will contribute to TF 1 by designing, building and operating a large-scale renewable hydrogen facility (67.5 MW) that is expected to use solely renewable electricity and target a yearly capacity of around 7 400 tonnes for different end-users in the industrial and mobility sectors. It is estimated that the project can save around 111 000 tonnes of CO_2 emissions per year. The renewable hydrogen will be supplied to different type of end-users, each with their specificities (e.g. hydrogen demand profile). The project will be located nearby the emerging European hydrogen backbone that is being developed by the Belgian gas infrastructure operator Fluxys.

8. ENGIE NL

ENGIE NL will contribute to the goals of TF 1 with the construction of a 100 MW electrolyser, which will be powered by 200 MW of wind capacity supplied by offshore wind turbines and will be able to follow the intermittent supply of electricity. The electrolyser will generate approximately [10 000-20 000] tonnes of renewable hydrogen per year and will be supplying several off-takers, including methanol and ammonia producers.

9. Fluxys

Fluxys will establish a hydrogen transmission network with open, transparent and non-discriminatory access to link hydrogen supply (upstream) and demand (downstream). This infrastructure will enable hydrogen to be used for industrial, mobility and energy related purposes. Fluxys will roll out hydrogen transmission infrastructure to industrial clusters located in the ports of Antwerp, Bruges, North Sea Port, Hainaut and Liège, and cross-border interconnections between Belgium and neighbouring countries, namely Germany, the Netherlands and France, are also foreseen.

10. H2-Fifty

The H2-Fifty project involves the building of a 250 MW electrolyser, which operates by using off-shore wind and solar power to generate up to 40 000 tonnes of renewable hydrogen per year to be used in various applications for the decarbonisation of industries across the Rotterdam harbour and the wider Benelux/West-German region. The project's location is close to the forthcoming hydrogen pipeline networks spanning the port of Rotterdam, the Netherlands and major parts of Europe.

11. HyCC

HyCC aims to build a 100 MW electrolyser (with an upscaling potential of more than 500 MW) powered by offshore wind farms, thereby achieving a CO_2 saving of 65 000 to 80 000 tonnes per year. The project intends to make renewable hydrogen available for existing and new industries located in the port of Amsterdam, including the steel sector, and for other customers in the Amsterdam metropolitan area and beyond. This additional market area will be served thanks to a hydrogen pipeline to be installed during the project, the regional integrated backbone, which will be part of the Dutch hydrogen backbone.

12. Iberdrola

The project by Iberdrola involves the construction of total electrolyser capacity of 780 MW powered by renewable energy, in proximity to the planned European hydrogen backbone. The goal of the project is to supply hydrogen and oxygen to a fertiliser producer (Fertiberia), to other industrial and mobility off-takers and ultimately to the export market. The project aims to generate up to 87 600 tonnes of hydrogen per year, which should reduce CO_2 emissions by up to 926 500 tonnes per year.

13. <u>MassHylia</u>

This project contributes to the objectives of TF 1 by building and operating a 120 MW electrolyser that will supply hydrogen to a refinery and other customers, in particular in the mobility sector. Approximately 15 000 tonnes of hydrogen will be generated per year by late 2025. More than two thirds of the planned electricity sourcing is based on dedicated RES (PV plants and wind farm) and less than a third on grid supply, thereby ensuring the low-carbon nature of the electricity supply. CO_2 emission avoidance is estimated at 33 500 tonnes per year. A connection to local hydrogen storage will also be realised and, at a later stage, connection to the European hydrogen backbone is also envisaged.

14. <u>Orlen</u>

The project involves the building of generation capacities for renewable hydrogen of a total of approximatively 27 300 tonnes per year, with the aim to reduce CO_2 emissions by approximatively 184 000 tonnes by 2030. In particular, 100 MW electrolyser capacities generating approximately 11 000 tonnes per year of renewable hydrogen will be built using renewable electricity from a new offshore wind farm, for the mobility, industrial and energy sectors. Furthermore, two waste-to-hydrogen plants using municipal waste with carbon capture and utilisation will be constructed to generate approximately 15 000 tonnes of low-carbon hydrogen per year. Finally, the building of publicly accessible hydrogen refuelling stations within the Trans-European Transport Network ("TEN-T") core network is also planned.

15. <u>Ørsted</u>

Ørsted aims to realise a hydrogen facility integrated into a regional and transnational hydrogen transport and distribution system. The project comprises the construction of a 100 MW electrolyser, fed with power from an offshore wind farm located off the coast of Zeeland. The electrolyser will generate 9 200 tonnes of renewable hydrogen per year and is expected to lead to a reduction of around 92 000 tonnes of CO_2 per year. The project will supply hydrogen to a fertiliser producer, as well as to other industrial and mobility off-takers that can be supplied with the forthcoming hydrogen backbone to be built in the region.

16. <u>Petronor</u>

This project contributes to the objectives of TF 1 by designing, building, operating and validating a 100 MW electrolysis plant, which is expected to generate around 16 000 tonnes of renewable hydrogen per year, thereby achieving a CO_2 reduction of approximately 167 000 tonnes per year. The project will be linked to the installation of the renewable generation capacity necessary to cover the electrolyser's operation, which will be accompanied by power and hydrogen storage to cover the total operating hours. The renewable hydrogen is planned to be sold to customers in different sectors, such as mobility, industry (including refinery), steel and agricultural, as well as being injected into the infrastructure grid.

17. P2X

The P2X project consists of installing electrolysers with a total capacity of 70 MW, generating hydrogen for various end-users in the industrial and mobility sectors. It is estimated that the project will provide cumulative CO_2 emission reductions (direct and indirect) of up to 1 million tonnes by 2031. Part of the generated hydrogen will be used to produce renewable synthetic methane by combining hydrogen with captured CO_2, thereby replacing import-dependent fossil fuels in Europe. The realisation of this project will increase demand for the Nordic – Baltic Corridor of the European hydrogen backbone, which is expected to be one of the main hydrogen export routes to central Europe. The project also includes building publicly-accessible hydrogen refuelling stations within the TEN-T core network.

18. Repsol

The project by Repsol consists in the design, construction, operation and validation of the 100MW electrolysis plant. The project will allow for the generation of 16 500 tonnes of hydrogen per year and is expected to achieve a reduction of approximately 167 000 tonnes of CO_2 emissions per year. Thanks to the proximity of the project site to an industrial and a port area, the project plans to provide renewable hydrogen for regional and local industrial clusters (including refinery, biomethanol and plastics) and for mobility and maritime applications. It will also facilitate the hydrogen injection into the existing natural gas grid (part of TEN-E) and the emerging European hydrogen backbone.

19. Shell

The project by Shell consists of the installation of a 200 MW electrolyser in the port of Rotterdam (within a dedicated electrolyser park) to be supplied by renewable electricity sourced directly from an offshore wind farm, thereby aiming to produce at least 55 tonnes per day of renewable hydrogen. The generated hydrogen will be transported by a new high-capacity open access hydrogen pipeline to be built in the area as part of the planned Dutch hydrogen backbone. Shell will develop common infrastructure that is needed for the electrolyser and the whole park (for example water and high voltage power) in collaboration with the Port of Rotterdam. It is the intention that the common infrastructure within the park will be available to future third party electrolyser developers.

20. Uniper

The project involves the construction and operation of an electrolyser of up to 100 MW to be powered by renewable energy from wind power. The project also includes the necessary equipment that is needed for the implementation of subsequent process steps, before feeding the hydrogen to the to-be-developed hydrogen grid infrastructure in the port of Rotterdam, i.e. compression of the hydrogen as well as treatment (oxygen removal, drying, etc.).

2.4.1.1.2. Description related to the complementarity of the individual projects

(55) The Member States have explained that the individual projects in TF 1 are interlinked and complementary to each other. This complementarity is shown by the division of the four main task of TF 1: following the installation of the large-scale electrolysers (task one), the connection to transport and storage infrastructure (task two), as well as the integration of the renewable and low-carbon hydrogen into the network (task three), it is also important to work towards improving safety issues related to the operation of large-scale electrolysers (task four).

(56) The complementary character of the individual projects is also illustrated by a number of collaborations within the TF, as explained in section 2.4.3.1.

2.4.1.2. Description related to the significant added value and complementarity of the individual projects for the achievement of the goals of TF 2

(57) TF 2 involves 15 individual projects[16] by the participating undertakings: Borealis, Endesa, ENGIE BE, Everfuel, Fertinagro, HDAB, NextChem, RINA-CSM, RONA, SardHy, SIGHy, Solar Foods, TfL, TITAN and VERBUND.

(58) According to the Member States, the significant added value lies in the fact that all of the individual projects commonly aim to scale up the integration of renewable and low-carbon hydrogen generation into the industrial processes, thereby increasing the energy efficiency and contributing to the reduction of GHG emissions, in line with the objectives of the EU Hydrogen Strategy and the EU Green Deal.

(59) TF 2 is divided in two general main tasks, which are common to all sectors concerned. Moreover, each sector displays its own technical characteristics and is further sub-divided into additional tasks. The Member States submit that this overall division is important and add significant value for the achievement of the TF’s common goal, as it enables the participating undertakings to aggregate better the objectives and challenges of the individual projects, in such a way that downtimes are minimised and the quality of the projects is still ensured.

(60) Task one concerns the scaling up and the implementation/integration of electrolyser capacity. The respective R&D&I and FID phases contain the following components.

(61) For R&D&I:

[16] With the inclusion of Barents Blue and TiZir from Norway, the total number of individual projects participating in TF 2 is 17.

a) ensuring a safe and reliable implementation and operation of the electrolyser;

b) developing, implementing and deploying a cost-efficient electricity sourcing strategy;

c) increasing the efficiency of operation through computer-aided strategies; and

d) developing an optimisation algorithm aimed at selecting the best operation strategy for the electrolyser, taking into account hydrogen demand profiles and availability of RES.

(62) For FID:

a) ensuring the deployment of emission-free industrial plants;

b) ensuring efficiency in renewable energy generation and hydrogen generation;

c) supplying to the electrolysis system with additional flexibilities, thereby enabling the provision of services to the electricity grid; and

d) optimising the electrolysis operation taking into account the various associated value streams.

(63) Task two concerns the improvement of competences for the industrial use of hydrogen. This task involves the following R&D&I activities:

a) developing competences and know-how for industrial use of renewable and low-carbon hydrogen; and

b) contributing to the definition of proper technical conditions favouring the use of renewable and low-carbon hydrogen in different sectors.

(64) Moreover, each of the sectors concerned is further divided into additional sub-tasks. For instance:

a) for ammonia, the integration of renewable and low-carbon hydrogen and oxygen in the industrial process, during both the R&D&I and FID phases, thereby optimising the hydrogen feed and the technical and economic aspects of nitric acid production;

b) in the metals' sector, the design and development of pilot plants and related components for the use of hydrogen (e.g. installing during R&D&I modules for the production of DR of iron, thereby reducing CO_2 emissions);

c) for chemical and food, the improvement and optimisation of the overall energy efficiency of the integrated system for the generation of hydrogen, and carbon capture (e.g. improving during FID the efficiency of the microbial growth process in a larger bioreactor);

d) for e-fuels and refineries, the specification, design and integration of electrolysers and the integration of the generated renewable and low-carbon hydrogen (e.g. combining a large-scale electrolyser with a methanation plant, using thermo- and biocatalytic methanation, by utilising the CO_2 stream of an industrial lime kiln); and

e) in the cement and glass sectors, the development and operation of pilot kilns (e.g. integration of renewable fuels in heating).

2.4.1.2.1. Description related to the significant added value of the individual projects

1. Borealis

(65) Borealis will contribute to TF 2 by using hydrogen and oxygen generated by the electrolyser that will be built by VERBUND, for the production of ammonia, fertilisers and technical nitrogen products in its existing ammonia and nitric acid plants. In particular, the Borealis project will among other things specify and demonstrate the feasibility of the exact technical parameters for the supply and integration of hydrogen and oxygen, including qualities, pressures, ramps, flexibilities and expected maintenance cycles and downtimes, using a purposely developed advanced process control system.

2. Endesa

(66) Endesa will contribute to the activities of TF 2 by using a direct current converted ("DC-DC") connection between a photovoltaic plant ("PV") and a, electrolyser, as well as a connection with an alternating current ("AC") line. The aim is to introduce a significant hydrogen percentage blended with natural gas in industrial size jet spins and atomiser dryers, thereby reinforcing renewable hydrogen uptake in multiple hard-to-abate sectors.

3. ENGIE BE and Tfl

(67) These two interconnected, nonetheless individual projects, from ENGIE BE and TfL respectively, aim to generate e-methane by capturing (using CCU solutions) the hazardous CO_2 emissions (process and combustion emissions) from an oxy-combustion lime kiln and integrate them with renewable hydrogen in a methanation plant. ENGIE BE will synthesise the renewable hydrogen with the captured CO_2 from the lime kiln into e-methane that will be injected into the natural gas grid. TfL will be responsible for developing and operating the processes for purification, compression and storage of the CO_2 from the lime kiln.

4. Everfuel

(68) Everfuel will contribute to the activities of TF 2 by deploying an electrolyser and Power-to-X ("PtX") facility, which will be integrated in a refinery, and is expected to generate renewable hydrogen to feedstock chemical processes. In addition, the project aims, among other things, to provide flexible integration with the electricity grid and balancing in 15-minute intervals; integrate the waste heat from the electrolyser into district heating, thereby enhancing efficiency; and, stabilise the hydrogen supply by using 16 tonnes storage capacity.

5. Fertinagro

(69) Fertinagro will contribute to TF 2 by developing an integrated electrolysis (25MW) with a Haber-Bosch plant for producing 15 000 tonnes per year of ammonia, destined for the manufacture of fertilisers. In particular, the project will develop a digital twin solution that will allow for the integration of all of the industrial processes involved (i.e. power generation, hydrogen generation and renewable ammonia generation). This will enable the project to examine the best configuration and operating parameters for reducing capital and operating costs.

6. HDAB

(70) HDAB will construct and ramp up an industrial scale plant for hydrogen-based DR of iron to meet the increasing demand for steel with low-carbon content. In particular, the project will enable the production of ore-based iron in a sustainable way by replacing coal and coke, used in the blast furnace / basic oxygen furnace process, with fossil-free hydrogen in a hydrogen-DR process, thereby creating a fossil-free value chain for steel production.

7. NextChem

(71) NextChem will contribute to the activities of TF 2 by developing, testing and optimising large-scale integration of solid waste (such as non-recyclable plastic/rubber/composites) gasification process with syngas fermentation, thereby developing an industrial process able to produce ethanol, using low-carbon hydrogen. Furthermore, NextChem aims to develop a programmable waste feeding system including real-time waste type characterisation and a gasifier performance process monitor through remote simulation system.

8. RINA-CSM

(72) RINA-CSM will establish an open industrial platform in the form of a European excellence centre that will develop and validate the use of hydrogen in steelmaking processes. In particular, the project will develop innovative process designs for DR of iron, electric arc furnaces ("EAF") and reheating furnaces, thereby supporting hydrogen-based production of steel for a wide variety of steel grades.

9. RONA

(73) RONA will contribute to TF 2 in the field of large-scale hydrogen combustion technologies for glass melting and definition of process parameters. The significant added value lies in the development of a novel glass furnace and automatic line forming and processing stemware with zero-emissions by replacing natural gas with hydrogen. During the FID phase, the main goal is to design the technological process of the production of emission-free glass to the level of daily production of 23 tonnes.

10. SardHy

(74) SardHy's project involves the development of technologies for the installation of an electrolyser, its connection to the grid and the sourcing of renewable electricity deriving from PV, wind and hydroelectric. The electrolyser will

produce 100% renewable hydrogen (as well as by-product oxygen) to be integrated n the refinery. For this integration the focus lies on modulating the traditional hydrogen production to comply with the variability of the electrolysis system, as well as in designing the electrolyser to collect oxygen from water electrolysis and to store it for utilisation.

11. SIGHy

(75) SIGHy will contribute to TF 2 by developing technologies for the installation of electrolysis powered by RES (in two plants) thereby allowing for the complete integration of the generated renewable hydrogen in the refinery process and the partial replacement of hydrogen deriving currently from fossil fuels. In particular, the main elements of the project comprise the complete system specification, including grid management and optimisation for energy utilisation on an industrial scale, electrolysis specification and hydrogen piping and management.

12. Solar Foods

(76) Solar Foods will contribute to TF 2 by integrating renewable hydrogen into the production of microbial proteins for human consumption. The significant added value of the project lies in the combination of a set of technologies: generation of renewable hydrogen from water electrolysis; application of direct air capture ("DAC") in an industrial context; and, CCU and use of hydrogen, oxygen and CO_2 as input in the biofermentation process.

13. TITAN

(77) TITAN will contribute to TF 2 by developing technologies for the operation of a pilot kiln, which will pursue the maximisation of hydrogen use as fuel for cement production. It is expected that this will increase the capacity for end-use of hydrogen in high quantities. Using hydrogen as fuel in the main kiln burner is expected to significantly improve the current hydrogen combustion technology in the rotary kiln system, thereby reducing fossil fuel consumption and CO_2 emissions and potentially increase productivity.

14. VERBUND

(78) VERBUND will develop technologies for integrating a PEM electrolyser with hydrogen (gaseous and metal-hydride) and oxygen storage it into ammonia and nitric acid plants operated by Borealis. The core task of the project will be the specification and optimisation of all system components, parameters and operational domains for this electrolyser, the interfaces with other components (including the ammonia and nitric acid production plants), as well as with the electricity grid.

2.4.1.2.2. Description related to the complementarity of the individual projects

(79) Within TF 2, the participating undertakings will develop related activities in the different sectors concerned aiming to ensure overall efficiency in the generation of hydrogen. For instance, the core activities of all of the projects notified by the participating undertakings involve the integration of renewable and low-carbon

hydrogen into existing industrial processes and the implementation of a cost-efficient electricity sourcing strategy.

(80) The complementary character of the individual projects is illustrated by a number of collaborations within the TF, as explained in section 2.4.3.1.

2.4.2. Description related to the significant added value and complementarity between the TF for the achievement of the objective of Hy2Use

(81) The Member States submit that each of the two TF significantly adds value to and is complementary with each other to meet the objectives of the Hy2Use (see recital (11)).

(82) The figure below shows a schematic representation of the complementarity between the different TF:

Figure 2: Schematic representation of collaborations envisaged in Hy2Use

2.4.2.1. Description related to the significant added value of TF 1 and its complementarity with TF 2

(83) TF 1 significantly adds value for the completion of TF 2, given that the construction and installation of large-scale electrolysers is needed to generate renewable and low-carbon hydrogen, thereby fostering end-uses, notably in hard-to-abate sectors (i.e. sectors in which it is difficult to reduce the level of CO_2 emissions).

(84) Concerning the complementarity with TF 2, the renewable and low-carbon hydrogen generated by individual projects under TF 1 is offered for end-use, as well as for feedstock and for Power-to-Liquid production in TF 2. Furthermore, the projects under TF 1 contribute to improved transport and storage of large quantities of hydrogen for a secure supply, thereby optimising the generation of hydrogen deriving from renewable sources in a way that fits best for industrial processes.

(85) The complementarity is illustrated in particular by the many collaborations between the different TF, as described in section 2.4.3.2.

2.4.2.2. Description related to the significant added value of TF 2 and its complementarity with TF 1

(86) TF 2 significantly adds value for TF 1, as it focuses on developing technologies that will create demand for generation, transport and storage of hydrogen. Furthermore, it stimulates hydrogen demand by end-users in a range of different industrial sectors that are expected to apply the new technologies to be developed.

(87) The complementarity of TF 2 with TF 1 lies in the fact that the end-users in the industrial sectors concerned (in TF 2) need to implement new processes and technologies or adapt the existing ones, thereby enabling greater use of renewable and low-carbon hydrogen that is to be generated by large-scale electrolysers, such as those to be installed in TF 1.

(88) The complementarity is illustrated in particular by the many collaborations between the different TF, as described in section 2.4.3.2.

2.4.3. Collaborations within Hy2Use with respect to the relevant TF

(89) In addition to the significant added value and complementarity of the individual projects within each TF, strong collaborations between the participating undertakings within and across the TF will exist, which, according to the Member States would not occur to the same extent without Hy2Use.

2.4.3.1. Examples of collaborations intra TF

(90) In TF 1:

- ENGIE Electrabel and Iberdrola will collaborate to compare experiences on technical and financial challenges and consequences stemming from a varying load electrolyser profile (e.g. potential higher electricity costs and/or the need for hydrogen storage, thereby improving cost-efficiency).

Furthermore, this collaboration furthermore is expected to display the differences (and consequences) between the RES electricity input of the electrolysers in Spain (high RES PV and low wind potential) and Belgium (low RES PV and high wind potential), with the aim of reducing delays and facilitating the reduction of costs. The collaboration between ENGIE Electrabel and Ørsted is of a similar scope.

- The collaboration between EDP-A and EDP-LB with Uniper will cover the following components: assessment and development of blueprint on optimal reuse of existing power and water supply for the electrolyser; assessment and development of blueprints to reuse the existing brownfield installations of the current coal power plant; and, downstream supply of hydrogen with regard to quality, technology, regulation and transport options.

- P2X will collaborate with MassHylia to develop industry-wide safety standards for the operation of large electrolysers, for the purposes of obtaining regulatory permits and for the recovery and use of by-products (e.g. oxygen, low-grade heat). They moreover aim to create a certification chain at EEA level to ensure compliance of renewable hydrogen with the relevant standards.

- P2X will also collaborate with H2-Fifty and HyCC on the generation of zero-emission hydrogen for mobility and industry and the achievement of commercially sustainable prices for hydrogen.

- Repsol and Petronor will collaborate with Bondalti to propose possible safety, operational and commissioning standards at EEA level for the development and effective implementation of large electrolysers, as well as to develop a methodology for assessing the CO_2 footprint of chemicals that incorporate renewable and low-carbon hydrogen in the chemical/petrochemical industry.

(91) In TF 2:

- Borealis, VERBUND and Fertinagro will collaborate to develop a renewable and low-carbon ammonia market from an integrated value chain: from renewable electricity to renewable and low-carbon hydrogen for the production of ammonia and fertilisers. The benefit of this cooperation lies in the integration of renewable and low-carbon hydrogen into existing or new ammonia processes. Furthermore, the collaboration will seek to reach alignment on certification, standardisation and other regulatory topics, thereby aiming toward the creation of a European standard.

- The collaboration between Endesa and SIGHy aims at exchanging information, best practices an operational strategies on themes related to the management of hydrogen plants, RES flexibility in the context of renewable and low-carbon hydrogen projects, design and engineering of innovative integrated systems, as well as on the relevant engineering, technical, normative and regulatory aspects of renewable and low-carbon hydrogen projects to be deployed in hard-to-abate sectors.

- The collaboration of Borealis and Everfuel aims at integrating a large-scale electrolyser into industrial production processes and at valorising the by-products generated. Borealis will share its knowledge and experience in feeding oxygen to the industrial users, as well as in the use of CCU technologies in its ammonia plants, which can help Everfuel to significantly accelerate the deployment of a potential e-Fuel plant in the future. Everfuel on the other hand, will share its experience in feeding hot water into the greed, as well as in the design of the necessary integration concept.

- SardHy and TITAN will share best practices towards enabling renewable and low-carbon hydrogen use in industry. The undertakings will jointly pursue engineering studies and procurement related to industrial equipment for hydrogen generation. Their collaboration furthermore includes agreements related to the provision of renewable electricity for hydrogen generation and exchange of knowledge regarding products and services with low-carbon footprint.

- The collaboration between ENGIE BE and Solar Foods aims at developing technical and economic standards for the supply of hydrogen and oxygen, as well as for electrolyser performance, gas fermentation, bioconversion of CO_2, power to protein, industrial CCU and the use of industrial side-flows (CCU and oxygen) from local industry.

- The collaboration between VERBUND and HDAB aims at knowledge-sharing related to large-scale deployment of electrolysis for the generation of hydrogen. Further aspects covered in the collaboration are: hydrogen generation plant and process design, evaluation, procurement and performance of electrolysers, water handling (purification and/or recirculation), balancing of electrolyser operation with availability to renewable electricity and to electricity prices, offset of by-products such as oxygen and heat, safety methods and procedures relating to handling of large quantities of hydrogen, and certification issues.

2.4.3.2. Examples of collaborations inter TF

(92) Concerning the collaborations between TF 1 and TF 2 the following examples show the complementarity of the individual projects:

- Air Liquide CurtHyl, Air Liquide ELYgator, Air Liquide FR, HDAB, H2-Fifty, HyCC, Orlen, Ørsted, P2X, TiZir, Uniper, VERBUND, have entered into a Memorandum of Understanding for knowledge-sharing that is expected to cover the following thematic areas: hydrogen generation plant and process design; evaluation, procurement and performance of electrolysers; water handling (purification and/or recirculation); balancing of electrolyser operation with availability to renewable electricity and to electricity prices; offset of by-products such as oxygen and heat; safety methods and procedures relating to handling of large quantities of hydrogen; and certification for renewable and low-carbon hydrogen.

- MassHylia and Everfuel will exchange the results of their research activities on the flexible operation of large-scare storage systems (e.g. banks, materials, valves, system integration and compression). The benefits of this collaboration comprise value optimisation, safety enhancement and contribution to standardisation bodies, as regards pressure, safety standards, valving arrangement and control).

- NextChem will produce hydrogen from municipal waste, thereby complementing Orlen’s project for the establishment of production, transport and distribution capacities for zero/low-emission hydrogen for the mobility sector. The collaboration will envisage synergies and technical challenges related to the hydrogen generation via waste feedstock.

- The collaboration between P2X and Borealis concerns the latter’s expertise in the area of certification practices for electricity and renewable hydrogen, to the synfuels sector, where P2X has an established presence.

- Iberdrola and Borealis will deploy a large-scale electrolysis. Their collaboration will envisage electrolysis technology, integration in greater industrial systems and the balancing of volatile production and stable offtake needs.

- Orlen will supply renewable and low-carbon hydrogen, which will contribute to the development and deployment by RONA of a unique glass furnace and automatic line forming and processing stemware with zero-emissions. The collaboration will contribute to the creation of a circular and sustainable hydrogen value chain.

- The collaboration between ENGIE BE, TfL and Fluxys aims at connecting the network of ENGIE BE’s and TfL’s producers and customers to Fluxys’ hydrogen backbone.

- ENGIE Electrabel and Solar Foods will jointly explore technical and economic standards for hydrogen and oxygen supply and electrolyser performance, gas fermentation, bioconversion of CO_2 and conversion of energy to protein, industrial CCU and use of industrial side streams (CCU and oxygen) from local industry. ENGIE Electrabel will provide Solar Foods data and information regarding the available infrastructure, technical performance and available quantities, while Solar Foods will identify and define the technical and economic specifications.

- Petronor, Repsol and VERBUND will demonstrate the feasibility of deploying a renewable hydrogen project at a refinery site. The cooperation will include exchanges on technologies for producing synthetic fuels from CO_2 and renewable hydrogen, traceability procedures and certification methods for renewable hydrogen.

2.5. Positive spillover effects generated by Hy2Use

(93) The Member States submit that Hy2Use will generate important dissemination and spillover effects across the EU. This dissemination will be made possible through:

a. the dissemination and spillover of results that are not protected by intellectual property ("IP") rights (see section 2.5.1);

b. the dissemination and spillover of results that are protected by IP right (see section 2.5.2);

c. the dissemination and spillover of results during the FID (see section 2.5.3);

d. the dissemination and spillover of results to other indirect partners and to other sectors (see section 2.5.4); and

e. additional spillover effects generated by large-scale electrolyser projects in TF 1 (see section 2.5.5).

(94) The individual projects notified as part of Hy2Use detail that each participating undertaking commits to and will participate in activities enabling dissemination and spillover effects up until, and including, the final year of its individual project. A member of the FG will be designated as key contact for the implementation of the dissemination and spillover commitments.

2.5.1. *Dissemination and spillover of results that are not protected by IP rights*

2.5.1.1. Overview of the dissemination and spillover strategy of non-protected results

(95) The participating undertakings to Hy2Use commit to disseminate knowledge and the individual project results that are not protected by IP rights to the scientific community and the industry.

(96) The table below displays the mapping of the main dissemination actions of the non-protected IP rights of Hy2Use within the Union:

Event[17]	**Participating undertakings**	**Scope (examples)**
Conference/Meeting/Fair	EDP-A, EDP-LB, Everfuel, Fertinagro, HDAB, Ørsted, P2X, SIGHy, Solar Foods	• Summits and meetings with external experts • Public conference on project results • Exchange of information between all participants
Further Public Events	Air Liquide ELYgator, ENGIE Electrabel, ENGIE NL, HDAB, Iberdrola, NextChem, Ørsted, P2X, RONA, SIGHy	• Creation of a stakeholder's network • Online transparency and knowledge • Sharing platform • Webinars about the project • Training sessions
Kick-Off Event	ENGIE NL, HDAB, HyCC, Repsol	• Public relations ground-breaking ceremony • Product launch event • Opening event
Newsletters/Brochures	Air Liquide FR, EDP-A, EDP-LB, Endesa, H2-Fifty, HDAB, HyCC, Fertinagro, MassHylia, RONA, SardHy, Solar Foods	• Updates on the project evolution to the general public • Main deliverables and milestones

[17] If no location of an event is mentioned, the location is either changing each time, online or not (yet) defined, etc.

Open-Day/Site visits	Bondalti, ENGIE BE, ENGIE NL, Everfuel, Fertinagro, Fluxys, HDAB, H2-Fifty, Iberdrola, MassHylia, Ørsted, Petronor, P2X , Repsol, RINA-CSM, RONA, Solar Foods, TfL, TITAN, Uniper, VERBUND	• Open Days and events for different stakeholders • Prototype show • Visitor centre and guided tours • Invite local municipality, schools, undertakings and partners to road show
Press Release/Press Event	Air Liquide FR, Bondalti, EDP-A, EDP-LB, Endesa, ENGIE BE, ENGIE Electrabel, ENGIE NL, Everfuel, Fertinagro, Fluxys, H2-Fifty, HDAB, HyCC, Iberdrola, MassHylia, P2X, RINA-CSM, RONA, Repsol, SardHy, SIGHy, Solar Foods, TfL, TITAN, Uniper, VERBUND	• Technology development, demonstrator release, announcement of cooperation • Press conference • Yearly update on progress
Social Media	Air Liquide FR, Bondalti, EDP-A, EDP-LB, Endesa, Everfuel, HDAB, Fertinagro, Orlen, P2X, SardHy, Solar Foods, Uniper	• Direct communication instruments for reaching the general public, stakeholders and industry professionals, as well as increasing acceptance and stimulate interest of/for project scope • Info graphics
Website	Air Liquide FR, Bondalti, EDP-A, EDP-LB, Endesa, Everfuel, H2-Fifty, HDAB, HyCC, MassHylia, NextChem, RONA, SardHy, Solar Foods, Uniper	• Communication • Dissemination of scope, progress, technological solutions • Hydrogen-oriented magazines and websites
Workshop/Seminar/Summer School	Air Liquide CurtHyl, Air Liquide ELYgator, Air Liquide FR, EDP-A, EDP-LB, Endesa, ENGIE Electrabel, Everfuel, HDAB, Iberdrola, NextChem, Ørsted, Petronor, P2X, RINA-CSM, RONA, SardHy, SIGHy, Solar Foods, TITAN, Uniper, VERBUND	• Disseminate project results and discuss with stakeholders • Technical workshops for research organisations and academic community • Masterclass • Educational lectures • Networking events

Table 2: Matrix of dissemination and spillover strategy of non-IP protected results

(97) The table below details in a quantitative manner the main dissemination actions envisaged by the participating undertakings, as a result of the commitments made by the participating undertakings:

KPIs	Expected dissemination in the course of Hy2Use (estimates per year)	Difference with "business as usual" (estimates per year)[18]
Industrial/Scientific publications	130	+107

[18] The Member States have requested from the participating undertakings to submit estimates of the number of dissemination actions that they carry out ordinarily (i.e. 'business as usual') and to compare them with the envisaged number of dissemination actions that the participating undertakings expect to carry out as part of the individual projects notified in Hy2Use.

Participation in conferences (presentations, papers, exhibitor, etc.)	255	+177
Company internal events	131	+92
Organiser of external events	182	+110
Funding of PhD studies	46	+38
Funding of master thesis	109	+93
Financed university chairs	14	+10

Table 3: KPIs for dissemination and spillover knowledge

2.5.1.2. Participation in external events

(98) The participating undertakings commit to participate in conferences and public presentations within the EEA in the framework of international events listed in the table below, during which they will disseminate knowledge and the individual project results that are not protected by IP rights.

(99) These events cover a number of Member States including but not limited to the participating undertakings. They relate to a number of different sectors beyond the sector(s) where each participating undertaking operates. They are open to participants from all EEA States and ensure wide geographic coverage, beyond the participating undertakings.

Conference Title, Location[19]	Participating undertakings	Main topics addressed (examples)
Connecting Green Hydrogen Europe	EDP-A, EDP-LB, Fertinagro, Iberdrola, Petronor, Repsol, VERBUND	Expediting and accelerating the development of green hydrogen in Europe.
European Clean Hydrogen Alliance (ECH2A)	H2-Fifty, P2X, Solar Foods, Uniper	Focus on production, storage and consumption of energy, with carbon-free power generation, increased energy efficiency and the deep decarbonisation of transport, buildings and industry.
The European Hydrogen Conference (EHC)	Air Liquide CurtHyl, Air Liquide ELYgator, Air Liquide FR, RINA-CSM	Focus on the latest projects, hydrogen technologies and regulations.
European Steel Technology and Application Days (ESTAD)	HDAB, NextChem, RINA-CSM	• Ironmaking, steelmaking, rolling and forging • Steel materials and their application • Additive manufacturing and surface technologies • Industry 4.0 • Environment and energy.
European Fuel Cell Forum (EFCF) –Low-Temperature	SardHy SIGHy	• Science, engineering, materials, systems, applications and markets for all types of solid oxide fuel

[19] If no location of an event is mentioned, the location is either changing each time, is online or not (yet) defined, etc.

Electrolysers, Fuel Cells and H2 Processing		cells, solid oxide electrolysers and solid oxide electrochemical reactors • CO_2 emission reduction and reuse.
European Gas Tech: delivering on 2050 (Eurogas)	EDP-A, EDP-LB, Fertinagro	Focus on how innovative renewable and decarbonised gas technologies are contributing to the decarbonisation of Europe.
European Hydrogen Energy Conference (EHEC)	Air Liquide FR, HyCC, Iberdrola, NextChem, RINA-CSM SardHy, SIGHy, Solar Foods	• Updates on hydrogen energy technologies • Advances in R&D projects and products • Latest breakthroughs in research and business • Technologies in electrolysis and fuel cell science for strategic business collaborations to arise.
European Hydrogen Forum, Brussels, Belgium	MassHylia, NextChem, P2X, Solar Foods, Uniper	Latest developments on renewable and low-carbon hydrogen.
European Hydrogen Week	Petronor, P2X, Repsol	• Cover several aspects of the hydrogen economy • Discusses the latest developments at Union level in the hydrogen sector.
European Research and Innovation Days (EU Commission)	EDP-A, EDP-LB, Fertinagro	To debate and shape the future of research and innovation in Europe and beyond.
Fundación Repsol Conference Program	Petronor, Repsol	• To address the carbon footprint generated in various sectors • To study proposed solutions for improvement from a financial point of view by analysing their economic, legal, and ethical impact.
Gastech exhibition and conference	SardHy, SIGHy	• Solutions to the challenges faced on the journey to net-zero • New global products, solutions and technologies across the gas, liquefied natural gas, hydrogen and energy value chain • Industry topics, including changing gas demand dynamics, the impact of new technology, shifts in government policy.
Green Hydrogen Forum, Prague, Czech Republic	EDP-A, EDP-LB, Fertinagro	• Scale up of renewable and low-carbon hydrogen in the global energy transition • Mass industrialisation of renewable and low-carbon hydrogen • Transport infrastructure for renewable and low-carbon hydrogen.
Hannover Messe, Hannover, Germany	Endesa, Everfuel, Iberdrola, SardHy, SIGHy	• Energy and environment • Research and development

		• Industrial automation and IT • Production technologies • Industrial supply.
Hydrogen and Fuel Cells exhibition and conference	Air Liquide FR, SardHy, SIGHy	• Research on all aspects of hydrogen and fuel cells technologies and clean energy • Trends, practical challenges and solutions in the fields of hydrogen and fuel cells technologies and clean energy.
Hydrogen Europe conference and events	Ørsted, Petronor, Repsol	To propel global carbon neutrality by accelerating European hydrogen industry.
Hydrogen Europe flagship Event and Expo	H2-Fifty, Petronor, Repsol, Uniper, VERBUND	Emerging hydrogen-based solutions, trends and approaches in the global energy sector.
Hydrogen Technology Expo, Germany	HDAB, RINA-CSM	• Discussion of advanced technologies for the hydrogen and fuel cell industry • Focus on developing solutions and innovations for low-carbon hydrogen production, efficient storage and distribution, applications in a variety of stationary and mobile applications.
HyVolution, Paris, France	HyCC, MassHylia	• Business meetings and exchanges on every solution for all carbon-free hydrogen markets • Production, distribution, and storage hydrogen services.
International Conference on Electrolysis (ICE)	SardHy, SIGHy, Solar Foods	Focus on all aspects of electrolysis for energy conversion and storage.
International Conference on Hydrogen Production (ICH2P)	Air Liquide FR, Air Liquide ELYgator, Air Liquide CurtHyl, Endesa, SardHy, SIGHy	• Focus on developments of the sustainable generation of hydrogen via electrolysis, solar, wind, biological, catalytic and photo-catalytic based systems • Latest research on hydrogen utilisation in transportation, fuel cells, for GHG mitigation, and industry, and on hydrogen storage (chemical carriers, hydrides, gas, and liquefaction).
International Conference on Hydrogen Safety	HyCC, MassHylia	Bring together leading academic scientists, researchers and research scholars to exchange research results on all aspects of hydrogen safety.
International Refining and Petrochemical Conference (IRPC)	ENGIE BE, NextChem	To share knowledge and learn about best practices and the latest industry advances.

Solar Wind Congress, Spain	Petronor, Repsol	Development of renewable capacities, new projects and new actors on the market, permits, subsidies, legislative issues on additionality and time correlation of renewables.
World Hydrogen Congress (WHC)	Endesa, Everfuel, Fluxys, H2-Fifty, Petronor, Repsol, SardHy, SIGHy, Uniper	To accelerate the global commercialisation of clean hydrogen and to help connect the industry.
World Hydrogen Energy Conference (WHEC)	Air Liquide ELYgator, Air Liquide CurtHyl, Iberdrola, SardHy, SIGHy	• Focus on all aspects of hydrogen energy, such as hydrogen production, hydrogen storage, hydrogen separation and purification, hydrogen delivery, fuel cells, hydrogen economy • Policies, and regulations and commercialisation.
World Hydrogen Summit and Expo, Rotterdam, NL	EverfuelH2-Fifty, HyCC, MassHylia, Ørsted, Petronor, Repsol, Shell	• Various themes related to the advancement of the hydrogen industry.

Table 4: Events/conferences where at least two participating undertakings will participate

2.5.1.3. Dissemination and spillovers through the EEA collaborative R&D&I ecosystem

(100) The participating undertakings commit to disseminate the IP non-protected results acquired in the framework of Hy2Use to the scientific community. In particular, the participating undertakings will collaborate with the scientific community and with indirect partners (see recitals (135) to (139)).

(101) The participating undertakings will, in particular, finance and contribute to the creation or development of university chairs related to technologies developed under Hy2Use with a view to train future European scientists, experts, engineers, technicians and operators. The locations of the research technology organisations ("RTOs") go beyond the Member States, thus providing genuine spillover effects to e.g. Germany and Estonia.

(102) It is expected that the following indicative list of RTOs, will benefit from the dissemination of the results of Hy2Use:

Institution	Participating undertakings	Scope of the Funding/Collaboration[20]	Member State
COMET Center Hy-CentA / TU, Graz	VERBUND	Focus on main hydrogen technologies like electrolysis, storage, fuel cells, sector integration of hydrogen.	Austria
CSIC	TfL	Developing structural research programmes on several topics,	Spain

[20] As general overview/examples presented. Individual projects include a detailed description for each participating undertaking.

		such as the optimisation and control of mineral oxy-combustion calcination.	
Danish Technological University (DTU)	Everfuel	Focus on academia and a number of technological fields of expertise, e.g. compression technology advancement and related topics herein.	Denmark
DBI (fire and security technology)	Everfuel	Focus on fire and security aspects in general, including the field of hydrogen and PtX. Creating best-practice security and safety systems as well as relevant procedures.	Denmark
European Cement Research Academy (ECRA)	TITAN	Development of industrial practices for hydrogen injection in cement kilns.	Germany
Aragon Hydrogen Foundation	EDP-A, EDP-LB. Endesa, Fertinagro, Iberdrola, Petronor, Repsol	The development of new hydrogen technologies integrated with renewable energies and the promotion of Aragon´s involvement in economic activities relating to the use of hydrogen as an energy vector.	Spain
Aalto University	P2X	Research cooperation, site visits, guest lectures and traineeships.	Finland
Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA)	NextChem	Materials for hydrogen transport, handling and storage.	Italy
Association for Research and Industrial Cooperation of Andalucia (AICIA)	EDP-A, EDP-LB	To promote, guide and develop industrial research with the basic objective of favouring society and industry both at Andalusian and international levels.	Spain
Catalonia Energy Rese-arch Institute (IREC)	Petronor, Repsol	Development of renewable and low-carbon hydrogen technologies.	Spain
Chalmers University of Technology's Mistra Electricity Transition Program	HDAB	Technoeconomic energy systems modelling under different scenarios to evaluate sector integration and flexibility for integration of variable renewable electricity.	Spain
Centre for Functional and Surface Functionalized Glass (TNUAD-FUNGLASS, University of Trenčín	RONA	Focus on glass research and other technological specific activities.	Slovakia
Centro Nacional del Hidrógeno (CNH2)	Iberdrola, Petronor Repsol	Focus on the industrialisation of the hydrogen production process and study of connection to the European Hydrogen Backbone.	Spain
CIC ENERGIGUNE	Petronor	Supporting program for PhD studies in the hydrogen sector.	Spain
Ecole Centrale de Marseille	MassHylia	Life-cycle analysis on hydrogen production and safety simulations.	France
Ecole des hautes études commerciales Paris (EHC	MassHylia	Project, innovation and conception in hydrogen sector	France

Paris)			
Ecole des Mines de Paris	MassHylia	Life-cycle analysis on hydrogen production and safety simulations.	France
Ecole Polytechnique Paris	MassHylia	Project, innovation and conception in hydrogen sector.	France
EOI, Industrial Organization School	Repsol	Sponsor Hydrogen Renewable Executive Programme EOI-Repsol.	Spain
Faculty of Industrial Technologies (TNUAD - FPT), University of Trenčín	RONA	Creation of material models of burners. Design and implement the experimental tests, modelling the effect of a decrease in the mechanical properties of the material from the degree of hydrogenation and degradation due to high-temperature loading.	Slovakia
Global Cement and Concrete Association (GCCA)	TITAN	Enabling cement decarbonisation with renewable and low-carbon hydrogen. The advancement on the green hydrogen application on the cement global market.	Greece
Helsinki University	Solar Foods	A lifecycle analysis will be performed on the demonstrated process during the R&D stage of the IPCEI project. This will set a new industrial standard for food production transparency and environmental performance.	Finland
HyLAB - Green Hydrogen Collaborative Laboratory	Bondalti, EDP-A, EDP-LB, Fertinagro	Production, transport, storage; end-uses - focus on the promotion of partnerships and new business models within the scope of the hydrogen economy.	Portugal
IDONIAL	EDP-A, EDP-LB, Fertinagro	Focus on the development of materials, advanced manufacturing and the digital industry through technological development and innovation.	Spain
IMDEA, Madrid Institutes of Advanced Studies	Petronor, Repsol	Focus on development of renewable and low –carbon hydrogen technologies.	Spain
Institute of Power Engineering (IEN)	Orlen	Technical cooperation on electrolysis technology.	Poland
Institute of Science and Innovation in Mechanical and Industrial Engineering (INEGI)	Bondalti	Training programmes provided by INEGI to other undertakings regarding decarbonisation, circular economy, renewable hydrogen, etc.)	Portugal
Institute for Sustainable Process Technology (ISPT)	HyCC, Ørsted	The upscaling of electrolysis manufacturing, hydrogen safety and hydrogen plant design.	The Netherlands
Instituto de Catálisis y Petroleoquímica del CSIC	Petronor, Repsol	Collaboration regarding development of renewable and low-carbon hydrogen technologies	Spain
International Iberian Nanotechnology Laboratory	EDP-A, EDP-LB, Fertinagro	Precise Personalized Health Tech, Clean Energy, Sustainable Environment, Smart Digital	Spain

(INL)		Nanosystems, and Advanced Materials and Computing.	
Lappeenranta University of Technology (LUT)	P2X, Solar Foods	Performance of a technical validation and assessment of global operational opportunities and impact of the Solar Foods solution.	Finland
Luleå University of Technology's (LTU) Competence centre for hydrogen use in industrial processes (CH2ESS)	HDAB	The characteristics of iron ore pellets for DR and on the DR process and system level issues connected to the production, distribution and storage of hydrogen in the context of large-scale use.	Sweden
Lund University's program within Environmental and Energy Systems Studies	HDAB	Hydrogen DR considerations.	Sweden
Multisectoral Research Technology Center (CETIM)	Petronor, Repsol	Collaboration on development of renewable hydrogen technologies.	Spain
National Center for Scientific Research "Demo-kritos"	TITAN	Industrial use of hydrogen for cement, lime and minerals sectors.	Greece
National Laboratory of Energy and Geology (LNEG)	EDP-A, EDP-LB, Fertinagro	Development of geoscientific knowledge of the territory, the continental shelf and deep-water zones.	Portugal
National Technical University of Athens	TITAN	Industrial use of hydrogen for cement, lime and minerals sectors.	Greece
Netherlands Organisation for applied scientific research (TNO)	HyCC Ørsted	The upscaling of electrolysis manufacturing, hydrogen safety and hydrogen plant design.	The Netherlands
Politecnico Bovisa University (Milan)	SardHy	Exchange and discussion relevant to the use of renewable and low-carbon hydrogen as electrochemical storage.	Italy
Politecnico di Milano	RONA	The accessibility of hydrogen infrastructure will boost other industries.	Italy
Polytechnic University of Valencia (PUV)	EDP-A, EDP-LB, Fertinagro	Related to the positive impact of sustainable ammonia for a more sustainable agriculture, hydrogen demos and training.	Spain
Portuguese association of chemical industry (APQuimica)	Bondalti	Development of the Portuguese chemical industry.	Portugal
Rotterdam University of Applied sciences	H2-Fifty	Focus on hydrogen production and usage technologies. Research and development and host students on key technology topics and know-how on hydrogen generation and usage technology.	The Netherlands
Rijksunversiteit Groningen	HyCC	Electrolyser fundamentals	The Netherlands
Rovira i Virgili University, Tarragona	Repsol	Inter-university Master in Hydrogen Technologies	Spain

Sapienza University of Rome	NextChem, SardHy, SIGHy	Co-funding for two PhD studies focusing on: • Green Hydrogen production and electrolysis processes; • Green Hydrogen Storage and logistics.	Italy
Tallinn University of Technology	P2X	Creation of hydrogen-related know-how in the Baltic Sea area by training future talents on hydrogen and PtX.	Estonia
TECNALIA	EDP-A, EDP-LB, Fertinagro, Iberdrola, Petronor, Repsol	Advanced manufacturing, digital transformation, energy transition, sustainable mobility, health and the urban ecosystem.	Spain
Technical University Delft	HyCC, H2-Fifty	Electrolyser fundamentals	The Netherlands
Technical University Eindhoven	HyCC, H2-Fifty	Electrolyser fundamentals	The Netherlands
Technology Research Institute COMILLAS	Iberdrola	To obtain the maximum profit managing parameters like RES, grid, hydrogen production facility, hydrogen storage system and customer needs.	Spain
TEKNIKER	Petronor	Optimisation of electrolyser components (mainly mem-branes) and testing new modules. Collaboration with electrolyser manufacturers to optimize manufacturing and installation of electrolyser components.	Spain
The Royal Institute of Technology's (KTH) KC-H2 centre	HDAB	Electrolyser process. Development catalysts with high activity and stability. Optimising membrane electrode assemblies with improved catalyst utilisation, low internal resistance and satisfactory transport properties of gases, water and ions.	Sweden
Universidad de Alicante	Repsol	Collaborating for the development of renewable hydrogen technologies.	Spain
Université de Mons	ENGIE BE, TfL	Developing structural research programmes, e.g. the gas cleaning technologies to reach the specifications of CCU.	Belgium
University of Amsterdam	HyCC	Socio-economic aspects of energy transition.	The Netherlands
University of Cagliari	SardHy	Organising seminars, meetings, workshops and internships.	Italy
University of Cádiz	EDP-A, EDP-LB	General Directorate of R&D&I Campus in Algeciras Bay.	Spain
University of Catania	SIGHy, SardHy	Contacts are ongoing for the joint establishment of hydrogen related studies.	Italy
University of Huelva	EDP-A, EDP-LB, Fertinagro	Dissemination conferences related to the positive impact of sustainable ammonia and hydrogen on the whole food system and human wellbeing.	Spain

University of Mondragon	Petronor, Repsol	Promotion of the hydrogen academic programmes. Electrochemical and materials, purifications storage and compression, power electronics and control.	Spain
University of Oviedo, ES. Laboratory for Electrical Energy Management Unified Research (LEMUR)	EDP-A, EDP-LB	Multidisciplinary research team incorporating a holistic view on complex research projects.	Spain
University of Porto, Faculty of Engineering	Bondalti	Focus on key technological areas, namely electrolyser studies for optimised operation.	Portugal
University of Seville (Andalusia, Spain). Higher Technical School of Engineering (ETSI).	EDP-A, EDP-LB	Studying, teaching and researching in the field of engineering.	Spain
University of the Basque Country	Petronor, Repsol	Promotion of the hydrogen academic programmes. Electrochemical and materials, purifications storage and compression, power electronics and control.	Spain
University of Twente	HyCC	Electrolyser fundamentals.	The Netherlands
University of Zaragoza	EDPR, Fertinagro, Repsol	Dissemination conferences related to the positive impact of sustainable ammonia and hydrogen on industry, economy and society.	Spain
Utrecht University	H2-Fifty	Learnings on the integration of renewable and low-carbon hydrogen into industrial clusters.	The Netherlands
Warsaw University of Technology	Orlen	Technical cooperation on electrolysis technology.	Poland

Table 5: Non-exhaustive network of RTOs, benefitting from spillover effects with participating undertakings

2.5.1.4. Dissemination and spillovers through the participation of participating undertakings in clusters and other initiatives

(103) The non-IP protected results of Hy2Use will also be disseminated through the clusters and other initiatives in which the participating undertakings are members. These include for instance, alliances, (non-profit) professional associations, industry-oriented platforms expert commissions and research consortia.

(104) Table 6 illustrates the clusters represented in Hy2Use and the participating undertakings involved. All the clusters are described by each participating undertaking in its respective individual project.

Hydrogen Cluster and Description	Participating undertakings
AeH2 – Spanish Hydrogen Association	EDP-A, EDP-LB, Fertinagro, Petronor, Repsol

AELEC – Spanish electricity industry association	EDP-A, EDP-LB, Fertinagro
Andalucia's Hydrogen Association	EDP -LB
ASIAN - Andalucia's Hydrogen Table	EDP- LB
Ammonia Energy Association	Horisont Energi AS
A.SPIRE	Petronor, Repsol, TfL
Asturias H2 Regional Table	EDP-A
Basque Energy Cluster Hydrogen Sector Forum	Petronor
Basque Hydrogen Corridor (BH2C)	Petronor
BotH2nia	P2X
CO2 Value Europe	ENGIE BE, ENGIE NL, TfL
Confindustria	NextChem, SardHy, SIGHy
EFET – Working Group Renewable Gas	Fertinagro, EDP-LB, EDP-A
E-fuels Alliance	Petronor, Repsol
Eurelectric – Working group Power and Gas Interactions	EDP-A, EDP-LB, Fertinagro
European Clean Hydrogen Alliance	EDP-A, Everfuel, MassHylia, NextChem, P2X, Petronor, Repsol, RONA, SardHy, SIGHy, Solar Foods, TITAN, Uniper, VERBUND
FEIQUE – SUS-CHEM BUSINESS FEREDATION OF THE SPANISH CHEMICAL INDUSTRY	Petronor, Repsol
Hydrogen Europe	ENGIE BE, ENGIE Electrabel, ENGIE NL, Everfuel, Fluxys, Petronor, Repsol, Uniper, VERBUND
Hydrogen Valley Catalonia	Petronor, Repsol
Hydrogen Valley Murcia	Petronor, Repsol
H2 IT	NextChem, SIGHy
H2 Platform	Air Liquide ELYgator, Air Liquide CurtHyl, Uniper
Renewable Hydrogen Coalition	EDP-A, EDP-LB, Fertinagro
Rotterdam conversion park cluster	H2-Fifty, Shell
Smart Delta Resources (SDR)	Air Liquide ELYgator, Ørsted
SolarPower Europe – WG Hydrogen	EDP-A, EDP-LB, Fertinagro
Spanish Association of the Renewable Ammonia	EDP-A, EDP-LB, Fertinagro
WaterstofNet (the Netherlands, Belgium)	ENGIE BE, ENGIE Electrabel, Everfuel, Fluxys, Uniper
WindEurope – WG Hydrogen	EDP-A, EDP-LB, Fertinagro

Table 6: Representation of clusters in Hy2Use

2.5.1.5. Dissemination and spillovers through publications in scientific journals

(105) The participating undertakings will, over the course of Hy2Use, disseminate their research results in various scientific peer reviewed journals either Europe-wide and/or globally. The following table displays some indicative examples:

Journal Title	Scope of Journal
Applied Energy	The journal provides information on innovation, research, development and demonstration in the areas of energy conversion and conservation, the optimal use of energy resources, analysis and optimisation of energy processes, mitigation of environmental pollutants, and sustainable energy systems.
Applied Microbiology and Biotechnology	Microbiology and Biotechnology.
Biochemical Engineering Journal	Chemical engineering aspects of the development of biological processes associated with every-thing from raw materials preparation to product recovery relevant to various industries.
Cement and Concrete Research	Research on the materials science and engineering of cement, cement composites, mortars, concrete and other allied materials that incorporate cement or other mineral binders.
Ceramics International Ceramics-Silikaty	Glass Community Journal.
Chemical Engineering Science	Chemicals, minerals, energy and fuels, water, environment, sustainability, food, medicine including pharmaceuticals, and other areas to which chemical engineering applies.
Chemical Papers	Glass Community Journal.
Climate Policy Journal	All aspects of climate policy, including mitigation and adaptation.
Energy and Environmental Science	An international journal tackling the key global and societal challenges relating to energy conversion and storage, alternative fuel technologies and environmental science.
Food and Bioproducts Pro-cessing	Chemical Engineering, Food Science. Biochemistry; Biotechnology.
Glass Science and Technology A	Glass community journal.
Glass Technology: Glass Science and Technology B	Glass community journal.
International Journal of Hydrogen Energy	Exchange and dissemination of new ideas, technology developments and research results in the field of hydrogen, including production, storage, transmission, utilisation, enabling technologies, environmental impact, economic and international aspects of hydrogen and hydrogen carriers.
International Journal of Applied Ceramic Technology	Glass community journal covering applied research and development work focused on commercialisation of engineered ceramics, products and processes.
International Journal of Applied Glass Science	Glass community journal, which reports glass science and engineering research aimed at meeting the challenges of using glass in consumer, commercial and industrial applications.
Iron and Steelmaking	Dissemination of information of technology and plant providers' activities on iron and steel products, processes and plants.
Joule	Laboratory research into energy conversion and storage up to impactful analysis at global level.
Journal "Sklar a Keramik"	Glass community journal.
Journal of Cleaner Production	Transdisciplinary research on cleaner production.
Journal of Non-Crystalline Solids	Glass community journal with focus on the chemical, electronic, optical and mechanical properties of glasses, amorphous semiconductors and metals, sol-gel materials, the liquid state of these solids and the processes.
Journal of Power sources	This journal covers all aspects of the science, technology and application of sources of electrochemical power.

Journal of Thermal Analysis and Calorimetry	Glass community journal covering all aspects of thermal analysis, calorimetry, thermodynamics, heat and energy.
Metallurgical and Materials Transactions B	Archival, peer-reviewed, bi-monthly publication that is uniquely focused on the processing science and engineering of metals and materials.
Microbial Cell Factories	Microbial cells as producers of recombinant proteins and natural products, or as catalysers of biological transformations of industrial interest.
Nature Communications	Multidisciplinary: biological, health, physical, chemical and Earth sciences.
Renewable Energy	Renewable energy systems and components.
Science of The Total Environment	The total environment, which interfaces the atmosphere, lithosphere, hydrosphere, biosphere and anthroposphere.
Solar Energy	Science and Technology of Solar Energy solutions and applications.
The International Journal of Life-Cycle Assessment	Life-cycle assessment, ecological burdens and impacts connected with products and systems, or, more generally, with human activities.
The Journal of Physical Chemistry C	Glass community journal.
Vibrational Spectroscopy	Glass community journal which focuses on vibrational spectroscopy and deals with developments in applications, theory, techniques and instrumentation.

Table 7: Representation of scientific journals in Hy2Use

2.5.1.6. Dissemination and spillovers through training events

(106) The participating undertakings have committed to organise educational academic dissemination through dedicated training of professionals and researchers. The envisaged activities follow up on the development of the different hydrogen technologies under Hy2Use and aim to strengthen the skills of those involved and maintain competitiveness in the hydrogen market. The training activities will cover a broad range of formats, such as regular series of lectures, technical trainings, virtual reality programmes, hydrogen academies, remote online modules/e-learning platforms, exchange programmes and internships and will cover various issues, such as: safe hydrogen with a focus on safety and regulatory permits energy efficiency, use of hydrogen in cement industry, hydrogen steelmaking, hydrogen in glass melting and forming, safety designs, health and environmental benefits of using renewable hydrogen in microbial proteins, evolution of gas and electricity markets, etc. Each of the training activities that a participating undertaking has committed to provide is set out in more detail in its respective individual project.

2.5.2. Dissemination and spillover of knowledge that is protected by IP rights

(107) The participating undertakings have committed to disseminate of the IP-protected results achieved through their individual projects under Hy2Use. This dissemination will be carried out in different ways. As a matter of principle however, all participating undertakings will disseminate the IP-protected results of their individual projects under Hy2Use on fair, reasonable, and non-discriminatory terms ("FRAND").

(108) Indicatively, some concrete examples are presented in the following:

(109) Endesa commits to establish licenses or other agreement schemes in the following main lines of research: DC-DC connection between solar plant and electrolyser, replacement of natural gas in furnaces and steam boilers,

introduction of renewable and hydrogen in spray drying systems and design of hydrogen burners and dual combustion.

(110) ENGIE NL will carry out test programs and trials at larger-scale to assess the feasibility of co-firing hydrogen in existing combined cycle power plants. ENGIE NL will share the test results in working groups and technical forums, and once a viable business case is in place, non-confidential information of the results will be shared within the industry via relevant online and live events.

(111) Everfuel commits to establish FRAND licensing conditions for the generation of IP rights concerning methods and equipment for integrating heated cooling water from the electrolyser operation into the local district heating system, and equipment solutions and configuration to enable electrical grid balancing.

(112) Fertinagro states that the technology developed within its project is expected to have an impact on the definition of standards related to ammonia production based on renewable energies. It therefore commits to promote this technology and to identify potential licensees in the fertiliser sector that use renewable ammonia from RES as a basis for the production of fertilisers.

(113) HDAB has a strategy to license the results of the hydrogen DR project to facilitate the Nordic steel industry transition. Licencing to third parties is expected to occur either through independent licensing agreements or through strategic commercial partnerships with technology providers.

(114) Nextchem's main research activities that have been identified for potential exploitation include: innovative integration processes (e.g. gasification, production and purification of hydrogen syngas and production of ethanol using syngas). The results and technology will be granted through licenses or patents on FRAND terms to facilitate use in different sectors.

(115) TfL is expected to promote the results of the technology developed within the project towards the relevant regulatory bodies. The undertaking also commits to promote the technology and to identify potential licensees for the technology in the lime sector.

(116) RINA-CSM commits to create patents that can be offered to interested parties on an non-exclusive basis and on FRAND terms in the following areas: hydrogen technologies including electrolytic cells, pipes, hybrid (hydrogen natural gas) and special tank storage steelmaking feeding system; processes for producing DR of iron; hydrogen burners for DR of iron, EAF and process integration (heat treatment furnaces) and related technologies; optimised product process control and furnace refractory materials for EAF/submerged arc furnace processes; and, gas water control treatment related technologies.

(117) RONA expects that several R&D&I results will be protected by patents or licenses registered by the main partners responsible for the activities, namely refractory material formula, glass melting technology process, design of hydrogen burner for glass melting and for glass forming. Third parties will have access to these results on the basis of separate licensing agreement to be concluded on FRAND terms.

(118) Solar Foods commits to license the system technology rights concerning to the protein production process, food processing and biological fermentation to food manufacturers.

(119) VERBUND will produce IP-protected results in the form of a customised optimisation tool to ultimately minimise hydrogen generation costs by taking into account the electricity market data, potential revenue streams gained by grid balancing as well as the demand profiles of industrial processes. By utilising this tool VERBUND commits to provide services non-exclusively and on FRAND terms for optimising similar electrolyser projects beyond the ammonia sector.

2.5.3. Dissemination and spillover effects in FID

(120) The participating undertakings that will carry out FID activities will use several ways for disseminating results generated during that phase. The Member States have provided information showing that the FID activities will lead to spillover effects in downstream markets among the participating undertakings but also beyond them, involving indirect partners and the society in general. A close collaboration with RTOs and SMEs is inevitable to scale-up technologies from laboratory to industrial scale. Moreover, providing access to pilot lines for, among others, testing and validation of products and services to a wide range of industrial entities is necessary to spread the results during FID. Standardisation activities will also serve as means to support the exploitation and dissemination strategies.

(121) Some examples are provided in the following.

(122) Endesa's results during FID concern the development of technologies related to the combustion of hydrogen, as well as a wider application of the know-how deriving from the aforementioned technological development. Endesa commits to disseminated these results by various communication and dissemination activities (e.g. publications, conferences and social media), as well as standardisation activities (e.g. participation in standardisation committee to improve technical regulation with a focus on electrolysis safety standards).

(123) ENGIE BE will develop a small-scale mobile unit that would be deployable at potential sites with varying levels of CO_2 purity and types of contaminants in the gases. This will enable ENGIE BE to evaluate the replicability of its project and processes in other geographical locations, not only in the lime sector, but also in other sectors that seek similar solutions. As a result, the operational return of this project is expected to test future sites, beyond those covered by the project itself, on both technical and financial feasibility.

(124) In the course of FID, Everfuel will open its facility to external, non-partner organisations, thereby enabling third parties to acquire practical, hands-on knowledge gained through Hy2Use. Other activities encompass the organisation of workshops and seminars related to specific expertise, as well as other knowledge-sharing activities.

(125) Fertinagro commits to grant access to the plant and/or to non-confidential data or information, to other parties with the purposes of disseminating the use of renewable hydrogen in the production of ammonia. The knowledge dissemination activities are expected to benefit primarily SMEs and RTOs along

the hydrogen supply chain. These partners will receive early access to the latest engineering methods and innovative testing equipment, thereby enabling them to shorten the development cycles and release novel technologies and products on the market.

(126) HDAB's project will develop a new technology for future steelmaking, contributing to the reduction of the global CO_2 emissions. HDAB will also have extensive research collaborations during the FID phase to support relevant academic programs. An ambitious knowledge-sharing plan will support the global transition to hydrogen steelmaking, which will feature a master's level engineering course in hydrogen-based steelmaking.

(127) NextChem will facilitate the sharing of results and data with all the potential stakeholders that could be interested in its technologies by, for instance, providing academic reviews and participating in conferences and public events, by providing access to manufacturing facilities against a market fee, by disseminating timely information on the results of the testing phase, and by putting in place a form of one-stop-shop access to the manufacturing facilities which could stimulate the diffusion of the innovation developed in the project.

(128) In the course of FID, RINA-CSM will promote an open approach, granting access to the plants both virtually and physically and promote thereby the dissemination of its project's results through specific exploitation agreements (e.g. with SMEs, start-ups and RTOs). The virtual meetings will allow visitors to explore a high-level digital reconstruction of the physical plant via the use of virtual and augmented reality, which will provide information and documentation linked to the plant's main components.

(129) FID-related spillovers for RONA's project will comprise the sharing of the knowledge on planning, engineering, construction, and commissioning, as well as operation of the hydrogen-based technology within the domestic glass manufacturing process. Many novel methodologies, installations and processes will be deployed at industrial scale for the first time (e.g. know-how on glass melting and forming with the use of hydrogen). The knowledge gained during the FID will be shared through specific communication and dissemination activities targeted at industrial, academic, or public sector actors.

(130) SardHy's results in the FID not only concern the refinery sector but also include a wider set of benefits with application of knowledge deriving from refinery implementation (e.g. connection of electrolysers to renewable sources and grid balancing, management of the different hydrogen sources into the refinery, continuous monitoring of the performances of the electrolysers and optimisation). SardHy will disseminate the know-how generated by the project and with reference to the integration of hydrogen in hard-to-abate sectors, by generating publications and participating in international conferences and workshops.

(131) In the course of FID, SIGHy is expected to test the hydrogen production system and validate all related installations (e.g. grid management system, electrolyser, compression units, etc.). SIGHy commits to disseminate the results of these activities, through publications and participation in conferences, to all interested shareholders.

(132) Solar Foods will engage with universities, industry associations and local hydrogen clusters to support the dialogue on standardisation of regulation and guideline with priority to safety, renewable and low-carbon hydrogen classification and transparency, and CCU standardisation and transparency. Solar Foods will furthermore assess the regulations with respect to interplay of different standards in a novel food value chain with different technology subsystems (i.e. renewable and low-carbon hydrogen, natural bio-fermentation, CCU and food manufacturing).

(133) Know-how generated within TITAN's project is expected to contribute to improvements in technical and commercial standardisations and regulations, including safety operational procedures and standards, by sharing best practices and industrial experience, as well as by acting as a precursor in its project technology.

(134) VERBUND's project will open the way for the deployment of large-scale electrolysis applications and their integration in complex industrial processes. The planned dissemination activities during the FID phase include: open plant visits and information exchanges, especially for, but not limited to, SMEs, RTOs and start-ups; publication of results and findings, particularly from the demo-operation phase; certification of renewable and low-carbon hydrogen and qualification of electrolysis for advanced grid services and provision of services on FRAND terms on optimising similar electrolyser projects on other sectors.

2.5.4. Dissemination and spillover effects to other indirect partners and to other sectors

(135) The participating undertakings have committed to disseminate knowledge and results arising from their individual projects with other undertakings, organisations and sectors outside Hy2Use, through the participating undertakings' participation in numerous collaborations with over 160 indirect partners, as shown in table 5 under recital (102) and further supplemented below in recitals (138) and (139).

(136) The indirect partners are undertakings or organisations that have not submitted an individual project within Hy2Use. Nevertheless they hold collaboration agreements with one or more participating undertakings of Hy2Use and they can therefore benefit from the various dissemination activities (e.g. wider infrastructure access, knowledge dissemination of R&D&I and FID results or open access to laboratory facilities, etc.).

(137) The participating undertakings commit to collaborate with several undertakings and RTOs (see table 5) from the same or different Member State inside or outside Hy2Use.

(138) In TF 1, the participating undertakings will collaborate with 95 indirect partners. The Commission refers to the following collaborations as examples: Fluxys (Belgium) will collaborate with Gasunie (the Netherlands) to connect the Belgian and Dutch hydrogen networks at the North Sea Port in the wider framework of the European hydrogen backbone plan; Iberdrola (Spain) will collaborate with LOTOS Asfalt (Poland) to develop industry wide safety standards for large scale electrolysis, as well as on the utilisation of electrolysis sub-products in the industry; ENGIE NL will collaborate with the Technical

University Delft (the Netherlands) to study and assess the impact of electrolysis flexibility on technical performance of the equipment during testing and operational phase, as well as to optimize and standardise performance testing procedures; P2X (Finland) will collaborate with 1s1 Energy Portugal (Portugal) for the validation of a PEM water electrolysis module in a renewable hydrogen production and distribution operating environment.

(139) In TF 2, the participating undertakings will collaborate with 67 indirect partners. For example, VERBUND (Austria) will collaborate with Siemens Energy (Germany) to jointly solve concerns regarding the concrete design of the electrolyser engineering process; RONA (Slovakia) will collaborate with Politecnico di Milano (Italy) to develop standards for the safety of operation of hydrogen technologies in glass industry and define the set of safety principles, rules and standards to be accepted for the processes of melting and forming using hydrogen; NextChem (Italy) will collaborate with ENEA (Italy) to develop a technical study and evaluate the feasibility of increasing the biomass content of the feedstock; Solar Foods (Finland) will collaborate with Helsinki University (Finland) to study, model and estimate the ecological and socioeconomic impacts of the protein production, and compare them with alternative plant- and animal-based protein sources.

(140) Furthermore, Hy2Use will generate spillover effects to other industrial sectors. Hydrogen is expected to be widely and urgently needed by many industries, which are currently highly dependent on energy and materials based on fossil sources. Thus, the impact of developing hydrogen technologies and related infrastructure will be significant, allowing to increase energy efficiency and accelerate decarbonisation processes.

(141) For TF 1, the renewable and low-carbon hydrogen generated by the planned hydrogen generation projects (e.g. the construction of large electrolysers), is expected to be absorbed by off-takers in multiple downstream industrial sectors. For example:

- The generation of renewable hydrogen through the large-scale electrolyser projects in the regions of Spain (i.e. EDP-A, EDP-LB, Iberdrola, Petronor and Repsol), France (i.e. MassHylia) and Belgium/the Netherland (e.g. Fluxys and HyCC) will serve, amongst others, the cement and steel industry sectors;

- The generation of renewable hydrogen for the production of synthetic methane within the project of P2X is expected to contribute to the decarbonisation of the relevant industry and can furthermore be used to store renewable energy and balance the electricity grid, thereby leading to lower electricity prices in other industrial sectors;

- Orlen expects that the development of renewable hydrogen production in the electricity sector will lead to larger integration of renewables into the electricity systems, thereby resulting to a direct reduction of CO_2 emissions due to the reduction of direct natural gas consumption; and

- Ørsted, in particular, plans to contribute, to a sustainable food value chain through the production of sustainable ammonia with renewable hydrogen. The renewable ammonia is used to produce fertilisers which are ultimately used to grow crops and food. Furthermore, the ammonia ultimately resulting from Ørsted's project can constitute a valuable early phase development to initiate the use of ammonia for shipping. As the project is located in close proximity to important commercial ports, e.g. Rotterdam and Antwerp, a knowledge exchange can be expected between the various stakeholders, regarding product quality as well as safety and security standards.

(142) For TF 2, in addition to the direct impact that the individual projects are expected to have on the hard-to-abate sectors concerned by each project separately, they aim at bringing benefits to many other up- and downstream industrial sectors in the EEA. For example: decarbonisation and replacement of fossil resources (e.g. coal and natural gas) in the mobility sector (e.g. Everfuel and NextChem); and, integration of electrolysers into district heating systems and as dispatchable load into electric transmission systems (e.g. Everfuel).

(143) The food industry and the (bio) material technologies are also expected to benefit from the generation of renewable and low-carbon hydrogen. Solar Foods' project to produce protein for human consumption is expected to generate the following spillover effects to other sectors: additional (sustainable and nutritious protein) ingredient and protein source for the emerging plant-based food sectors; enabling the emergence of sustainable smart cities or megacities with localised food production; medical applications, production of growth factors, hormones, vitamins and nutrients; potential for future use of the protein in space or in extreme conditions; and, reduction of reliance on pesticides and antimicrobials, reduction of excessive fertilisation, expansion of organic farming, improvement of animal welfare and biodiversity.

2.5.5. Additional spillover effects generated by large-scale electrolysers projects in TF 1

(144) The Member States submit that the participating undertakings in TF 1, in addition to contributing to other dissemination and spillover effects described in sections 2.5.1 and 2.5.4, in particular related to sharing new knowledge and experience with large-scale deployment of electrolysers obtained during the implementation of TF 1, will also generate other positive spillover effects that are specific to the scope of these projects.

(145) Those additional spillover effects derive from the fact that hydrogen can serve as a stabilising reserve by storing surplus electricity from intermittent RES and feeding it back into the grid in peak hours. This has the dual benefit of avoiding especially renewable power curtailment and thereby increasing overall grid efficiency while substituting baseload capacities from fossil fuels hence reducing GHG emissions. Therefore, as a vector for storing renewable energy, hydrogen can bridge between demand and supply centres contributing to better balancing the electricity system.

(146) In particular, electrolyser capacities developed within TF 1 will enable the valorisation of excess wind and solar electricity, e.g. from large-scale off-shore wind parks in the North Sea and in the Baltic Sea, or large-scale solar installations in Southern Europe. According to the Member States, this constitutes a specific spillover effect generated by these projects and benefits the electricity sector in the context of an increased participation of RES.

(147) Indicatively, some concrete examples are presented in the following.

(148) By consuming offshore wind in peak periods as a considerable share of their power needs, the installed electrolysers in the North Sea Regions of Belgium and the Netherlands will enable systemic integration of RES and contribute to avoiding over congestion of the electricity supply grid and with this a curtailment (i.e. the deliberate reduction in electricity output in order to balance energy supply and demand or due to transmission constraints in the electricity sector) of RES. The electrolysers will also enable flexible production of hydrogen and virtual storage of renewable energy. Thanks to these major investments in large-scale and flexible electrolysers, expansive upgrades of the power transmission grid, that would be needed to accommodate peak production from intermittent RES, can be avoided.

(149) In particular, ENGIE Electrabel aims at designing, building and operating a large-scale renewable hydrogen production plant in the port area of Ghent (Rodenhuize site). The electrolyser will be operated by sourcing the renewable electricity from newly built renewable assets developed in Belgium and secured through a renewable power purchasing agreement. The electrolyser plant will be operated in a flexible way (approximately 5800 equivalent full load hours), increasing the integration of renewable production and thereby reducing the curtailment of renewable electricity.

(150) Air Liquide ELYgator and Air Liquide CurtHyl will support the deployment of renewable power in the Netherlands, minimising the impact of such deployment on the local electricity grid. It is expected that these projects will facilitate the addition of further renewable energy production by acting as a virtual storage and providing a useful avenue to utilise excess electricity production. This aims to improve the efficiency of renewable energy production and to reduce the societal costs related to grid intensification and curtailment of renewable energy production.

(151) HyCC will ensure flexible operation and address electricity grid congestion. The project installation will not only investigate the opportunities to help balance the current grid and dampen fluctuations from wind energy, but will also be used to investigate if congestion problems on the grid can be avoided or limited by means of flexible operation of the electrolyser. The effects and boundary conditions of ramping up and down at the end-user are expected to enable flexible HyCC operation and avoid electrical grid congestion, without the need for hydrogen buffer capacity.

(152) The electrolysers located on the Iberian Peninsula will notably connect to additional planned PV generation in a region with abundant solar power generation potential. Thus, these projects will help stabilise the energy system by the contribution of these electrolysers to the overall flexibility, efficiency and safety of the electricity sector. They are expected to ensure the reduction of curtailment risks by new renewable plants linked to hydrogen in the near future due to the increase of generation capacity. In addition, a few projects will also test the possibility for participating in balancing markets with the electrolyser in collaboration with the corresponding energy trading areas.

(153) Bondalti will turn otherwise curtailed electricity into stored energy in the European gas networks, which, in turn, will promote a lower dependency of

foreign produced fuel, such as natural gas, which is currently imported into the Union.

(154) Furthermore, a specific spillover effect delivered by EDP-LB is the integration of the production of renewable and low-carbon hydrogen into an existing (and at least partially closing) coal power plant, repurposing or sharing several of the facilities already existing in the plant (e.g. water, electricity systems, buildings, pipelines, etc.). This project can then be a showcase to be replicated in other similar sites in EEA's regions facing the challenge of a transition out of coal.

2.6. Description of the aid measures

2.6.1. Total eligible costs in Hy2Use

(155) The Member States indicate that the projects within Hy2Use either comprise R&D&I and FID within the meaning of points 22 to 24 of the IPCEI Communication or consist of infrastructure projects within the meaning of point 25 of the IPCEI Communication.

(156) They also submit that the total Hy2Use eligible costs[21] are approximatively EUR 9 545 million.

2.6.2. Aid amounts per participating undertaking and chronology of funding per Member State

(157) The Member States have submitted the amounts of State aid under the measures that will be provided to the participating undertakings[22], together with the individual eligible costs and funding gaps:

Undertaking	**Eligible Costs (nominal)**	**Funding Gap (discounted)**	**State aid (nominal)**
	Million EUR	***Million EUR***	***Million EUR***
Borealis	[40-50]	-[100-200]	40
Verbund	[100-200]	-[60-70]	60
Sum	140	-198	100

Table 9: Austria – State aid in million EUR

Undertaking	**Eligible costs**	**Funding Gap (discounted)**	**State aid (nominal)**

21 Eligible costs are only those costs of the individual projects, which comply with the requirements of the Annex to the IPCEI Communication. They, however, do not represent all costs required to conduct the individual projects concerned. The remaining portion of the costs required to conduct those activities, which are not considered eligible for public financing, will be absorbed by the participating undertakings.

22 The aid is capped in nominal terms by the eligible costs. Member States will also ensure that the discounted value of the aid for each participating undertaking (using the relevant weighted average cost of capital ("WACC") as the discount factor) will not exceed the notified funding gaps. The amounts shown under the funding gap column are expressed in discounted or present value terms, while the amount in all other columns are expressed in nominal terms. In some cases, the notified State aid does not fully cover the funding gap of the respective individual projects. In those cases, the Member States concerned submit that the participating undertakings will proceed with the individual projects while seeking additional sources of funding.

	(nominal)		
	Million EUR	*Million EUR*	*Million EUR*
ENGIE Electrabel	[80-90]	-[60-70]	32
ENGIE BE	[100-200]	-[100-200]	50
TfL	[20-30]	-[30-40]	29
Fluxys	[1000-10000]	-[300-400]	95
Sum	1 331	-587	206

Table 10: Belgium – State aid in million EUR

Undertaking	**Eligible costs (nominal)**	**Funding Gap (discounted)**	**State aid (nominal)**
	Million EUR	*Million EUR*	*Million EUR*
Everfuel	[40-50]	-[40-50]	41
Sum	[40-50]	-[40-50]	41

Table 11: Denmark – State aid in million EUR

Undertaking	**Eligible costs (nominal)**	**Funding Gap (discounted)**	**State aid (nominal)**
	Million EUR	*Million EUR*	*Million EUR*
P2X	[200-300]	-[100-200]	133
Solar Foods	[100-200]	-[100-200]	111
Sum	358	-296	244

Table 12: Finland – State aid in million EUR

Undertaking	**Eligible costs (nominal)**	**Funding Gap (discounted)**	**State aid (nominal)**
	Million EUR	*Million EUR*	*Million EUR*
Air Liquide FR	[300-400]	-[100-200]	199
MassHylia	[200-300]	-[90-100]	120
Sum	551	-266	319

Table 13: France – State aid in million EUR

Undertaking	**Eligible costs (nominal)**	**Funding Gap (discounted)**	**State aid (nominal)**
	Million EUR	*Million EUR*	*Million EUR*
Titan	[40-50]	-[20-30]	26
Sum	[40-50]	-[20-30]	26

Table 14: Greece – State aid in million EUR

Undertaking	**Eligible costs (nominal)**	**Funding Gap (discounted)**	**State aid (nominal)**
	Million EUR	*Million EUR*	*Million EUR*
NextChem	[300-400]	-[100-200]	194
RINA-CSM	[80-90]	-[70-80]	88
SardHy	[100-200]	-[80-90]	102
South Italy Green Hydrogen S.r.l.	[100-200]	-[100-200]	113

Sum	669	-420	497

Table 15: Italy – State aid in million EUR

Undertaking	Eligible costs (nominal)	Funding Gap (discounted)	State aid (nominal)
	Million EUR	*Million EUR*	*Million EUR*
Air Liquide CurtHyl	[300-400]	-[200-300]	255
Air Liquide ELYgator	[300-400]	-[200-300]	151
ENGIE NL	[100-200]	-[100-200]	132
H2-Fifty	[600-700]	-[100-200]	143
HyCC	[300-400]	-[100-200]	14
Ørsted	[200-300]	-[100-200]	111
Shell	[400-500]	-[400-500]	386
Uniper	[100-200]	-[100-200]	137
Sum	2 690	1 585	1 329

Table 16: The Netherlands – State aid in million EUR[23]

Undertaking	Eligible costs (nominal)	Funding Gap (discounted)	State aid (nominal)
	Million EUR	*Million EUR*	*Million EUR*
Orlen	[700-800]	-[500-600]	511
Sum	[700-800]	-[500-600]	511

Table 17: Poland – State aid in million EUR

Undertaking	Eligible costs (nominal)	Funding Gap (discounted)	State aid (nominal)
	Million EUR	*Million EUR*	*Million EUR*
Bondalti	[500-600]	-[100-200]	228
Sum	[500-600]	-[100-200]	228

Table 18: Portugal – State aid in million EUR

Undertaking	Eligible costs (nominal)	Funding Gap (discounted)	State aid (nominal)
	Million EUR	*Million EUR*	*Million EUR*
Rona	[30-40]	-[20-30]	28
Sum	[30-40]	-[20-30]	28

Table 19: Slovakia – State aid in million EUR

Undertaking	Eligible costs (nominal)	Funding Gap (discounted)	State aid (nominal)
	Million EUR	*Million EUR*	*Million EUR*

23 The Commission takes notes that, at the time of notification, the Dutch authorities have not completed their national procedures concerning the allocation of State aid for the participating undertakings within Hy2Use and that the present notification is without prejudice to the results of such national procedures. On that basis, the amounts of aid notified by the Netherlands for the participating undertakings in Hy2Use should be understood as maximum potential aid amounts.

EDP-A	[100-200]	-[60-70]	78
EDP-LB	[100-200]	-[60-70]	78
Endesa	[20-30]	-[20-30]	28
Fertinagro	[50-60]	-[40-50]	53
Iberdrola	[1000-10000]	-[700-800]	768
Petronor	[200-300]	-[100-200]	160
Repsol	[200-300]	-[100-200]	155
Sum	1 889	-1 287	1 320

Table 20: Spain– State aid in million EUR

Undertaking	Eligible costs (nominal)	Funding Gap (discounted)	State aid (nominal)
	Million EUR	*Million EUR*	*Million EUR*
HDAB	[400-500]	-[300-400]	473
Sum	[400-500]	-[300-400]	473

Table 21: Sweden – State aid in million EUR

(158) The Member States submit that the durations of the individual projects of the participating undertakings differ. The eligibility period (i.e. the period during which the costs that the undertakings can claim as eligible, should be incurred) is the following, per TF:

TF	Starting date[24]	End date
TF 1	This TF starts at the earliest in 2021.	The last eligible year is planned at the latest 2036.
TF 2	This TF starts at the earliest in 2021.	The last eligible year is planned at the latest 2031.

2. ***Table 22: Hy2Use cost eligibility period***

2.6.3. The aid instruments

(159) The aid to be granted by all the Member States will take the form of direct grants.

2.7. Granting of the aid under the notified measures

(160) All of the Member States participating in Hy2Use have subjected the implementation of State aid to the prior approval of the Commission.

(161) The Member States have committed to suspend the granting of the notified aid if the beneficiary still has at its disposal earlier unlawful aid that was declared incompatible by a Commission Decision (either as individual aid or aid under an aid scheme having been declared incompatible), until that beneficiary has reimbursed or paid into a blocked account the total amount of unlawful and incompatible aid and the corresponding recovery interest.

[24] Hy2Use cost eligibility period begins with the start of the works. Some participating undertakings have already started, at their own risk, their works in 2021.

(162) The Member States have further confirmed that the participating undertakings are not undertakings in difficulty as defined in the rescue and restructuring guidelines[25].

(163) Finally, the Member States have indicated that cumulation with other aid, de minimis aid[26] or EU funding will be allowed to cover the same eligible costs, provided that the total amount of public funding granted in relation to the same eligible costs does not exceed the most favourable funding rate laid down in the applicable rules of Union law.

2.8. Claw-back mechanism

(164) In order to further ensure that the aid is kept to the minimum necessary, the Member States have in their notification committed to introduce a claw-back mechanism, pursuant to point 36 of the IPCEI Communication. The basis for the claw-back mechanism will be *ex post* figures, which have been subject to annual approval by an independent auditor. For this purpose, separate analytical accounting will be required from the participating undertakings in the relevant Member State. The detailed conditions of the claw-back mechanism are explained in Annex I to this Decision.

(165) The claw-back mechanism for the individual projects of the participating undertakings only applies in case of a 'Surplus' including the actual State aid disbursements, as defined in Annex I to this Decision. To ensure, however, that the beneficiaries have an incentive to deliver their project in an efficient manner, a share of any potential 'Surplus' will remain with the participating undertakings.

(166) In line with previous case practice[27], the claw-back mechanism will apply at minimum to participating undertakings having a notified aid amount, per individual project, above EUR 50 million. This threshold is appropriate as ensures that the majority of participating undertakings, representing approximatively 95% of the total aid to be granted for the execution of Hy2Use will be subjected to the mechanism and at the same time avoids imposing burdensome administrative requirements on the relatively smaller projects.

(167) The Member States are required to report to the Commission on the implementation of the claw-back mechanism one month after each application of that mechanism.

---

25 Guidelines on State aid for rescuing and restructuring non-financial undertakings in difficulty (OJ C 249, 31.7.2014, p. 1).

26 Commission Regulation (EU) No 1407/2013 of 18 December 2013 on the application of Articles 107 and 108 of the Treaty on the Functioning of the European Union to de minimis aid (OJ L 352, 24.12.2013, p. 1).

27 SA.54794 (2019/N) and others - Important Project of Common European Interest (IPCEI) on Batteries, recital 196 (OJ C 292, 29.7.2022, p. 1) and SA.55831 (2020/N) and others - Important Project of Common European Interest on European Battery Innovation (EuBatIn), recital 316 (not yet published).

2.9. Transparency

(168) The Member States have in their notification committed to comply with the transparency and publication requirements of points 48 and 49 of the IPCEI Communication. In particular, Member States have committed to publish in the Commission's transparency award module or on a comprehensive State aid website, at national or regional level, the full text of the individual aid granting decision and its implementing provisions or a link to it, as well as all related information as specified in point 48 of the IPCEI Communication.[28]

3. ASSESSMENT OF THE MEASURES

3.1. Presence of State aid pursuant to Article 107(1) TFEU

(169) According to Article 107(1) TFEU, "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 internal market".

(170) In order to qualify as State aid under Article 107(1) TFEU, the following cumulative conditions must be met: (i) the measure must be imputable to the State and financed through State resources; (ii) it must confer an advantage on its recipient; (iii) that advantage must be selective; and (iv) the measure must distort or threaten to distort competition and affect trade between Member States.

(171) The public support measures of the Member States will be financed with funds stemming from the respective State budgets. The measures therefore involve State resources and are imputable to the relevant States.

(172) The aid measures in the form of direct grants to the participating undertakings will relieve them from costs that they would have had to bear themselves under normal market conditions. By contributing to the financing of their infrastructure projects and the R&D&I and FID activities with funds that would not have been obtained under normal market conditions, the aid measures confer an economic advantage on the aid beneficiaries over their competitors. These measures are granted only to the aid beneficiaries listed in section 2.2.3 on the basis of their individual projects. The aid measures are therefore selective.

(173) The aid beneficiaries involved in the relevant TF described above in section 2.2, operate in different sectors along the hydrogen value chain, for example

[28] The Member States have notified the following websites for this purpose: www.bmk.gv.at/ipcei (Austria), www.vlaanderen.be, www.wallonie.be/fr, www.economie.fgov.be (Belgium), https://erhvervsstyrelsen.dk/industrialliancen-ren-brint (Denmark), www.businessfinland.fi (Finland), https://www.europe-en-france.gouv.fr/fr/trouver-une-aide (France), www.ggb.gr (Greece), www.rna.it (Italy), https://webgate.ec.europa.eu/competition/transparency/public and https://www.rijksoverheid.nl/onderwerpen/staatssteun (the Netherlands), www.sudop.uokik.gov.pl (Poland), https://www.portaldiplomatico.mne.gov.pt/sobre-nos/gestao-e-transparencia/documentos-legais (Portugal), hppts://semp.kti2dc.sk, hppts://www.mhsr.sk, hppts://www.siea.sk (Slovakia), https://planderecuperacion.gob.es/ (Spain), www.energimyndigheten.se (Sweden).

hydrogen production, energy production, gas transmission and storage, production of ammonia, metals, chemical and food, e-fuels and refineries, cement and glass. These are economic sectors open to intra-EU trade (both in terms of supply and demand). Therefore, the measures are liable to distort or threaten to distort competition and intra-Union trade, since they improve the competitive position of the beneficiaries compared to other undertakings with which they compete.

(174) In light of the foregoing, the Commission considers that the public support granted to the beneficiaries in the form of direct grants, as described within the framework of Hy2Use, qualifies as State aid within the meaning of Article 107(1) TFEU.

3.2. Legality of the aid measures

(175) The Member States submit that they shall not grant State aid to any of the individual projects before notification of the Commission’s decision approving aid for the execution of Hy2Use. The granting of State aid will be governed by national funding agreements that are expected to be concluded following the Commission’s decision (see recital (42)). By notifying the measures before putting them into effect, the Member States have fulfilled their obligations under Article 108(3) TFEU.

3.3. Assessment of the aid measures

3.3.1. Applicable legal basis for assessment

(176) In derogation from the general prohibition of State aid laid down in Article 107(1) TFEU, aid may be declared compatible by the Commission if it can benefit from one of the derogations enumerated in Article 107(2) and (3) TFEU.

(177) The Commission will assess the compatibility of the notified measures on the basis of Article 107(3)(b) TFEU, which concerns aid to promote the execution of an IPCEI. The criteria for the analysis of the compatibility with the internal market of State aid to promote the execution of IPCEIs are laid down in the IPCEI Communication. The Commission will examine whether Hy2Use satisfies the conditions laid down in the IPCEI Communication in the subsequent sections, following the structure of the Communication.

3.3.2. Eligibility criteria

(178) In order to be eligible for aid under Article 107(3)(b) TFEU, the notified measures must involve a project. That project must be of common European interest, and it must be important. These three criteria are considered below.

3.3.2.1. Definition of a project

(179) According to point 13 of the IPCEI Communication, the Commission may consider eligible an "integrated project", that is to say, a group of single projects inserted in a common structure, roadmap or programme aiming at the same objective and based on a coherent systemic approach. The individual components of the integrated project may relate to separate levels of the supply chain but must be complementary and significantly add value in their

contribution towards the achievement of the important European objective see recitals (190) to (204)).

(180) The Member States, as explained in section 2.4, consider the notified Hy2Use to constitute an integrated project.

(181) The Commission finds that Hy2Use is designed in such a way as to contribute to the common objectives, formulated by the Member States and participating undertakings, as described in section 2.1. As mentioned therein, the main aim of Hy2Use is to ensure the development of a renewable and low-carbon hydrogen market by supporting the construction of hydrogen-related infrastructure, notably large-scale electrolysers and transport infrastructure, and by supporting the development of hydrogen technologies across multiple industrial sectors.

(182) In particular, the Commission recognises the Member States' endeavour to jointly develop the hydrogen technologies and systems value chain, given its importance for the attainment of the Union's energy and climate targets (see recital (1)), as also illustrated in the EU Hydrogen Strategy. Furthermore, the Commission notes that, in this framework, the Member States have developed different national hydrogen strategies to address the hydrogen value chain with specific focuses and timelines. The Commission considers that the joint design of Hy2Use contributes to aligning the Member States' specific objectives and timelines towards the common Union's objectives.

(183) Specifically, the Commission considers that Hy2Use integrates 35 individual projects based on coherent systemic approach. The presence of this coherent systemic approach is illustrated by the fact that the Member States prepared a common programme over the period from January 2021 to August 2021 (see recital (2)), which resulted in the design of the Chapeau document. The Commission notes that the Chapeau document includes an overall work plan aimed at facilitating cross-border efforts towards common objectives.

(184) In particular, the Commission notes that the common programme established in the Chapeau document includes the definition of overall objectives at the level of Hy2Use (see section 2.1), articulated in specific objectives at the level of the two TF (see section 2.2.2), to be implemented and monitored under a common governance structure (see section 2.3).

(185) Furthermore, the organisation and work plan of the two TF is divided into different tasks, each of which consists of different components. The actions required in all of the tasks included within the organisation and work plan of the two TF add significant value for the achievement of Hy2Use's overall objectives (see sections 2.4.1 and 2.4.1.2).

(186) As described in section 2.4, each individual project is complementary to the other projects and significantly adds value in its contribution to the achievement of Hy2Use's objectives. In particular, the Commission notes that:

- the different individual projects in TF 1 will deliver infrastructure (notably large-scale electrolysers and transport infrastructure), which is expected to enable the distribution, storage and use of large quantities of renewable and low-carbon hydrogen; and

- the different individual projects in TF 2 constitute some important building blocks of the hydrogen value chain, enabling the development of technologies for applying hydrogen in different 'hard to abate' industrial sectors, thereby contributing to the decarbonisation of these sectors. The different end-users under TF 2 furthermore will among other things provide technical expertise to the participating undertakings in TF 1 for the construction of the required infrastructure and its integration into the various industrial processes.

(187) Furthermore, in order to ensure the coherent implementation of Hy2Use, the Member States will establish a common governance structure, as described in section 2.3, under a SB, which will have the task of reviewing the progress and the results of Hy2Use and propose changes if necessary, giving specific attention to the benefit for the European society. The Commission will be represented in the SB as an observer. The Commission considers that Hy2Use's common governance structure will ensure that by joining their forces in the integrated Hy2Use, the Member States will be incentivised to implement and report as planned on their individual projects, establish the planned collaborations and enable the dissemination of spillover effects in a timely manner, without thereby jeopardising the achievement of the common objectives.

(188) Therefore, in view of the above, the Commission concludes that Hy2Use qualifies as an integrated project in the meaning of the IPCEI Communication, as its individual projects and TF are inserted in a common programme, aiming at the same objectives and based on a coherent systemic approach. Furthermore, the individual projects and TF are complementary and significantly add value in their contribution towards the achievement of the important common objective of establishing an innovative and sustainable hydrogen value chain in the Union.

3.3.2.2. Common European Interest

(189) In order to establish that a project qualifies as being of common European interest, the IPCEI Communication sets out general cumulative criteria (section (3.3.2.2(a) below), as well as general positive indicators (section (3.3.2.2(b) below). In addition, the IPCEI Communication sets out certain specific criteria depending on the type of project (section 3.3.2.2(c)).

(a) General cumulative criteria (section 3.2.1 of the IPCEI Communication)

1.1.1.1.1.1. Important contribution to the Union's objectives

(190) According to point 14 of the IPCEI Communication, the project must represent a concrete, clear and identifiable important contribution to the Union's objectives or strategies and must have a significant impact on sustainable growth, for example by being of major importance among others for the European Green Deal, the New Industrial Strategy for Europe and its update, the Next Generation EU, the new European Research Area for research and innovation, the new Circular Economy Action Plan, or the Union's objective to become climate neutral by 2050.

(191) The Commission notes the important role that Hy2Use is expected to play in reaching the decarbonisation targets of the EU. The European Climate Law[29] presents a legally binding, EU-wide, economy-wide GHG emissions reduction target by 2030 compared to 1990 of at least 55%, a target endorsed by the European Council in December 2020.[30] Further, the Commission has adopted a communication presenting its long-term vision for a climate-neutral economy by 2050.[31] The development of clean and innovative technologies, the deployment of renewable sources of electricity and alternative sustainable fuels, the integration of low and zero-emissions mobility and transport solutions and the move towards a circular economy as a means to reduce GHG emissions, are set to be the main technological pathways to reach carbon neutrality.

(192) These initiatives will have a major impact on the uptake of renewable and low-carbon hydrogen, thus significantly contributing to the targets outlined in the EU Hydrogen Strategy.[32] In the first phase, the strategic objective is to install at least 6 GW of renewable hydrogen electrolysers in the EU and the production of up to 1 million tonnes of renewable hydrogen by 2024. By 2030, the goal is to reach 40 GW of renewable hydrogen electrolysers in the EU. In the short and medium term, however, other forms of low-carbon hydrogen are needed, primarily to rapidly reduce emissions from existing hydrogen production and support the parallel and future uptake of renewable hydrogen.

(193) In the context of the EU Hydrogen Strategy, the European Clean Hydrogen Alliance[33] was launched on 8 July 2020 to support the large-scale deployment of clean hydrogen technologies by 2030, by bringing together renewable and low-carbon hydrogen production, demand in industrial, mobility, transport and other sectors, and hydrogen transmission and distribution.

(194) Furthermore, the Next Generation EU package has been adopted as a temporary instrument designed to boost the recovery of Member States from the pandemic by addressing among others, climate and environmental challenges.[34] The

[29] 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). See also Communication from the Commission, to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *Stepping up Europe's 2030 climate ambition – Investing in a climate-neutral future for the benefit of our people*, COM(2020) 562 final, 17.9.2020.

[30] European Council meeting (10-11.12.2020) – Conclusions, 11.12.2020, EUCO 22/20, point 12.

[31] Communication from the Commission, to the European Parliament, the European Council, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank, *A Clean Planet for all – A European strategic long-term vision for prosperous, modern, competitive and climate neutral economy*, COM(2018) 773 final, 28.11.2018.

[32] 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, 8.7.2020.

[33] https://ec.europa.eu/growth/industry/strategy/industrial-alliances/european-clean-hydrogen-alliance_en

[34] 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, *Europe's moment: Repair and Prepare for the Next Generation*, COM(2020) 456 final, 27.5.2020.

Resilience and Recovery Facility ("RRF") for Europe constitutes a centrepiece of the Next Generation EU.[35] The RRF Regulation requires each Member State to dedicate at least 37% of its recovery and resilience plan's ("RRP") total allocation to measures contributing to climate objectives. This supports the green transition by contributing to the achievement of the EU's 2030 climate targets and by complying with the target of EU climate neutrality by 2050. Particularly, the RRF supports investments in flagship areas, such as hydrogen. Hy2Use will be partly funded by the RRF (see recital (249)).

(195) In addition, on 18 May 2022, the Commission presented the REPowerEU Plan, in response to the hardships and global energy market disruption caused by Russia's invasion of Ukraine.[36] The REPowerEU Plan and the March 2022 REPowerEU Communication[37], in addition to measures that promote energy savings, the diversification of energy supplies, the accelerated rollout of renewable energy and the reduction and replacement of fossil fuel consumption in industry and transport, include the implementation of a 'Hydrogen Accelerator', which sets a target of 10 million tonnes of domestic renewable hydrogen production and 10 million tonnes of renewable hydrogen imports by 2030,, as well as foresees supporting the development of an integrated gas and hydrogen infrastructure, hydrogen storage facilities and port infrastructure.

(196) All of the above initiatives supplement the Commission's Communication that sets out a European Green Deal.[38] The aim is to transform the EU into a climate-neutral society where economic growth is decoupled from resource use.[39]

(197) The Commission considers that Hy2Use will contribute to fulfilling the objectives laid down in the various EU initiatives mentioned above by:

- bringing together in an integrated project composed of 35 individual projects to be implemented in 13 EU Member States, with more than 160 indirect partners;

- installing large-scale electrolyser capacities within or in proximity to industrial centres and cross-border pipeline network, thereby contributing to an emerging European integrated hydrogen infrastructure;

---

35 Regulation (EU) 2021/41 of the European Parliament and of the Council of 12 February 2021 establishing the Recovery and Resilience Facility (OJ L 57, 18.2.2021, p. 17).

36 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*, COM(2022)230 final, 18.5.2022.

37 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, 8.3.2022.

38 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, *The European Green Deal*, COM(2019) 640 final, 11.12.2019.

39 See also, Communication from the Commission, to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *A new Circular Economy Action Plan For a cleaner and more competitive Europe*, COM(2020) 98 final, 11.3.2020.

- serving, through the technological innovations proposed, all five dimensions of the EU Energy Union: i) energy security, solidarity and trust; ii) a fully integrated European energy market; iii) energy efficiency contributing to moderation and demand; iv) decarbonising the economy; and, v) research, innovation and competitiveness; and

- covering the entire hydrogen value chain with sustainable hydrogen technologies, which are critical for a successful energy transition, thereby aiming to strengthen the supply and demand of renewable energy.

(198) Particularly, it is expected that Hy2Use will allow for substantial CO_2 emissions savings by substituting fossil fuel-based hydrogen or other conventional energy carriers with renewable and low-carbon hydrogen. In particular, it is expected that the installation of large-scale electrolysers will bring about 3.5 GW of generation capacity for renewable and low-carbon hydrogen, whereas the scaling up of hydrogen technologies will facilitate increasing the hydrogen generation capacity and storage, while, at the same time decreasing the Union's dependency on fossil energy imports.

(199) Hy2Use will in addition support Action 7 of the Integrated Strategic Energy Technology ("SET") Plan, which is the central pillar of the EU's energy and climate policy.[40] The SET Plan was revised in 2015 to help achieve the Union's research and innovation priorities, particularly in relation to the development of certain areas, namely 'integrating renewable technologies in the energy systems', 'reducing costs of technologies' and 'renewable fuels and bioenergy'. Hy2Use will support the SET Plan by focusing on hydrogen-related technologies for the generation of renewable and low-carbon hydrogen and by reducing the cost of hydrogen materials and components.

(200) The Commission further notes that Hy2Use will also contribute to the Innovation Union European Strategy, the EU Renewed Agenda for Research and Innovation[41] and the new ERA for Research and Innovation[42]. In this context, Hy2Use will:

- host R&D&I activities for innovative and sustainable hydrogen related materials for industrial applications to unlock the full technological potential of the hydrogen value chain in the Union;

- contribute to the transfer of hydrogen-related knowledge to new or improved applications and different output sectors;

---

40 Communication from the Commission, *Towards an Integrated Strategic Energy Technology (SET) Plan:* Accelerating *the European Energy System Transformation*, COM(2015) 6317 final, 15.9.2015.

41 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, *A Renewed Agenda for Research and Innovation – Europe's chance to shape its future*, COM(2018) 306 final, 15.5.2018.

42 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *A new Era for Research and Innovation*, COM(2020) 628 final, 30.9.2020.

- support the training of highly skilled staff; and
- help coordinate hydrogen-related activities across Europe in order to create an integrated EU hydrogen ecosystem, thereby redeeming the goals of the European Hydrogen Alliance and delivering on the ambition of Hy2Use.

(201) Particularly, it is further expected that Hy2Use will trigger significant R&D&I and FID investments by the participating undertakings and the participating undertakings will directly target piloting their R&D&I results in 17 newly set-up pilot plants.

(202) The Commission considers, in view of the above, that Hy2Use will deliver on its overall objectives (see recital (13)). In addition, it will contribute significantly to fostering R&D&I, especially through the substantial investments undertaken by the participating undertakings. The numerous collaborations will further contribute to ensuring R&D&I cooperation across the EU, as well as facilitating cooperation between the industry and the RTOs.

(203) As regards the contribution of Hy2Use to the New Industrial Strategy for Europe[43], the Commission acknowledges the importance of Hy2Use for supporting significant investments in the EU's hydrogen value chain and that Hy2Use is expected to contribute, according to estimates provided by the Member States, to job creation by creating approximately 26 000 direct jobs in total over its implementation.

(204) Based on the foregoing, the Commission concludes that Hy2Use contributes in a concrete, clear and identifiable manner to one or more Union objectives and has in particular a significant impact on sustainable growth and value creation across the EU and more largely the EEA.

Important market or systemic failures

(205) According to point 15 of the IPCEI Communication, the project must demonstrate that it is designed to overcome important market or systemic failures, preventing it from being carried out to the same extent or in the same manner in the absence of the aid, or societal challenges, which would not otherwise be adequately addressed or remedied.

(206) The Commission's assessment of important market or systematic failures has been performed per project, focusing on identifying the existence of a market failure as such and elaborating on how each project addresses such failure specifically. This allowed the Commission to define the overarching market and systematic failures specific to Hy2Use.

(207) First, the individual projects in Hy2Use will contribute to addressing a market failure in the form of negative environmental externalities, by developing highly innovative technologies and solutions to production processes necessary to generate, store and use renewable hydrogen more efficiently, thereby reducing

43 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, *A New Industrial Strategy for Europe,* COM (2020) 102 final, 10.3.2020.

GHG emissions. The underlying source of negative externalities is that undertakings do not always bear the full cost of the harm they impose on society, which leads to the use of more polluting technologies, with resulting pollutants, presenting thus a direct or indirect health hazard to society. The role of policy intervention is to reinforce the incentives to shift towards using less polluting production processes. Absent State aid, undertakings would likely not have the incentive to invest in less polluting technologies and resulting production processes.

(208) The individual projects under Hy2Use will address negative environmental externalities for instance by:

- contribution to the construction of a European hydrogen backbone and large-scale infrastructure for the production, storage and transport of renewable and low-carbon hydrogen, allowing for the introduction of cleaner technologies in hard-to-abate industrial sectors; and

- developing highly-innovative technologies with reduced GHG emissions in hard-to-abate industrial sectors. Examples include integrating renewable hydrogen in the refining process or adapting current industrial processes to use new circular feedstock derived from waste from the production of chemical.

(209) Second, the individual projects in Hy2Use are expected to address positive externalities of innovation efforts, not fully internalised by the beneficiaries, through dissemination of knowledge and results to other market participants, including those beyond the beneficiaries' own sectors of activities. In other words, undertakings will share the stock of knowledge with other undertakings without being directly compensated for it. This is further reinforced in the case of commitments to disseminate knowledge and results. In the presence of positive externalities, the social rate of return on the R&D&I investment made by undertakings is higher than the undertakings' private return from the R&D&I investment.

(210) Where individual projects may provide benefits to society that are not fully captured by the undertakings, the undertakings' private rate of return may not be sufficiently attractive for each project to be funded fully privately, even though the overall benefits of that project justify the investment from a societal perspective. This leads to the underinvestment (or underproduction) in renewable energy technologies, from the social perspective, which justifies the need for State intervention. State aid may complete this gap, and ensure a level of investments in renewable hydrogen technologies closer to a socially optimal level

(211) Projects under Hy2Use will address such positive externalities, for example by:

- generating benefits from innovation efforts going beyond undertaking-specific benefits by creating jobs and training opportunities along the different levels of the hydrogen value chain and, thereby, stimulating regional employment not only in undertakings that indirectly benefit from the renewable hydrogen market, such as suppliers, but also in the local economy more generally;

- improving economic activity by creating a new market and promoting the auxiliary industry associated with the hydrogen market; and

- supporting further innovations beyond hydrogen infrastructure, production or storage (e.g., reservoirs for the storage of CO_2 or synthetic methane production) through the data collected and methodologies developed in the individual projects and in particular considering the commitment undertaken by the aid beneficiaries to disseminate knowledge and results.

(212) Third, the integrated, coordinated and simultaneous nature of the individual projects in Hy2Use is expected to address coordination problems in the development and adoption of new hydrogen technologies, by aligning the incentives of multiple actors along a value chain, thereby enabling invest simultaneously along a value chain through Hy2Use.

(213) When the profitability of various projects is interdependent, multiple actors may end up underinvesting, if they are not able to coordinate and invest simultaneously. This is for instance the case for the development of new hydrogen technologies that require complementary components or infrastructure and inter-industry cooperation. The integrated, coordinated and simultaneous nature of Hy2Use allows the market failure to be addressed.

(214) Hy2Use will address such coordination problems, which include for example:

- coordination problems relating to investing and ramping up of renewable hydrogen production: unclear market conditions on the demand-side may prevent large-scale development of hydrogen technologies and their integration in production processes In the same way, the absence of hydrogen technologies and production processed on the supply side may hinder development on the demand side (i.e. the "chicken and the egg" problem). The coordinated approach followed in the framework of Hy2Use will create an opportunity for multiple actors on the demand- and supply-side to simultaneously invest and ramp up production capacities in order to commercialise innovative production processes in hydrogen generation. This includes integrated planning, common technical and safety standards for interoperability, and a joint and coordinated approach of relevant stakeholders; and

- coordination problems between the different levels of the hydrogen supply chain (e.g. generation, distribution, logistics, refuelling and end use): Hy2Use brings together market participants from all levels of the hydrogen supply chain in an integrated project with a single and coordinated focus and plan of action, creating benefits for society as a whole by developing hydrogen technologies that would not be realised through multiple independent and fragmented smaller projects.

(215) Fourth, the individual projects in Hy2Use are expected to address the problem of asymmetric information on innovative hydrogen projects and their prospects, showing the willingness of Member States to support hydrogen related projects.

(216) The presence of asymmetric information may lead to a situation where innovators may face difficulties convincing investors of the prospects of their projects in light of the risks and uncertainties involved. The Commission's

assessment of Hy2Use relies on a transparent, public, open process of individual project selection together with the explicit joint commitment by Member States across the EU to contribute to projects in Hy2Use. This specifically contributes to addressing this market failure by reducing information asymmetry and providing regulatory certainty.

(217) Hy2Use seeks to address problems with respect to asymmetric information in the following way:

- the residual risks pertaining to the deployment of highly-innovative industrial processes based on renewable hydrogen and the fragmented set of information around its specific deployment for hard-to-abate industries may limit access to capital as compared to other more mature technologies. Hy2Use will help overcome this through the creation of a value chain that kick-starts the market. Once this has been achieved, investors are expected to be less reluctant to invest in similar renewable and low-carbon hydrogen production technologies; and

- given the high cost and the irreversibility of an investment in new and innovative industrial processes based on renewable hydrogen, undertakings potentially willing to adopt these innovations remain reluctant to invest in an unproven solutions. However, suppliers of these innovative solutions need to demonstrate the viability of their disruptive innovations before being able to sell their product in high volumes. Therefore, the development of potentially superior yet unproven technologies can be trapped into a dead end because of the asymmetry of information between technology suppliers and their potential customers. Hy2Use will help overcome this by providing State aid necessary to trigger investments in innovative technologies for industrial processes.

Member States involved

(218) Point 16 of the IPCEI Communication requires that at least four Member State shall ordinarily be involved. The notified Hy2Use involves 13 Member States, i.e.: Austria, Belgium, Denmark, Finland, France, Greece, Italy, the Netherlands, Poland, Portugal, Slovakia, Spain and Sweden.

Open procedure for Member States

(219) On 17 December 2020, 22 Member States plus Norway signed a joint manifesto in which they committed to launch IPCEI on hydrogen. In line with point 17 of the IPCEI Communication, the signatory Member States invited all other interested EU and EFTA Member States to join this initiative, open to countries willing to participate in the design of IPCEI on hydrogen. Therefore, the Commission concludes that the eligibility condition of ensuring a genuine opportunity for all interested Member States to participate in the IPCEI has been fulfilled.

Positive spillover effects

(220) Point 18 of the IPCEI Communication, requires that an IPCEI must benefit the European economy or society via positive spillover effects. In particular, the benefits of the project must not be limited to the undertakings or to the sector

concerned but must be of wider relevance and application to the economy or society in the Union through positive spillover effects (such as having systemic effects on multiple levels of the value chain, or up- or downstream markets, or having alternative uses in other sectors or modal shift) which are clearly defined in a concrete and identifiable manner.

(221) The IPCEI Communication requires for spillover effects to be identified at all of the following levels: beyond the Member States ("economy or society in the Union"); beyond the aid beneficiaries ("not be limited to the undertakings"); beyond the sector(s) in which the aid beneficiaries are active ("[…] or to the sector concerned").

(222) In view of the commitments for spillover effects as submitted by the Member States for each individual project, the Commission observes that different dissemination levels, ranging from awareness to exploitation, are proposed to ensure the translation of developments and outputs into new findings and market opportunities. The objective is to reach a wide range of potential users and uses amongst research, social, investment and policy makers.

(223) As regards spillover effects for non-IP protected results of R&D&I and FID activities, the Member States have provided an extensive list of activities (described in section 2.5.1) illustrating that the results of Hy2Use are not limited to the participating undertakings, but will be disseminated to the whole scientific community and be of wider relevance and application to different economic sectors. For example, the Commission recognises that involvement in conferences and events as speakers, contributors, or participants will contribute to the dissemination of the knowledge, skills and results obtained through the IPCEI in the sense that participation in these events is typical of all key actors (undertakings, RTOs, universities, etc.) of the hydrogen value chain, as they provide an opportunity to exchange on the specific results produced by each individual project and the technological advancements achieved (see section 2.5.1.2). Moreover, the establishment of collaborations with numerous and various indirect partners (see recitals (135) to (139)), as well as the close communication and connection to clusters, professional trade associations and other intermediary bodies will enhance the dissemination effort (see section 2.5.1.4).

(224) The Commission also notes the significant effort undertaken by the participating undertakings to spread and share knowledge and results through publications in peer-reviewed journals (see section 2.5.1.5) and in increasing links with the academic world, including through collaborations for the implementation of Hy2Use, but also through a significant sponsorship of PhD and MSc degrees and university chairs related to technologies developed under Hy2Use (see recital (97) and (101) to (102)). This is particularly important to ensure that the knowledge and individual project's results of Hy2Use are transmitted to the next generations and that the future workforce can acquire the skills and knowledge that will be needed in the future. This is, furthermore, corroborated by the commitments undertaken by all participating undertakings to provide training activities in collaboration with RTOs and universities, targeting professional and researchers (see recital (106)).

(225) As regards spillover effects for IP-protected results of R&D&I (see section 2.5.2), the Commission considers that the Member States have shown adequately the dissemination activities and the commitments undertaken by the participating undertakings to spread those results as widely as possible to interested parties, e.g. SMEs or RTOs, the scientific community and across economic sectors through non-exclusive licensing based on FRAND conditions, without jeopardising the objectives of Hy2Use. Thus, the IP-protected results will not only benefit the participating undertakings, but will go beyond the undertakings generating those results during Hy2Use.

(226) In line with the commitments provided by each participating undertaking (see recital (107)), the setting of the licence fees will be fixed in the respective cooperation contracts between the participating undertakings and the interested parties. This dissemination will provide interested parties with the possibility to reap the benefits of the R&D&I activities undertaken by Hy2Use across the TF. Through access on FRAND terms to IP-protected results of R&D&I stemming from individual projects falling within Hy2Use, it can be expected that interested parties will be able to exploit the results of Hy2Use in different applications, in up- or downstream markets, increasing therefore their technological expertise and their own research activities, improving their own equipment, materials and processes and having the opportunity to develop new products or establish new collaborations.

(227) As far as particular spillover effects of FID activities are concerned, the Commission considers that, on the basis of the information provided by the Member States (described in section 2.5.3), the FID activities expected to lead to significant spillover effects in downstream markets. Hy2Use will enable the participating undertakings to develop new product applications and designs and acquire specific skills and know-how, which can be used in cooperation with third parties within or outside Hy2Use. Hy2Use will also provide access to next generation hydrogen-related technologies and know-how to other interested large undertakings, as well as to SMEs and RTOs that want to develop new knowledge and applications considering the entire lifecycle of these technologies. These parties should benefit from early access to the latest technologies available and may thus be able to reduce their development time.

(228) In this regard, the Commission notes that some of the participating undertakings have committed to granting access to R&D&I lab production lines for SMEs (including start-ups) and RTOs that do not have the capability to build up their own lab system (see section 2.5.3, for example recitals (125), (129), (130) and (134)) in order to carry out their own research and testing. These facilities are in principle planned to function as start-up incubators for knowledge-based ventures in areas related to the operation of electrolysers and to hydrogen technologies, for different applications within the hydrogen value chain, creating as a result spillover effects in the downstream markets.

(229) Finally, as regards additional spillover effects generated by the large-scale electrolyser projects in TF 1, the Commission notes that such projects will deliver positive systemic effects specifically by contributing to the stability of the electricity network, providing flexibility and facilitating the integration of large volumes of intermittent RES (see section 2.5.5).

(230) Based on the description of the positive spillover effects generated by Hy2Use as presented in section 2.5, the Commission considers that the benefits of Hy2Use are clearly defined in a concrete and identifiable manner and the Member States have adequately shown how Hy2Use benefits interested parties beyond those directly involved in Hy2Use and beyond the sectors concerned. In addition, the Commission notes that at both integrated and national governance levels Hy2Use will monitor the correct implementation of the committed dissemination activities and spillovers of the participating undertakings (see recitals (36) and (42)) in compliance with the provisions of the IPCEI Communication and the national funding agreements.

(231) Therefore, in view of the above the Commission considers that this eligibility condition is satisfied, in accordance with point 18 of the IPCEI Communication.

Co-financing by the aid beneficiaries

(232) As required by point 19 of the IPCEI Communication, the project must involve important co-financing by the beneficiaries. The Commission estimates that the total financing needs for the implementation of the beneficiaries' projects are approximately EUR 12.2 billion in total, more than double the aid notified by the Member States for Hy2Use.

Principle of 'do no significant harm'

(233) Point 20 of the IPCEI Communication requires Member States to provide evidence as to whether the project complies with the principle of 'do no significant harm' within the meaning of Article 17 of Regulation (EU) 2020/852 (the "Taxonomy Regulation"), or other comparable methodologies.[44]

(234) Article 17 of the Taxonomy Regulation defines what constitutes 'significant harm' for the six environmental objectives covered by the Taxonomy Regulation, taking into account the life-cycle of the products and services provided by an economic activity including evidence from existing life-cycle assessments:

- an activity is considered to do significant harm to climate change mitigation if it leads to significant GHG emissions;

- an activity is considered to do significant harm to climate change adaptation if it leads to an increased adverse impact of the current climate and the expected future climate, on the activity itself or on people, nature or assets;

- an activity is considered to do significant harm to the sustainable use and protection of water and marine resources if it is detrimental to the good status or the good ecological potential of bodies of water, including surface water and groundwater, or to the good environmental status of marine waters;

[44] 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 (OJ L 198, 22.6.2020, p. 13).

- an activity is considered to do significant harm to the circular economy, including waste prevention and recycling, if it leads to significant inefficiencies in the use of materials or in the direct or indirect use of natural resources, or if it significantly increases the generation, incineration or disposal of waste, or if the long-term disposal of waste may cause significant and long-term harm to the environment;

- an activity is considered to do significant harm to pollution prevention and control if it leads to a significant increase in emissions of pollutants into air, water or land, as compared with the situation before the activity started; and

- an activity is considered to do significant harm to the protection and restoration of biodiversity and ecosystems if it is significantly detrimental to the good condition and resilience of ecosystems, or detrimental to the conservation status of habitats and species, including those of Union interest.

(235) In order to assess compliance with point 20 of the IPCEI Communication, the Commission requires Member States to provide evidence that demonstrates that the individual projects comply with the above-mentioned six environmental objectives of the Taxonomy Regulation, by reference in particular to the screening criteria developed in Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives (the "Delegated Regulation")[45].

(236) The Commission assessed the environmental impact of all of the individual projects against the six environmental objectives set out in Article 9 of the Taxonomy Regulation. For all individual projects included in the Hy2Use the Commission finds the following:

(237) Concerning climate change mitigation, the Member States have shown that:

a) projects consisting in the production of hydrogen or hydrogen-based synthetic fuels aim at achieving GHG emission savings significantly exceeding, or at least corresponding to, 70% compared to a fossil fuel comparator of comparator of 94 g CO_2e/MJ by producing electricity-based hydrogen or by producing hydrogen from the gasification of non-recyclable waste with capture of CO_2;

b) projects linked to the manufacturing of glass, cement, steel, aim at developing processes avoiding direct GHG emissions and thus achieving GHG emission levels below the thresholds set out in the Delegated Regulation on climate change mitigation for those products as well as substantially below Emissions Trading System ("ETS") benchmarks. In cases like the glass sector, hydrogen will be used as fuel for high

[45] OJ L 442, 9.12.2021.

temperature processes substituting fossil alternatives. In steel manufacturing, hydrogen will replace coke as feedstock to reduce the iron. In projects targeting R&D&I and FID in the cement sector CO_2 will be captured and used together with renewable and low-carbon hydrogen to synthesise hydrocarbons and thereby binding emerging CO_2 over various amounts of time; projects linked to the blending of renewable hydrogen in jet spins and atomiser dryers will lead to a reduction in GHG emissions bringing them down below the ETS benchmark for fuel in processes in which emissions remain hard to abate; and

c) projects consisting in the deployment of transmission pipelines dedicated to hydrogen only. As transmission pipelines dedicated to hydrogen are deemed to contribute substantially to the climate change mitigation objective on the basis of Delegated Regulation[46], such project thereby also fulfil the required standards to do no significant harm to climate change mitigation).

(238) Concerning climate change adaptation, the Commission finds that no negative effects are foreseeable from the individual projects. Many projects already conducted a climate screening or will carry out such screening and usual climate hazards will be taken into account in the design of the projects. In addition, as far as projects involving electrolysers are concerned, Member States confirmed that projects were either not located in regions subject to water stress (north and east Europe) or would undergo climate screening with special attention to water stress. Projects in the south will either use seawater or introduce measures to recycle and reuse process water. Several of them can use industrial water that was previously used for a steam methane reforming ("SMR") plant which the electrolyser will replace, thereby not increasing the water demand.

(239) Concerning the sustainable use and protection of water and marine resources, the Member States have demonstrated that the individual projects will not be located in protected areas. Projects have already been subject to or will be subject to an environmental impact assessment, where required by EU and national environmental legislation or to environmental permit containing specific requirements on water, including the monitoring of effluents. Waste water, where it is an issue will be treated before returning to the environment. In that case water quality is monitored. Projects involving electrolysers pay particular attention to minimise possible impact on water resources by using rainwater and closed water circuits, where the process water is reused; air coolers instead of water coolers to avoid the discharge of warmer water, etc.

(240) The Delegated Regulation on climate change mitigation does not contain any technical screening criteria for determining the conditions under which an economic activity involving the production of hydrogen, ammonia or steel causes no significant harm to the circular economy objective and deems circularity as not applicable. However, most projects contribute to the circular economy by paying particular attention to the choice of the equipment used and giving priority to equipment that can easily be repaired and/or recycled or composed of subparts that can be refurbished (like the stacks). Also the

[46] See Annex 1, Section 4.14, OJ L 442, 9.12.2021.

production of hydrogen through electrolysis generates heat and oxygen and several projects found ways to reuse the waste heat and the oxygen. Some individual projects involve the repurposing of existing industrial sites (e.g. repurposing of a coal power plant). As far as the waste gasification projects are concerned, only non-recyclable waste will be used as feedstock. When based on mixed waste, only the fraction that cannot be recovered and otherwise valorised will be used, hence not preventing separate collection of waste. One of the gasification projects (NextChem) envisages using already landfilled waste (through waste mining), thereby reducing the amount of landfilled waste and reducing leachates from this landfilled waste. The process does not involve the incineration of waste and generates a syngas and an inert solid product that can be used, due to its composition, as an aggregate.

(241) The Commission verified that the development of hydrogen technologies and systems under Hy2Use does not lead to a significant increase of pollution to air, water or land. Member States confirmed that the projects did not involve any of the substances listed in Appendix C to the Delegated Regulation on climate change mitigation. For hydrogen produced from electrolysers, no polluting emissions are expected, as emissions linked to fossil fuel consumption will be replaced by hydrogen, oxygen and water. Furthermore, projects have already been subject to or will be subject to an environmental impact assessment, where required by Union and national environmental legislation or to environmental permit. Where soil pollution linked to the use of chemicals has to be controlled, operating instructions, installed retention tanks and kits in the event of a spill will be installed. Projects linked to the production of steel, cement, ammonia and glass also committed to comply with applicable best available techniques.

(242) Finally, the Commission considers that it is unlikely that the activities carried out under Hy2Use will have a significant negative impact on the protection and restoration of biodiversity and ecosystems. No project will be located in a protected area and most projects will be located in existing industrial areas. Furthermore, projects have already been subject to or will be subject to an environmental impact assessment, where required by EU and national environmental legislation or to environmental permit. Projects closer to natural areas will implement additional nature protection measures. For example, Air Liquide FR will introduce the marking of sensitive areas, and install semi-impermeable small fauna barriers, Shell will install around 2 ha of biodiverse landscaping around the facility, Air Liquide CurtHyl and Air Liquide ELYgator will use nature-based solutions (introduction of a pond) to improve the climatic efficiency of the facility.

(243) In view of the above, the Commission concludes that the Member States have sufficiently demonstrated compliance with point 20, including footnote 20, of the IPCEI Communication.[47]

<u>Conclusion</u>

[47] Insofar as an individual project under this Decision falls under a measure of a national RRP, this conclusion is without prejudice to the assessment of the Commission in the context of the RRF Regulation, of the satisfactory fulfilment of any related milestones and/or targets, as established in the respective Council Implementing Decisions approving the RRPs.

(244) Based on all of the above considerations, the Commission considers that the general cumulative criteria for eligibility of the notified Hy2Use for aid under Article 107(3)(b) TFEU are met.

(b) General positive indicators (section 3.3.3 of the IPCEI Communication)

<u>Involvement of the Commission in the design</u>

(245) The Commission facilitated the emergence of Hy2Use and helped enhance coordination between Member States in the project by having participated and contributed during the period preceding the pre-notifications from January 2021 to August 2021 in several technical meetings with open invitations for all Member States interested in participating in Hy2Use. This is consistent with point 21(a) of the IPCEI Communication.

<u>Involvement of the Commission in the governance</u>

(246) As described in detail above under section 2.3, the governance structure of Hy2Use involves the Commission through participation into the SB. This is consistent with point 21(c) of the IPCEI Communication

<u>Important collaborative interactions</u>

(247) The Member States provided detailed information (see section 2.4.2) describing how each individual project creates important collaborative interactions in terms of the number of partners, involvement of undertakings participating in the same and different TF and the involvement of undertakings of different sizes.

(248) The Commission takes note of the number of collaborations within each and across the different TF, as illustrated in table 23 and further elaborated in section 2.4.3 (collaborations within Hy2Use) and recital (137) to (139) (collaborations with indirect partners). It is evident from the information submitted by the Member States that, all of the participating undertakings in Hy2Use are involved in multiple cross-border and national collaborations either with other participating undertakings of the same or different TF or with indirect partners, such as Universities and RTOs. The Commission considers that such collaborations are in line with point 21(d) of the IPCEI Communication.

<table>
<tr><th>TF</th><th>Number of collaborations with indirect partners</th><th>Number of collaborations intra TF</th><th>Number of collaborations inter TF</th></tr>
<tr><td>TF 1</td><td>95</td><td>36</td><td rowspan="2">36</td></tr>
<tr><td>TF 2</td><td>67</td><td>31</td></tr>
<tr><td>Total</td><td>162</td><td>67</td><td>36</td></tr>
</table>

Table 23: Summary of the different inter and intra TF collaborations

<u>Co-funding or co-financing from a Union fund</u>

(249) The Commission acknowledges that most of the Member States will be using for all of their projects co-funding or co-financing from the European Regional Development Fund, the Just Transition Fund, the Innovation Fund and/or the

RRF. The inclusion of co-funding or co-financing of individual projects within Hy2Use is consistent with point 21(e) of the IPCEI Communication.

Significant strategic dependency

(250) The Commission acknowledges Hy2Use's furthering of the EU's policy to decrease its dependency on fossil energy imports and provide energy security (see recitals (195) to (198)). This is consistent with point 21(g) of the IPCEI Communication.

(251) In view of all of the foregoing, the Commission considers that on grounds of section 3.2.2 of the IPCEI Communication, five out of seven general positive indicators, in accordance with point 21 of the IPCEI Communication are met.

(c) Specific criteria

Specific criteria for infrastructure projects

(252) All individual projects within TF 1 consist of infrastructure projects in the energy sector within the meaning of point 25 of the IPCEI Communication.

(253) Point 25 of the IPCEI Communication provides that infrastructure projects in the environmental, energy, transport, health or digital sectors, to the extent that they are not covered by points 22 and 23 of the IPCEI Communication, must be of great importance for the environmental, climate, energy (including security of energy supply), transport, health, industrial or digital strategies of the Union or contribute significantly to the internal market, including, but not limited to those specific sectors, and can be supported for the period until becoming fully operational following construction.

(254) Given the features of these projects, in order to establish whether they can be deemed of great importance for the respective strategy, and beyond their important contribution, together with those of TF 2 as part of Hy2Use, to several general Union objectives notably in the climate and energy as shown in section 3.3.2.2, the Commission has taken into account[48], in particular, the relevant criteria established by the revised TEN-E Guidelines, which identify hydrogen transmission and storage, as well as electrolysers among the trans-European energy infrastructure priorities and therefore the targeted energy infrastructure categories[49].

(255) All projects except one (Fluxys) within TF 1 involve the deployment of large-scale electrolysers. Against this background, the Commission has verified whether , in line with the relevant TEN-E criteria, the electrolysers to be built in the framework of those projects can contribute significantly to the energy policy objectives of sustainability, including by reducing GHG emissions and

48 Also in light of the reference made by the Commission to the priorities of the TEN-T in the assessment of a previous IPCEI concerning an infrastructure project, namely the Fehmarn Belt project. See Commission Decision (EU) 2020/1472 of 20 March 2020 on the State aid SA.39078 – 2019/C (OJ L 339, 15.10.2020, p. 1), and in particular recital 272.

49 See in particular Annex II of Regulation (EU) 2022/869 (OJ L 152, 3.6.2022, p. 45), presenting the relevant energy infrastructure categories.

enhancing the deployment of renewable or low-carbon hydrogen; and security of supply, including by contributing to secure, efficient and reliable system operation, or by offering storage, flexibility solutions, or both, such as demand side response and balancing services.

(256) More specifically, the TEN-E Guidelines identify three relevant criteria that electrolysers must meet to comply with the general policy objectives: a) a capacity of at least 50 MW, which implies that they can have an impact of European relevance; b) generate hydrogen in a way that ensures high savings of GHG emissions; and c) have a network-related function, specifically for the electricity and hydrogen networks[50].

(257) With regard to the first TEN-E criterion for electrolysers, related to capacity, the Commission notes that all of the individual projects within TF 1 that involve the construction of electrolysers plan to reach capacities of at least 50 MW and in some cases much larger (see section 2.4.1.1). The total estimated capacity covered by these projects could reach approx. 3.5 GW (see recital (21)).

(258) With regard to the second TEN-E criterion for electrolysers, related to the environmental impact, the Commission verified that all the concerned projects within TF 1 will comply with life-cycle GHG emissions savings of at least 70 % relative to a fossil fuel comparator of 94 g CO_2eq/MJ (i.e. CO_2 equivalent per megajoule). This TEN-E criterion exactly corresponds to one of the requirements under the ‘do no significant harm principle’ as applied under the Taxonomy Regulation and, therefore, the Commission’s assessment of compliance of all individual projects within Hy2Use with the general eligibility criterion of compliance with the ‘do no significant harm’ principle (see recitals (233) to (243)) enables it to conclude that the projects involving electrolysers within TF 1 are in line with that specific TEN-E criterion.

(259) With regard to the third TEN-E criterion for electrolysers, concerning their network-related functions, the Commission considered separately the relevant projects’ contributions to the electricity and hydrogen networks.

(260) Concerning the electricity networks, the Commission notes that the large-scale electrolysers to be built in the framework of the individual projects within TF 1 will be designed to operate in a flexible manner so that they can facilitate system integration of high amounts of RES whilst reducing concurrently downstream electricity grid congestions (see section 2.5.5). Furthermore, several individual projects within TF 1 actively plan to participate to grid balancing services. This will allow such projects to contribute to secure, efficient and reliable operations of the electricity systems. Also taking into account the total capacity involved, of approximatively 3.5 GW (recital (21)), the Commission considers this contribution to the functioning of the electricity networks to be of great importance.

(261) Concerning the hydrogen networks, all the individual projects in TF 1 will contribute to large-scale supply within and close to large industrial areas of

---

50 The reference to these criteria is used for the exclusive purpose of the eligibility assessment under point 25 of the IPCEI Communication in this decision and is without prejudice to the implementation by the Commission of the TEN-E Guidelines and to the additional or more detailed parameters that may be established and applied in that framework.

potential demand (e.g. in proximity to large ports) and will therefore directly contribute to and encourage a faster roll-out of hydrogen transport infrastructure around those centres. In addition, the projects envisage, whenever this will be possible depending on general developments, to connect to the emerging European integrated hydrogen infrastructure or backbone. These projects are located along this emerging backbone, as shown in the figure below.

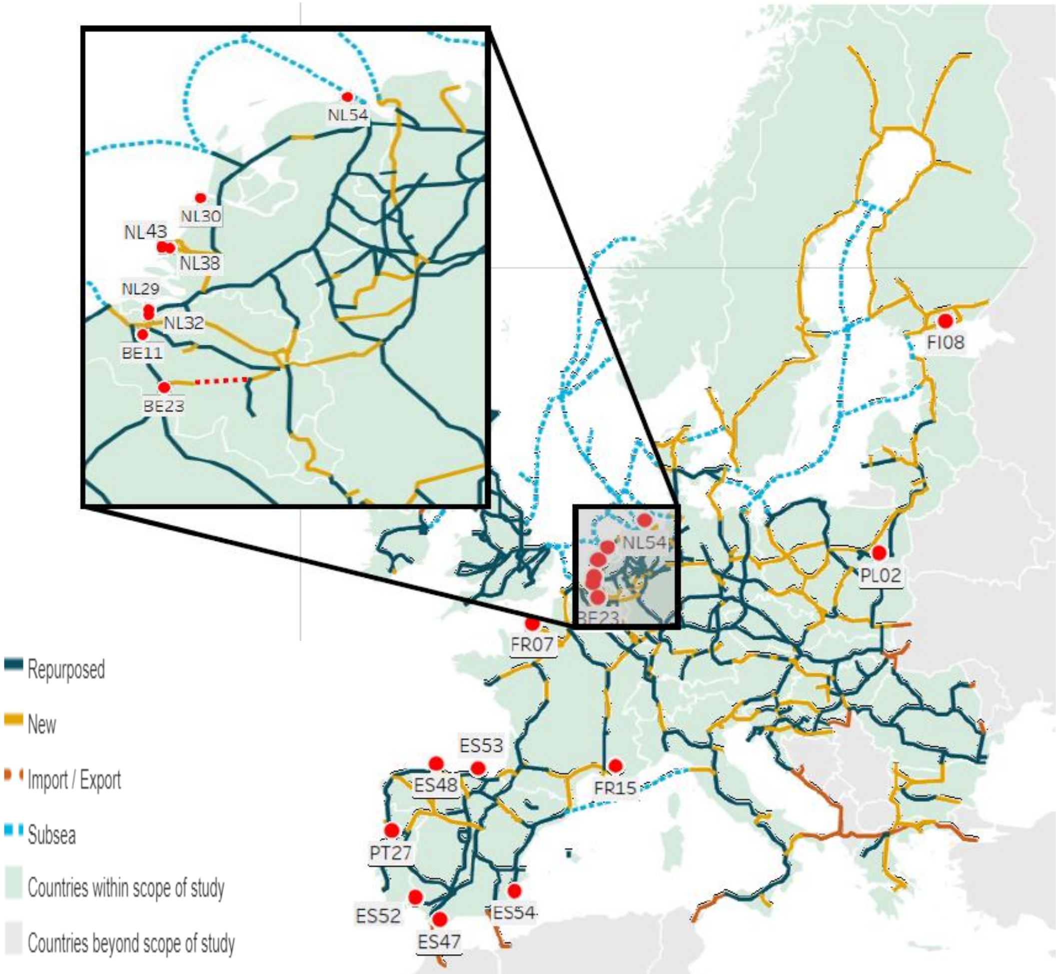

Figure 3: Localisation of the TF 1 projects in relation to the envisaged European hydrogen backbone

(262) In order to be able to assess whether they can contribute in an important manner to the functioning of hydrogen networks, it is also important to verify that the electrolyser projects are not exclusively dedicated to one off-taker. Indeed, while supplying exclusively one off-taker may have important benefits in terms of decarbonisation for one specific production plant, the Commission considers that such projects do not comply with principles of open and non-discriminatory access and lack the scope and ambition required for being deemed of great importance for the relevant Union strategy or contribute significantly to the internal market, as required by point 25 of the IPCEI Communication.

(263) Nevertheless, the Commission also notes that many large-scale initiatives in an emerging sector such as that of hydrogen, in which large parts of the expected demand still needs to materialise, for example in the industrial and transport sectors, may require so-called 'anchor' or 'launching' customers which can commit to a predictable demand for hydrogen in the initial phase of operation of the electrolysers and thus provide investors with reasonable expectations of

sufficient financial returns justifying the risks involved in building electrolysers of such large scale.

(264) To ensure that the role of such initial customers does not put into question the open nature of the projects and their ability to contribute effectively to achieving Union objectives in relation to the emerging hydrogen market, the Commission has verified that all of the individual projects involving the construction of electrolysers within TF 1 have concrete and realistic plans to supply a variety of customers in different sectors, notably in terms of available hydrogen generation capacities, technical characteristics of the electrolysers and localisation close to areas and regions where large hydrogen demand is forecasted during the lifetime of the individual project.

(265) Based on the preceding, the Commission considers that all the individual projects within TF 1 that involve the installation of large-scale electrolysers, are aligned with the criteria of the TEN-E Guidelines and can be deemed of great importance for the relevant Union strategy, in line with point 25 of the IPCEI Communication.

(266) In light of its scope, the Commission considers that the project by Fluxys, which involves the construction of an integrated hydrogen transmission network in Belgium, can also be deemed to be of great importance in the meaning of point 25 of the IPCEI Communication. The project consists of the construction of up to 500 km of pipelines for the transport of hydrogen, including repurposed natural gas infrastructure, giving access to multiple network users on a transparent and non-discriminatory basis. The planned connections with the Netherlands, France and Germany will directly support the emergence of a Union-wide network for hydrogen transport, in line with the TEN-E priority objectives.

(267) The Commission, furthermore, assessed the feasibility and maturity of all individual projects within TF 1 to ensure from a technical point of view that they can deliver the expected results and thus contribute effectively to achieving the Union's strategies in the energy sector.

(268) In detail, the key expected results of TF 1 and the corresponding contribution of the participating undertakings are the following:

Expected results	Participating undertakings
Hydrogen production and handling in key locations for decarbonisation of transport and industry, including safety aspects	Bondalti, ENGIE Electrabel, ENGIE NL, H2-Fifty, MassHylia, Orlen, P2X, Repsol
Alignment with emission reduction goals. Transparent certification system and regulatory framework	Air Liquide CurtHyl, Air Liquide ELYgator, Air Liquide FR, EDP-A, EDP-LB, ENGIE, Electrabel, ENGIE NL, Iberdrola, MassHylia, Ørsted, P2X, Petronor, Repsol, SHELL, Uniper
Circular use of by-products by integration in surrounding industry, including innovative processes for the production of low-carbon hydrogen from non-recyclable solid waste	EDP-A, EDP-LB, H2-Fifty, HyCC, P2X
Improving safety and technical regulations, public funding, certification, standardisation, guarantees of origin, training and create a stronger knowledge base	Air Liquide CurtHyl, Air Liquide ELYgator, Bondalti, EDP-A, EDP-LB, Iberdrola, Ørsted,

	H2-Fifty, P2X, Petronor, Repsol, Shell, Uniper
Participating to grid balancing services by flexible usage of hydrogen and natural gas to support the Union energy transition	Air Liquide ELYgator, EDP-A, EDP-LB, Uniper, Bondalti, ENGIE NL, H2-Fifty, HyCC, MassHylia, P2X, Shell
Providing a short term, flexible and significant hydrogen demand that will enable the building of a veritable hydrogen economy in Europe and thereby strongly develop the European hydrogen industry	Air Liquide CurtHyl, Air Liquide ELYgator, Air Liquide FR, Bondalti, EDP-A, EDP-LB, ENGIE Electrabel, ENGIE NL, Iberdrola, Iberdrola, MassHylia, Ørsted, P2X, Petronor, Repsol, Shell, Uniper.
Blueprinting hydrogen valleys: provide foundation for a hydrogen economy in a major European metropolitan area. Its open character, extending use of hydrogen to other industrial, mobility and residential users requires a huge amount of coordination and collaboration. Sharing knowledge with other H_2valleys enhances impact and effectiveness	Bondalti, ENGIE NL, H2-Fifty, HyCC, Repsol
Developing a dedicated control strategy and defining the renewable and low-carbon hydrogen production plant operative practice, including a risk assessment	Air Liquide CurtHyl, Air Liquide ELYgator, EDP-A, EDP-LB, Iberdrola, Ørsted, P2X, Petronor, Repsol, Shell, Uniper

Table 24: Expected results from TF 1

(269) Following the assessment against the relevant factors listed above, the Commission considers that the projects within TF 1 are aligned to the Union objectives and will contribute significantly to their implementation and to the achievement of their targets.

Specific criteria for projects involving R&D&I and FID activities

(270) All individual projects within TF 2 comprise either R&D&I or FID activities, or both.

(271) Point 22 of the IPCEI Communication provides that R&D&I projects must be of a major innovative nature or constitute an important added value in terms of R&D&I in light of the state-of-the-art in the sector concerned. According to point 23 of the IPCEI Communication, projects comprising of FID must allow for the development of a new product or service with high research and innovation content or the deployment of a fundamentally innovative production process. Regular upgrades without an innovative dimension of existing facilities and the development of newer versions of existing products do not qualify as FID.

(272) Further, point 24 of the IPCEI Communication defines FID as the upscaling of pilot facilities, demonstration plants or of the first-in-kind equipment and facilities covering the steps subsequent to the pilot line including the testing phase and bringing batch production to scale, but no mass production or commercial activities.

(273) In general, the Commission verified at the level of individual aid beneficiaries and per project within TF 2 that each aid beneficiary has a well-defined and

documented research programme regarding the innovations brought forward. The Commission conducted a technical assessment of each individual project to determine whether the projects that contain R&D&I and FID activities comply with the innovativeness requirements as laid out in the IPCEI Communication. Whenever possible, as a first point of reference for the current state-of-the-art, the Strategic Research and Innovation Agenda ("SRIA") document of the Clean Hydrogen Joint Undertakings[51] was utilised along with any other reference document available, such as peer review papers and available project deliverables. Individual projects were deemed to have shown innovation in line with the SRIA document, if they could demonstrate at least one of the following general advances that are relevant for both R&D&I and FID:

- technical performance beyond that of the current state-of-the-art technology at global scale;
- deployment of a technology at a scale that clearly goes well beyond the current state-of-the-art at global scale; and
- innovative applications or innovativeness of overall processes / approaches.

(274) In particular, the innovative nature of each individual project carrying out R&D&I and FID activities was analysed taking into account the following specific principles and parameters.

(275) For the R&D&I:

- State-of-the-art: the Commission has compared all product and process innovations of each participating undertaking against the state-of-the-art on the market at global scale;
- Innovation: as regards the technical assessment of the innovative nature of the different projects, the Commission examined whether each individual project set specific targets for achieving the innovation required for the R&D&I activities proposed; whether those activities and targets go beyond the state-of-the-art; the innovations brought forward; and the benefits and expected results stemming from these innovations;
- Technical process/approach: the participating undertakings were asked to provide a clear description of the technical process/approach needed to reach the innovation targets. The Commission assessed in this context the type of technology used, the challenges encountered by each participating undertaking (see section 2.2.2.2) and the means chosen to overcome those challenges; and

(276) For the FID:

- Member States described the testing, sampling and upscaling processes implemented by each participating undertaking during the FID and explained how they differed from mass production and normal

[51] This document is prepared in collaboration with Hydrogen Europe and the JRC: https://www.clean-hydrogen.europa.eu/system/files/2022-02/Clean%20Hydrogen%20JU%20SRIA%20-%20approved%20by%20GB%20-%20clean%20for%20publication%20%28ID%2013246486%29.pdf

commercial activities. The Commission examined whether the FID contains important R&D&I activities for example the optimisation of innovations developed in the R&D&I phase, the deployment and integration of technological innovations in industrial settings and production processes and the scaling up of different technology and processes from pilot to industrial scale; and

- The Commission further assessed the duration of the FID of each individual project, the criteria determining its start (i.e. at which point the undertaking starts using its pilot and industrial lines) and end period (i.e. at which point the undertaking produces samples, as well as the liability and return conditions applying to feedback sales and sales during the FID) and the scale of the FID (e.g. whether the FID envisaged by the individual projects is disproportionate in terms of size in comparison to the number of samples and tests projected). Whenever possible, this information has been cross-examined and compared with information provided by participating undertakings active in the same sector.

(277) Based on the information provided by the notifying Member States and following an assessment against the relevant factors listed above, the Commission considers that the R&D&I and FID activities carried out in TF 2 aim to advance the relevant technology substantially beyond the current state-of-the-art. The main general innovations and key expected results that the Commission identified as part of its assessment are described in the following recitals.

(278) The Commission considers that the Member States have demonstrated the innovativeness of all the individual projects within TF 2 including both R&D&I and FID activities, in all areas of the hydrogen technologies value chain that are specifically targeted by Hy2Use.

(279) The main innovations within the hard-to-abate sectors concerned that go beyond the current state-of-the art and which are expected to result from the R&D&I and FID activities of the Hy2Use, are explained in the following recitals.

(280) The *ammonia, cement and glass sectors,* according to the current state-of-the-art, use large amount of methane, thereby significantly emitting CO_2. The heat production in kilns and glass melting is currently designed to be fuelled with methane, and in some cases with liquid fuels. The use of hydrogen as fuel has not yet been implemented on a large-scale. Furthermore, kilns and furnaces are usually designed or adjusted for the combustion characteristics of the specific fuel, mainly methane, whereas the hydrogen’s combustion characteristics differ significantly from those of methane.

(281) Another characteristic of the current state-of-the-art in these sectors is that the hydrogen burners are tested up to 100 kW, which is typically not sufficient for the needs of these sectors. Finally, digital twin solutions have been proven to be a capable tool in other industrial developments, nevertheless they have not been used in a complete renewable energy integration to select the optimal technical-economic dynamic optimisation, as yet. The overall value chain stretching from renewable electricity to renewable and low-carbon ammonia via low temperature water electrolysis, as well as the comprehensive integration of

oxygen production and excess heat from the electrolyser into the industrial processes, has not been demonstrated at industrial-scale.

(282) Several innovations are necessary to overcome the current state-of-the-art and avoid using methane as a fuel (and feedstock). The main goal is to achieve a fully-fledged replacement of natural gas with hydrogen, thereby leading to carbon neutral production. For example:

- hydrogen-fired burners at a sufficient power level need to be developed. The use of such burners will be lifted from technology readiness level ("TRL") 5-6 to TRL 7;
- the materials used in the burners, kilns, and melting ovens will be advanced to make them fit for the use of hydrogen;
- the overall value chain stretching will be shifted from TRL 5 to TRL 6; and
- the digital twin solution will be developed beyond a mere model of plants and processes. It will be combined with virtual reality and telepresence technology, thereby reflecting the operational behaviour of the system and providing the basis to define the optimal integration with the electricity market.

(283) In *e-fuels and refineries*, based on the current state-of-the-art, several technologies produce hydrogen from fossil fuels, mainly through hydrocarbon reforming and pyrolysis. In addition, several electrolyser technologies currently exist at various stages of readiness, such as AEL and PEM electrolysis, which overcomes some of the issues associated with AELs, such as limited part load operation and low current density, and SOE, which operates at much higher temperatures, typically 800-1000 °C.

(284) Therefore, the hydrogen that is currently used for e-fuels and refineries is obtained from fossil fuels via SMR processes, instead of water electrolysis. During SMR process, hydrogen is combined with CO_2 to produce methane of natural gas grade purity. One possible source to obtain the CO_2 that is needed for the methanation are the lime kilns. In order to reduce the footprint and complexity of the purification process, it is desirable to produce a higher concentrated flow of CO_2 out of the kiln to facilitate maximising the capture rate. This can be done though oxy-combustion (i.e. use of pure oxygen instead of air, resulting in a fully concentrated CO_2 stream). However, currently there are no lime kiln to allow oxy-combustion.

(285) The main innovations that go beyond the current state-of-the-art are the following:

- as regards the size of the electrolysers, the scaling up from small-scale demonstrations to large-scale industrial electrolysers requires an important technological effort to overcome problems related to materials, efficiency, and in general reliability of the process;
- improved systems monitoring and digitalisation with the use of sensors, control logic and predictive maintenance technologies, thereby improving the reliability of the production chain;

- combination of hydrogen generation with CO_2 source (notably lime kiln): The development of the new type of kiln will allow the production of lime with a concentrated CO_2 dioxide stream (capturing both fuel- and process-carbon dioxide). The innovation lies also in the suitable integration of CO_2 purification process with the oxy-combustion process, and the selection of the most optimised purification process sequence to obtain a capture rate in excess of 90%; and

- upscaling of the methanation process and combining different methanation technologies, thereby developing existing technologies at industrial scale that can be used for other CCU projects in the lime industry and other large CO_2 emitting processes.

(286) In *metals (e.g. iron, steel and titanium)*, the current state-of-the-art for the main processes comprises the following:

- process gas heating: The current process of gas heating for DR processes is achieved by partial combustion of (fossil) flue gases, and if needed by combustion of additional fossil fuels. This process is not fossil-free;

- hydrogen-based DR of iron in steel production results from conventional natural gas DR process. Therefore, there are still considerations regarding the possibility of producing DR of iron at large industrial scale by using only hydrogen;

- optimisation of DR reactor: at laboratory level, the rate of reduction of iron oxides of the mineral with hydrogen is greater than with nitrogen. Over the years, the designers and manufacturers of pre-reduction plants have tried to optimise the design of the pre-reduction reactor and define the scale criteria that are based on the reduction kinetics;

- electrolyser technology development: regarding the various electrolyser technologies, currently there are only a handful technology suppliers that would be able to manufacture such electrolysers' at large size. Furthermore, the current life expectance does not exceed 10 years; and

- integration of the hydrogen production, pre-reduction and fusion: the most important aspect is the integration of the three main units, i.e. the electrolysers for the production of renewable and low-carbon hydrogen, the furnace for the DR process and the EAF fusion process. This integration process has currently not been implemented at industrial scale.

(287) As far as the innovations beyond the current state-of-the-art are concerned, they mainly comprise of the following:

- regarding decarbonised hydrogen heating, some individual projects plan to develop a direct electric gas heating concept at an intermediate scale with the installation of industrial scale heaters, thereby increasing the overall efficiency of the direct electrification of the hydrogen heating process;

- for the hydrogen-based DR of iron, a melting process in electric furnace based only on electric energy, possibly with the help of hydrogen burners, will be developed, thereby completely eliminating fossil fuels in the melting phase. In addition, during hydrogen-based DR, the reduction behaviour in terms of reduction rate and heat exchange between gas and pellets largely differs from traditional carbon monoxide/hydrogen reduction. Thus, adequate control schemes must be developed that are robust, reproducible and scalable, as well as new storage and aging tests that are expected to provide the basis for new regulations on how the material may be transported and stored; and

- regarding the electrolyser technology development, Hy2Use will enable the scaling up and integration of the two process systems (i.e. hydrogen and hydrogen-based DR) and allow taking full advantage of the excess heat and oxygen streams.

(288) In *chemicals and food*, the current state-of-the-art for the main processes comprise the following:

- Fields of hydrogen application: currently, use-cases for renewable and low-carbon hydrogen in protein production for human consumption are of minor or even no relevance. Several technologies as regards the valorisation of the carbon components of waste feedstock (e.g. transforming carbon and hydrogen contained in the waste into syngas, from which low-carbon hydrogen is produced through a dedicated chemical process), have not been tested at industrial scale; and

- Hydrogen bio-fermentation of single-cell protein has currently only been verified as pilot-scale.

(289) The main innovations are the following:

- alternative hydrogen solutions: development of renewable and low-carbon hydrogen in protein production for human consumption and use of DAC equipment; production of hydrogen, methanol and/or ethanol, which are chemical building blocks, sourced from the currently non-recyclable waste, thereby connecting waste management field with chemical production management field; development of a complete fluid dynamic model of gasifier, in order to evaluate and foresee gasifier performance when varying the feedstock and evaluate gasifier key-design parameters for future technology development; or, the use of large volumetric percentages of renewable and low-carbon hydrogen in methane in industrial furnaces, boilers and other pieces of equipment;

- hydrogen bio-fermentation of single-cell protein will be validated at large-scale production volumes;

(290) In light of the main general innovations described in the preceding recitals, the key expected results of the TF 2's R&D&I and FID specific innovation activities and the corresponding contribution of the participating undertakings are the following:

Key expected results	Contributing participating undertakings

R&D&I activities	
New process coupling, storage and transport strategies: • **Ammonia production and cracking** • **Efficient liquefaction with reduced energy need** **High safety of the plants using barrier management principles**	Fertinagro, RONA
Design the most suitable configuration of the electrolyser for optimum production and cost efficiency	Endesa, SardHy, SIGHy, VERBUND
Test, and integrate individual innovative components in electrolyser stacks	Endesa, VERBUND
Development of an integrated value chain from renewable energy (PV, Agri- photovoltaics), hydrogen production, hydrogen carriers, carbon capturing, chemical synthesis and or other elements	ENGIE BE, Fertinagro, Solar Foods, TfL VERBUND
Development of circular economy solutions, including innovative processes for the production of low-carbon hydrogen from non-recyclable solid waste	NextChem, Solar Foods, VERBUND
Catalyst for hydrogen based clusters and hubs	ENGIE BE, TfL
Test and design modifications in industrial equipment (burners, furnace, boilers and others) to allow the operation with renewable hydrogen as a fuel	Endesa, RONA
Define the optimal integration strategy between the electrolyser and the existing conventional hydrogen production systems	SardHy, SIGHy
Design the optimum condition for hydrogen use in industrial plant for steel production, kiln clinker production and glass melting	RINA-CSM, SardHy, TITAN
Design of the condition for evaluating performance, quality as well as relevance to standard and certification of materials and components for hydrogen use in industrial environment	RINA-CSM
Scientific investigation and engineering of the feed of green hydrogen, green oxygen and green excess heat for various industrial plants and uses to decrease in direct CO_2 emissions	Borealis, RONA, TITAN
FID activities	
Establishment of ammonia cracking facilities in ammonia terminals at major European ports, construction and successful demo operation of the feed of renewable and low-carbon hydrogen to existing ammonia plants, transition to renewable and low-carbon refineries	Everfuel, Fertinagro
Design specification, development, operational deployment and optimization of intelligent multi-ton, multi-bank hydrogen storage system	Everfuel
Contribute to strongly develop the European hydrogen industry	Endesa, ENGIE BE, Fertinagro, HDAB, NextChem, SardHy, SIGHy, TfL, VERBUND

Alignment with emission reduction goals	Endesa, ENGIE BE, Fertinagro, HDAB, NextChem, SardHy, SIGHy, Solar Foods, TfL, TITAN, VERBUND
Develop a dedicated control strategy and define the renewable and low-carbon hydrogen production plant operative practice, including a risk assessment	Endesa, ENGIE BE, Everfuel, Fertinagro, NextChem, TfL, VERBUND
Safety and technical regulations related to hydrogen, CO_2, oxygen, synthesis, etc., aspects of standardization, certification, safety codes, "learning plants" for educational visits by schools and/or research institutions, Dissemination and communication activities	Endesa, ENGIE BE, Fertinagro, NextChem, RINA-CSM, RONA, TfL, TITAN, VERBUND
Finding the best solutions for the excess heat and oxygen utilisation from the electrolysis process to be further used in other projects	Borealis, ENGIE BE, Everfuel, TfL
De-risk future projects and enhance the adaptation of renewable hydrogen	ENGIE BE, RONA, TfL
Contribute to the decarbonisation of hard-to-abate sectors, alignment with emission reduction goals	Endesa, RINA-CSM, SardHy, SIGHy
Participate to grid balancing services	Endesa, HDAB, SIGH
Use of renewable and low-carbon hydrogen as carbon neutral fuel and combustion enhancer in cement clinker manufacturing and glass production, in the iron/steel and metallurgical processes, to lower CO_2 emissions	RONA, TITAN

Table 25: Expected results from innovation - TF 2

(291) Based on the above, the Commission considers that content of the individual projects that will be implemented within Hy2Use satisfy the specific criteria set out in points 22 to 25 of the IPCEI Communication.

3.3.2.3. Importance of Hy2Use

(292) According to section 3.3 of the IPCEI Communication, in order to qualify as an IPCEI, a project must be important quantitatively or qualitatively. As demonstrated below, Hy2Use is particularly large in size and scope and implies a very considerable level of technological and financial risk.

(293) The Commission considers Hy2Use to be an important project meeting the quantitative and qualitative requirements set out in section 3 of the IPCEI Communication, based on the following:

- Hy2Use represents an important contribution to Union’s objectives (see recitals (190) to (204));
- Hy2Use is designed to overcome important market or systemic failures (see recitals (205) to(217));
- 13 Member States participate in Hy2Use (see recital (218));

- all Member States were given the opportunity to participate in Hy2Use (see recital (219));
- Hy2Use generates positive spillover effects (see recitals (220) to (231));
- Hy2Use involves important co-financing by the aid beneficiaries (see recital (232));
- Hy2Use complies with the principle of 'do no significant harm' (see recitals (233) to (243));
- The Commission was involved in the design of Hy2Use (see recital (245));
- The governance of Hy2Use involves the Commission (see recital (246));
- Hy2Use involves important collaborative interactions (see recitals (247) and (248));
- Hy2Use involves co-funding or co-financing from an Union fund (see recital (249));
- Hy2Use addresses a significant strategic dependency (see recitals (250) and (251)); and
- The infrastructure projects in Hy2Use are of great importance for the energy strategy of the Union and the projects involving R&D&I and FID meet the innovativeness requirements of the IPCEI Communication (see recitals (252) to (291)).

(294) In addition, the Commission acknowledges the considerable level of technological, economic, financial and other risks for the individual projects within Hy2Use.

(295) Regarding the technological risks, numerous individual projects within Hy2Use will be confronted with a number of technological hazards that could lead to an unacceptable failure in performance, cost and sustainability.

(296) Nevertheless, the large-scale electrolyser and transport infrastructure projects of TF 1 are highly complex and challenging, considering that they are based on interdependencies between generation, distribution and consumption. Especially in the ramp-up phase of these new infrastructures, which tend to be island-grids with few to no short-term switching options, the failure of one partner can become an investment risk for all other partners involved in the construction of the infrastructure. All the planned infrastructures have to fit into the hydrogen network, while any mismatches will inevitably lead to under- or over-dimensioning. As the entire network is still being erected, the likelihood of non-compatibility of the solutions developed in TF 1 within the growing network is significant. Therefore, in order to enable proper and cost-efficient repurposing of existing assets, the technical suitability must be fully assessed and novel retrofitting solutions should be developed to lower total investment costs of the future hydrogen infrastructure.

(297) The hydrogen technologies addressed in TF 2 are currently at an early stage of their development and they will require further validation and upscaling, in

order to meet the needs of the multiple industrial applications. In addition, a number of the materials, (sub-) components, and auxiliary systems required for the successful implementation of hydrogen projects either do not yet exist or have not yet been optimised, or they are only available at lab or demonstrator scale. It is therefore likely that delays will occur during R&D&I and FID activities, especially in cases of high-volume production requirements. Furthermore, all components developed within Hy2Use have to comply with the general hydrogen infrastructure. As this is still being erected, the likelihood of non-compatibility, as mentioned in recital (296), is significant.

(298) The technological risks also extend to the field of safety regulations. The handling of hydrogen requires multiple safety precautions. For example, hydrogen equipment requires a multitude of sensing and emergency shat off technical features, adding more complexity to the technical layout. Hydrogen technologies need to comply with established safety and standardisation rules that need to be verified by the responsible authorities. Potential disagreements over the technical lay out can lead to delays and additional costs.

(299) The deployment of hydrogen also faces economic and financial risks, considering that the amounts involved in Hy2Use are significant while the development of the hydrogen market is still uncertain. This uncertainty derives from the assumption that the participating undertakings may introduce their products on the market with a delay or the cost of competitive hydrogen technologies may decrease quicker than anticipated, thereby posing a significant economic risk to the innovative application of Hy2Use technologies.

(300) The participating undertakings furthermore will face strategic and organisational risks. The implementation period of Hy2Use and of the individual projects will be lengthy, and numerous changes of the projects' operating conditions are very likely to occur. The planned collaborations and synergies between multiple different stakeholders from various sectors, are expected to entail challenges. For instance, RTOs engaged in the development of certain building blocks of hydrogen technologies will need to cooperate with undertakings to achieve common scientific and technological objectives. In addition, the different contributors to Hy2Use will have to align their development schedules to reach the same level of maturity at the same time, in order to fit with customers' demand requirements. Any delay therefore will jeopardize the effective implementation of Hy2Use.

(301) The supply risks of Hy2Use moreover, will be significant in both TF. In TF 1 a substantial number of large-scale electrolysers will be installed. The manufacturing of electrolysers in turn depends on the availability of certain critical raw materials with low abundancy, e.g. Iridium, Platinum, Scandium or Yttrium). Any shortage in supply of such critical elements will inevitably and materially hinder the development of hydrogen technologies in TF 2 that is needed for the installation of the electrolysers.

(302) Finally, the participating undertakings will be confronted with high industrial risks. The large-scale deployment of the planned hydrogen technologies in TF 1 is unprecedented, whereas a stable and reliable infrastructure is required to generate large quantities of renewable and low-carbon hydrogen for industrial applications. In particular as regards the infrastructure projects of TF 2, these are

expected to run over a long period (see table 22 under recital (158)), during which changes of the operating conditions are very likely to occur. The can be exposed to numerous and significant risks that are not all identifiable and quantifiable at the start. The nominal objectives may not be achieved on their initial target date and unexpected events may affect the overall deployment. Therefore, the fulfilment of the initial schedule, as well as the construction and operational costs are subject to some degree of uncertainty.

(303) All of the above mentioned risks that the participating undertaking are confronted with during the implementation of their individual projects, demonstrate the importance of Hy2Use as a whole. The Commission considers that the Hy2Use is designed in such a way to enable the participating undertakings to overcome or at least minimise those risks. For example, the sharing of best-practices, know-how and results through the multiple collaborations established within Hy2Use, as well as with indirect partners, aim to enable the participating undertakings to overcome the technological risks involved, as well as to accelerate the implementation of the individual projects, thereby minimising the economic or financial risks that potential delays would have created. Furthermore, Hy2Use provides for the development of circular economy solutions that seek to promote the re-use and recycling of among other things critical raw materials, thereby minimising the risk of potential shortage of supply of such materials.

3.3.2.4. Conclusion on the eligibility of Hy2Use

(304) In view of the above, the Commission concludes that Hy2Use meets the eligibility criteria of the IPCEI Communication.

3.3.3. Compatibility criteria

(305) When assessing the compatibility with the internal market of aid to promote the execution of an IPCEI on the basis of Article 107(3)(b) TFEU, point 27 of the IPCEI Communication requires the Commission to take into account a number of criteria, as elaborated below in the present section. Moreover, point 28 of the IPCEI Communication also requires the Commission to carry out a balancing test to assess whether the expected positive effects outweigh the possible negative effects.

(306) The Commission analysed the compatibility criteria at the level of aid beneficiaries and per individual project.

3.3.3.1. Necessity and proportionality of the aid

<u>Necessity of the aid</u>

(307) According to point 30 of the IPCEI Communication, the aid must not subsidise the costs of a project that an undertaking would anyhow incur and must not compensate for the normal business risk of an economic activity. Without the aid, the realisation of the project should be impossible, or it should be realised in a smaller size or scope or in a different manner that would significantly restrict its expected benefits. According to footnote 26 of the IPCEI Communication, the application for aid must precede the starts of the works. According to point 31 of the IPCEI Communication, the Member State must provide the

Commission with adequate information concerning the aided project, as well as a comprehensive description of the counterfactual scenario, which corresponds to the situation where no aid is awarded by any Member State.

(308) The Commission has verified that all undertakings have submitted their applications for aid to the relevant Member States before the start of the works on their individual projects included in Hy2Use, therefore the formal incentive effect criterion, as required by the IPCEI Communication (footnote 26) has been met.

(309) The Member States have submitted information demonstrating that the aid has a substantive incentive effect for all aid beneficiaries, i.e. that the aid will induce the beneficiaries to change their behaviour by enabling them to engage in their individual projects in their full ambitious scope and in the time span as notified. More specifically, this is demonstrated by the counterfactual scenarios for each of the aid beneficiaries. For the participating undertakings with a clearly defined and sufficiently predictable counterfactual scenario, the Commission compared the net present value ("NPV") of the aided and of alternative projects, in line with point 32 of the IPCEI Communication. Furthermore, the Commission verified that the aid is kept to the minimum necessary to ensure the implementation of Hy2Use (see recitals (316) to (356)).

(310) The Member States confirm that, absent Hy2Use public financing, each of the aid beneficiaries has demonstrated that it either: (i) would not undertake their individual projects and, for example, would continue less environmentally-friendly activities or, (ii) if the beneficiaries would develop alternative projects, they would not undertake them with sufficient speed, or they would carry out activities with a significantly lower level of ambition, for example from an innovative or environmental point of view.

(311) The Member States have underlined that absent the aid, the development of a competitive, innovative and sustainable ecosystem would not take place. The innovations both in terms of increased performance and reduced environmental impacts, would not be made available to consumers, as each participating undertaking would have focussed on its own programme.

(312) In view of the above, the Commission notes that the information provided by the Member States shows that in the absence of aid, the participating undertakings would not undertake their individual projects under Hy2Use. Indeed, there is no evidence showing that the participating undertakings had considered such projects in their internal decision-making at the time of taking the decision to apply for the public support. Further, an analysis of the factual and counterfactual scenarios in the context of the funding gap (as discussed in recitals (341) to (343)), shows that undertakings would not have had a financial incentive to implement their projects in the absence of aid. Thus the absence of aid would jeopardise the materialisation of Hy2Use.

(313) The Member States submit (also where the aid would not cover the full funding gap (see recital (157)) that the aid helps to induce the change of the aid beneficiaries' behaviour in light of further strategic and security considerations (for example development of key enabling technologies to facilitate flexibility to the energy system, balancing supply and demand of electricity, strategic energy security considerations, etc.). Also, in its assessment of the eligible costs, the

Commission verified that the list of submitted costs would not include costs that an undertaking would have incurred in any event, such as costs linked to already existing laboratories in which research would have been conducted anyhow and the undertaking would have had to support those facility and personnel costs, even without Hy2Use.

(314) In view of the above, the Commission considers that the Member States have sufficiently demonstrated that the aid measures do not subsidise the costs of projects that the participating undertakings would have incurred in any event and do not compensate for their normal business risks.

(315) Considering the fact that the aid measures enable the participating undertakings to pursue ambitious projects, which would not have been pursued in the absence of Hy2Use, the Commission concludes therefore that the notified aid measures are necessary to induce a change in the aid beneficiaries' behaviour.

Proportionality of the aid

(316) According to point 32 of the IPCEI Communication, in the absence of an alternative project, the Commission will verify that the aid amount does not exceed the minimum necessary for the aided project to be sufficiently profitable, for example by making it possible to achieve an internal rate of return corresponding to the sector or firm specific benchmark or hurdle rate. According to point 33 of the IPCEI Communication, the maximum aid level is determined with regard to the identified funding gap and to the eligible costs. The aid could cover all of the eligible costs, provided that the aid amount does not exceed the funding gap.

(317) The Member States have submitted, for all participating undertakings, detailed calculations of the eligible costs for their individual projects as well as detailed funding gap calculations.

Assessment of eligible costs

(318) In its assessment of the eligibility of the costs, for all the individual projects, that the eligible costs comply with those that are set out in the Annex to the IPCEI Communication

(319) For all of the infrastructure projects within TF 1, the Commission consistently verified that the eligible costs are only those needed for the construction of the infrastructure until its full operation, as provided for in by the last sentence of point 25 of the IPCEI Communication. The aid is therefore exclusively meant to support the initial investment needed for the infrastructure to materials and not the functioning during its lifetime.

(320) Specifically, the Commission notes that all of the individual projects within TF 1 include in their eligible costs only the capital expenditures needed for the construction of the infrastructure to the exclusion of any costs related to its operation, including costs for supplies and for maintenance or refurbishments. Furthermore, the Commission verified that if the assets maintain a residual value at the end of the individual projects' financial projections, such value was appropriately deducted from the funding gap.

(321) The Commission consistently verified for all of the individual projects participating in TF 2 that a high innovation level is to be reached, and that the activities are not limited to merely enabling an incremental evolution of existing technologies embedded in hydrogen products already existing on the market (see recitals (270) to (291)). Moreover, the Member States have verified that the related R&D&I costs of each aid beneficiary comply with the Annex on eligible costs to the IPCEI Communication. The Commission confirms that these costs fall within the categories listed in points (a) to (h) as set out in the Annex to the IPCEI Communication. In line with points (b) and (c), if instruments and equipment or buildings, infrastructure and land are not to be used during the full life for Hy2Use, the Commission has verified that only the depreciation costs corresponding to the life of Hy2Use are considered for the calculation of the eligible costs. The Commission has also required that the aid beneficiaries demonstrate that the depreciation periods used correspond to good accounting practice.

(322) For the individual FID projects, the Commission verified, in order to determine whether they qualify as FID under the IPCEI Communication, that the FID activities:

a. concern “the development of a new product or service with high research and innovation content and/or the deployment of a fundamentally innovative production process”[52];

b. do not relate to “regular upgrades without an innovative dimension of existing facilities and the development of newer versions of existing products”[53];

c. consist in “the upscaling of pilot facilities, or [to] the first-in-kind equipment and facilities which cover the steps subsequent to the pilot line including the testing phase and bring batch production to scale”;

d. do not correspond to mass production nor to commercial activities”[54];

e. relate to the capital and operating expenditures ("CAPEX" and "OPEX") to the extent and for the period used for the project, as long as the industrial deployment follows on from an R&D&I activity and itself contains a very important R&D&I component, which constitutes an integral and necessary element for the successful implementation of the project[55].

(323) Having regard to the specificities of the hydrogen value chain concerned and the participating undertakings’ individual FID projects contained in Hy2Use, the

---

[52] Point 23 of the IPCEI Communication, first sentence.

[53] Point 23 of the IPCEI Communication, second sentence.

[54] Point 24 of the IPCEI Communication.

[55] Point (g) in the Annex to the IPCEI Communication. The wording of the IPCEI Communication implies that the very important R&D&I component that needs to be embedded in the FID costs in order for these to be eligible constitutes a limit both in scope and time ("as long as") on the eligible FID costs.

Commission has assessed the eligibility of FID costs for each aid beneficiary according to the above criteria, as follows.

(324) The Commission's assessment took into account, for each FID project specifically, the integration of the hydrogen technologies in systems and processes, their compatibility with the end-use applications, the technological complexity and performance going substantially beyond the global state-of-the-art hydrogen technologies and systems, the applications addressed and their specific constraints in particular in terms of safety and reliability. When assessing the setting up of processes (e.g. innovative process to integrate critical materials in electrolyser components or environmental compatibility of the electrolysis process, etc.), activities were only considered eligible where they relate to the introduction of processes that transfer the R&D&I performed before, into the FID phase, and are critical for the functionality of the resulting product. These activities were assessed against the most up-to-date publicly available information related to the different Hy2Use technologies and systems (including scientific and technical literature journals, corporate technical scientific publications, patents, etc.).

(325) The Commission finds for all aid beneficiaries, for each FID project, that it concerns either a new product with high R&D&I content or a fundamentally innovative production process or both (see recitals (270) to (291)).

(326) The Commission further finds for all aid beneficiaries engaging in FID projects that each of those projects concerns technologies with high R&D&I content or that are of a fundamentally innovative nature. These highly innovative technologies are a result from a preceding R&D&I activity, but they still require additional important R&D&I to be carried out, even after the R&D&I phase (e.g. for optimisation of electrolyser operation, for scaling up and integrating hydrogen technologies into the industrial processes or for in-plant validation of performing grid balancing services). As such, the FID of these specific technologies contains an additional important R&D&I component on its own (quantitatively or qualitatively), which is indispensable for the successful FID of the technologies.

(327) In relation to the very important R&D&I component, the Commission finds that all of the beneficiaries have provided an adequate demonstration of the very important (in quantitative and/or qualitative terms) R&D&I activities in their FID, which constitutes an integral and necessary element for the successful implementation of their individual projects. In particular, the Commission verified that each FID project demonstrated that the planned important R&D&I during the FID is necessary to solve outstanding technological roadblocks, among others in terms of hydrogen technologies integration, design stability, cost-effective automatized processes, testing and validation, safety and reliability of materials and components, in the context of the complex technologies and large number of processes involved. In particular, the assessment of the very important R&D&I component in the FID of each aid beneficiary took into account the following elements.

(328) In its assessment, the Commission verified, on the basis of the parameters established in recitals (322) and (324), that the FID is not a mere regular upgrade, without an innovative dimension, of existing facilities, or a

development of newer versions of existing products or technologies. Mere engineering work accompanying normal activities of FID does not constitute eligible costs for the required R&D&I in FID.

(329) In its assessment, the Commission further considered that where FID costs and the embedded R&D&I do not relate to the highly/fundamentally innovative technologies the beneficiary is developing, these are not eligible. Where the R&D&I in FID does not take place before the end of FID (end date in line with the IPCEI Communication), the FID costs are not eligible. The Commission has verified that such R&D&I costs are excluded from the eligible costs represented in tables 9 to 21, under recital (157).

(330) The Commission moreover verified that the FID as described by the Member States for the different aid beneficiaries does not cover mass production or commercial activities.

(331) In this context, the Commission first examined whether the different beneficiaries established KPIs (e.g. quality of product, durability, compatibility, energy consumption, safety, environmental impact, etc.) for identifying the moment in time that they reach a stabilised mass production. Any costs relating to production occurring after the KPIs have been met cannot be included in eligible FID costs. The Commission verified that they were not included in the eligible costs represented in tables 9 to 21, under recital (157).

(332) Furthermore, the Commission verified that the activities taking place during the FID phases notified by the Member States for the different participating undertakings correspond to FID activities and not mass production or commercial activities. Thus, in addition to verifying that the FID phases are accompanied by a significant R&D&I effort until the end of FID, the Commission also verified that the activities undertaken during these periods do not correspond to commercial activities both in quantitative and qualitative terms.

(333) In performing this verification, the Commission identified a FID phase as corresponding to a phase in which the undertaking starts to test the production of its new product or the new production method outside the lab and the pilot plant. Undertakings provide pre-commercial samples to selected potential customers to verify the quality of the sample and how it can be integrated in the potential customers' activities. Typically, at that moment, new issues will appear and the sample-product might need to be changed or the production process might need to be modified or further developed. During the FID, numerous trial runs and a critical number of testing scenarios will be performed at different days and shifts to validate the production process with many idle moments in between. This validation process is specific to the developed hydrogen technology, aiming to enable the preparation of a subsequent stable process that would facilitate the transition to mass production after the end of the FID phase (see (276)).

(334) In addition, as the activities supported under Hy2Use involve substantial innovations, the FID activities (including testing, sampling and upscaling) continue to involve an important R&D&I effort until the end of FID, which the Commission has verified, as indicated under recital (327)). During the ramp-up period, given that the production processes are put in place for the first time, complications are expected and adjustments will in any event be needed to

remedy the situation, potentially requiring that part of the production process to be redesigned.

(335) Even during the upscaling, potential customers expect the delivery of sample-products of a sufficiently high quality to be used for their own needs and requirements. In the FID phase, this cannot be achieved at arms' length. Customers will be particularly keen to require extensive liabilities from new entrants. Those quality assurances imply for the undertakings additional quality control, screening and sorting processes, which are not needed once the production process has stabilised and would also not be sustainable under normal commercial conditions (because they are too costly). During the FID phase, customers reserve the right to reject or return shipments not only in the event of a quality issue but also in cases that customer applications show technical problems or the market introduction is postponed, in particular from new entrants.

(336) The Commission verified that the planned FID activities included by Member States in the eligible costs calculations presented in tables 9 to 21, under recital (157): a) correspond only to the testing, sampling and upscaling activities described in recitals (333) to (335), b) include only activities that still require significant R&D&I effort, c) correspond only to a limited output volume, and d) when a small volume of sales is planned, those sales occur under extended liability conditions. Conversely, the Commission verified that sales occurring after product qualification and years for which high volumes of sales were already planned were not included in the FID and excluded from the eligible cost calculations summarised in tables 9 to 21, under recital (157), given that such sales would point to commercial activities.[56]

(337) The Commission's assessment confirms that the notified FID phases of all aid beneficiaries comply with the requirement of the IPCEI Communication not to cover either mass production or commercial activities and that the costs summarised in tables 9 to 21, under recital (157), for the FID phase of each beneficiary relate to FID within the meaning of the IPCEI Communication.

(338) With regard to the eligible FID costs, the Commission also verified that for cost items that are depreciated during several years, only depreciation costs until the end of the FID phase are included in the eligible costs. The Commission further required the aid beneficiaries to demonstrate that the depreciation periods used correspond to good accounting practice.

(339) With regard to the operating costs, which should be limited both in scope and in time to the R&D&I that the FID entails according to the Annex to the IPCEI Communication, the Commission examined thoroughly the costs information provided by the Member States and considers the requirement to have been fulfilled, because it has found that the operating costs constitute an integral and necessary part for the implementation of the R&D&I and FID activities of the individual projects.

---

56 According to footnote 24 of the IPCEI, "[l]imited sales, when necessary in the specific sector, related to the testing phase, including sample or feedback or certification sales, are excluded from the notion of 'commercial activities'".

(340) The Commission moreover generally reviewed the cost information provided by the Member States and summarised in tables 9 to 21, under recital (157), and considers that they fulfil the conditions set out in the Annex to the IPCEI Communication. Based on the above, the Commission finds that the costs notified by the Member States in relation to all aid beneficiaries constitute eligible costs for Hy2Use and fulfil the requirements of the Annex to the IPCEI Communication.

Assessment of funding gaps

(341) The Commission reviewed in detail the funding gap calculations provided by the Member States for each aid beneficiary and verified the main assumptions in those calculations, as explained below.

(342) The funding gap, as set out in point 33 of the IPCEI Communication, is equal to the difference between the NPV of the individual project within Hy2Use (or factual scenario) and the NPV of the counterfactual scenario (or the scenario where no State aid is provided). The NPV is the sum of the discounted future inflows and outflows of cash generated by an investment over its lifetime, thus also including the financial streams related to the mass production following from Hy2Use. The cash flows are discounted at the weighted average cost of capital ("WACC") of the aid beneficiary.

(343) The Commission assessed the funding gap of each project at the level of each aid beneficiary. This assessment comprises:

- first, ensuring that the funding gap is calculated as the difference between the NPV of the individual project within Hy2Use and the NPV of the counterfactual scenario; and

- second, reviewing and verifying the funding gap assumptions.

(344) Regarding the funding gap calculation, the Commission verified that each project provided a realistic factual scenario, as well as a realistic counterfactual scenario, this being essential to the correct calculation of the funding gap. For the counterfactual scenario, the Commission observes that the participating undertakings have reported the following options, in the absence of Hy2Use:

- they would undertake a project different, but comparable to the project under Hy2Use (e.g. delayed, smaller, etc.). This refers, for example, to projects that in the absence of Hy2Use would be delayed or would be undertaken on a smaller scale (e.g. smaller investment, leading to a smaller output or worse results in terms of emissions' reductions than the projects in Hy2Use); or

- they would continue their business as usual. This refers, for example, to those participating undertakings that are planning to introduce in Hy2Use renewable or low-carbon hydrogen in their production, with the aim to replace other and more polluting feedstock. In the absence of Hy2Use, these undertakings would continue producing with their usual methods; or

- they would undertake no alternative project in the hydrogen market. This refers, for example, to those participating undertakings that are currently energy producers, but that have not yet invested in any form of hydrogen and that are planning to start producing renewable or low-carbon hydrogen. In the absence of Hy2Use, these undertakings would not invest in the renewable or low-carbon hydrogen business.

(345) Regarding the funding gap assumptions, the Commission reviewed and verified them both for the factual and counterfactual scenarios. Particular scrutiny was applied to the revenues, terminal value and WACC assumptions.

(346) First, the Commission assessed and ensured that the projections of each individual project include all of the revenues expected to be generated from their respective investments. To this end, the Commission verified that the revenue streams:

- are comprehensive and thus in line with the technical characteristics of each of the individual projects;
- accrue over the entire lifetime of the investment and span over the expected life-cycle of the respective project; and
- lead during the project's lifetime to a profit margin in line with the market.

(347) Second, the Commission verified and ensured that each individual project's projections include a terminal value that captures any remaining expected market value of the project after the end of the projections.

(348) Third, the Commission verified that each individual project's WACC:

- corresponds to each undertaking's internal WACC. Deviations from this rule were assessed on a case-by-case basis.
- is calculated by applying the formula below:

$$WACC = \frac{E}{D+E} * \left(r_f + \beta * ERP\right) + \frac{D}{D+E} * (r_f + DP) * (1 - T),$$

where: E = equity, D = debt, r_f = risk-free rate, β = equity beta, ERP = equity risk premium, DP = debt premium and T = tax rate, and all of the parameters in the formula above, together with their sources and the methodology to determine them are provided.

- is in line with external benchmarks. To this aim, the Commission has identified benchmarks for the WACC's parameters based on publicly available data, with the aim of assessing the plausibility of the WACC.[57]

(349) Having verified compliance with each of the above elements for each of the individual projects, the Commission concludes that all participating undertakings have calculated their funding gap in line with the IPCEI Communication and guidance provided.

---

57 The benchmarks identified by the Commission reflect the country and industry risks of the individual projects.

(350) The Commission observes that both the eligible costs and the funding gaps have been calculated in line with the IPCEI Communication, and that the notified aid amounts do not exceed the minimum between the funding gap and the eligible costs (as reported in section 2.6.2).

Claw-back mechanism

(351) The Commission notes that the vast majority of individual projects will be subject, also in light of the very large aid amounts involved, to a claw-back mechanism, described in section 2.8 and in Annex I, which provides, in line with point 36 of the IPCEI Communication, an additional safeguard to ensure that the State aid remains proportionate and limited to the minimum necessary.

(352) In particular, by limiting to 60% the share of the extra profitability that can be clawed-back by the Member State (see Annex I), the claw-back mechanism notified by the Member States ensures, as provided for by point 36 of the IPCEI Communication, a balanced distribution of additional gains when the project is more profitable than forecasted and maintains strong incentives for beneficiaries to maximise their investment and project performance.

(353) Furthermore, the claw-back mechanism notified by the Member States will apply only to those investments which reach, based on the *ex post* cash flow results and of State aid disbursements, a rate of return exceeding the beneficiaries' cost of capital (specifically the beneficiaries' WACC, see Annex I).

(354) The Commission further notes that the IPCEI Communication recognises that it may be appropriate to take steps to ensure that the claw-back mechanism does not result in disproportionate burdens. In this respect, footnote 30 of the IPCEI Communication, states that "[f]or projects by SMEs, no claw-back mechanism needs to be implemented unless in exceptional circumstances, in particular in consideration to the amounts of aid notified for such projects". In Hy2Use, notwithstanding their size, some SMEs will be granted very large amounts of aid, in excess of EUR 50 million, which exceeds their turnover (i.e. P2X and Solar Foods in table 12). This amount can be deemed an exceptional circumstance considering that, in order to qualify as an SME under the relevant Union definition[58], the enterprise's annual turnover must not exceed EUR 50 million. In this light, the Commission considers that, in the present circumstances, a claw-back mechanism which is limited by reference to the amount of the notified aid, per individual project, is more appropriate to avoid disproportionate administrative burdens than a mechanism based on the size of the relevant undertaking. Consequently, the Commission considers it appropriate for the claw-back mechanism to apply also for individual projects by SMEs, where the notified aid amount is higher than EUR 50 million.

(355) In addition, the Commission notes that cumulation with other aid, de minimis aid or EU funding will be allowed to cover the same eligible costs, provided that the total amount of public funding granted in relation to the same eligible costs

[58] See Annex I of Commission Regulation (EU) No 651/2014 of 17 June 2014, declaring certain categories of aid compatible with the internal market in application of Article 107 and 108 of the Treaty, OJ L 187/1, 26.6.2014.

does not exceed the most favourable funding rate laid down in the applicable rules of Union law.

(356) Therefore, the Commission considers that the aid to be granted by the notifying Member States is proportionate.

3.3.3.2. Prevention of undue distortions of competition and balancing test

Appropriateness

(357) According to point 42 of the IPCEI Communication, the Member State must provide evidence that the proposed aid measure constitutes the appropriate policy instrument to address the objective of the project.

(358) The Member States submit that State aid is the appropriate policy instrument to support Hy2Use. In their view, due to the exceptional size of Hy2Use and the synergies it requires from the various partners, it could not be achieved without the support of the Member States involved in the financing of Hy2Use. Alternatively, the participating undertakings would not deliver breakthrough innovations and large-scale infrastructure projects whose spillover effects largely benefit the EU ecosystem.

(359) The Member States further argue that the payment of direct grants constitutes the appropriate instrument in view of the high risk of Hy2Use in financial and technological terms and the low expected profitability induced by the relevant spillovers. It is considered further that the use of direct grants limits the potential financial losses in case of project failure. Also, Member States submit that direct grants address the coordination problems and encourage the participating undertakings to commit to their projects for the achievement of common objectives.

(360) The Commission shares the views of the Member States that given the level of ambitions pursued by Hy2Use, its size and numerous collaborative interactions that it will induce, the public support through the notified State aid measures constitutes the appropriate policy instrument to address the objectives of Hy2Use. Considering the market failures identified, in particular the need to address the negative externalities involved (see recitals (207) and (208)), and taking into account the level of risk and uncertainty (see recitals (294) to (302)), the Commission considers the use of direct grants to be appropriate.

Identification of the potential risks of distortions of competition

(361) According to point 43 of the IPCEI Communication, aid can be declared compatible if the negative effects of the aid in terms of distortions of competition and impact on trade between Member States are limited and outweighed by the positive effects in terms of contribution to the objective of common European interest. The assessment of the potential negative effects of the aid under the IPCEI Communication needs to consider, in particular, the effects on competition between undertakings in the markets concerned, as well as risks of market foreclosure and dominance (points 44 and 45 of the IPCEI Communication).

(362) The Member States provided detailed information and reasoning on the absence of undue distortions to competition in relation to each individual project under the Hy2Use. In particular, the Member States argue that the markets impacted by Hy2Use are either non-existent (as they are yet to be developed) or are in the very early stage of their development. According to the Member States, this is reflected by the fact that most of the participating undertakings of Hy2Use are not currently active in the markets in which they intend to develop their products as a result of the discussed aid measures. In the few cases of participating undertakings already active in these markets, the Member States argue that there should be no concerns of undue distortions of competition for the markets impacted by Hy2Use. The Member States also argue that the current and expected market shares of the participating undertakings already active in markets impacted by Hy2Use are not material. The Member States in their submissions also indicate that there will be no risk of foreclosure and overcapacity as a consequence of Hy2Use.

(363) The Commission's analysis of undue distortions to competition is specific to the particular case at hand. The assessment of potential distortions to competition was carried out taking into account the particularities of the sectors and TF concerned and participating undertakings involved. The assessment of the potential negative effects of the aid under the IPCEI Communication needs to consider, in particular, the effects on competition between undertakings in the concerned product markets, as well as risks of market foreclosure and dominance.

(364) The assessment of distortions to competition has followed a consistent approach across all projects, while each project was assessed individually in detail by the Commission. Hy2Use involves a large number of undertakings, each with a current or future presence in a wide range of product and service markets concerned along the hydrogen production value chain. For this reason, in this particular case, the Commission adopted a two-step approach, as described below, in order to identify potential significant competition distortions that might result from the aid measures.

(365) First, the Commission screened projects based on the position of the participating undertakings in the markets affected by Hy2Use. In particular, the Commission screened participating undertakings based on a uniformly available metric on production in the EEA (the "PRODCOM" statistics on the production of manufactured goods collected by the EU Member States). The Commission requested and received data on the aid beneficiaries' past production (2016-2020) values by 8-digit PRODCOM classification for the products categories related to the aided project in Hy2Use. Based on this information, the Commission assessed the share of European production of the respective undertakings involved in the project, a proxy to horizontal market shares.

(366) This first screening step of the assessment was further developed by adapting it, when necessary, to the particularities of the sectors concerned and participating undertakings involved. In particular, the assessment considered the “type” of project as reflected by the technical field it addressed. This allowed defining and focusing the assessment to be tailored to the markets actually affected by the aid measure:

- for TF 1, the assessment was based on PRODCOM values, which proved to be well-fit for purpose; and

- the competition assessment has shown that the potential of distortions to competition was highest for projects under the technological field TF 2 . Indeed, projects under technological field TF 2 concern the development of new technologies in several hard-to-abate industrial sectors such as ammonia, metals, chemicals, e-fuels, refineries, cement and glass, where the latter are sectors where undertakings are already active. Accordingly, in this preliminary screening, the Commission requested and received data on the aid beneficiaries' past market shares (2016-2020) at a broader 4 digit NACE Rev. 2 level (statistical classification of economic activities in the European Community) corresponding to the end-use activities of the aid beneficiaries involved in the respective projects, as well its main competitors active in these categories. Consequently, the Commission followed a conservative approach in assessing proxies to horizontal market shares of undertakings, as it has undertaken its assessment both at both broader (4 digit NACE Rev. 2 level) and finer (PRODCOM) industry classifications.

- this assessment aimed at identifying individual projects where there may be risks of dominance and foreclosure by strengthening or maintaining substantial market power of the aid beneficiaries.

(367) For those undertakings and projects raising potential concerns based on their position in the markets affected by State aid to Hy2Use, the Commission further assessed whether other competitors active in the EEA markets, which may or may not have benefitted from public support, could be in any way foreclosed by the participating undertakings.

(368) The Commission has also undertaken the assessment of potential risk of overcapacity. The Commission's assessment has shown that the aid granted under the Hy2Use is limited in scope in relation to the current economic activity of the undertakings and the overall hydrogen-based economic activities. In particular, while projects under TF 1 of Hy2Use are expected to lead to the creation of approximately 3.5 GW of new electrolyser capacity (see recital (21)), the target goal outlined by the Commission in the EU Hydrogen Strategy is to reach 40 GW of renewable hydrogen electrolysers in the EU by 2030 (see recital (192)).

(369) Second, the Commission reviewed the more detailed information provided for each participating undertaking by the relative Member State and carried out an overall assessment of competition distortions based on that information.

(370) Following the assessment described above, the Commission has undertaken a balancing test to assess whether the expected positive effects of the aid outweigh its possible negative effects. The positive effects of the aid considered in the balancing test included concrete contributions of projects under Hy2Use to addressing well-defined market failures (see recitals (205) to (217), as well as the objective of the common European interest (see recitals (190) to (204)). Furthermore, potential negative effects in terms of market foreclosure and dominance are be mitigated by the participating undertakings' commitments to disseminate R&D&I results (see recitals (223) to (224)) and to unconditionally license IP-protected results of the funded projects based on FRAND conditions (see recitals (225) to (226)). Moreover, in view of the fact that the hydrogen

sector remains nascent and is expected to expand significantly, the Commission considers that the risks of Hy2Use giving rise to concerns based on overcapacity are limited.

(371) The analysis of the detailed information available to the Commission, therefore, leads to the conclusion that the risks of foreclosure, dominance and overcapacity are likely to be outweighed by the positive effects of Hy2Use (see recital (293).

3.3.3.3. Transparency

(372) The transparency requirement, specified in section 4.3 of the IPCEI Communication, is fulfilled (see recital (168)).

3.3.4. Conclusion on compatibility

(373) Based on the assessment under the IPCEI Communication, the Commission concludes that the notified aid measures are compatible with the internal market pursuant to Article 107(3)(b) TFEU.

3.3.5. Reporting obligation

(374) According to point 49 of the IPCEI Communication the execution of the project must be subject to regular reporting.

(375) As notified by the Member States, the execution of Hy2Use will be subject to annual reporting by the participating undertakings and the Member States. This reporting is three-fold:

- first, the participating undertakings will report annually the execution of their activities, as regards the advancements of their individual projects, the individually committed spillovers and the compliance with the principle of ‘do no significant harm’ to the national funding authorities and any other complementary activities with other EU initiatives, for example, the Clean Hydrogen Joint Undertaking or the Horizon Europe programme. The reporting period will ideally reflect the Member States’ annual reporting obligation towards the Commission;
- second, the Member States will provide annually a summary report (of the undertakings’ execution of their activities) to the Commission. In accordance with the Member States’ notifications, a template will be created by the FG during its first meeting and evaluated by the Commission. The reporting will be scheduled based on the annual FG meetings. A detailed description on the reporting mechanisms will be defined after the initial FG meeting, as well as the respective reporting period; and
- third, the SB, which has the role of supervising the monitoring and implementation of Hy2Use as a whole (see recital (33)), will report annually to the Commission on the progress of Hy2Use (including through KPIs). The reporting period should ideally follow the reporting of the Member States to the Commission.

(376) Further, the concerned Member States have agreed to report to the Commission on the application of the claw-back mechanism (see Annex I).

(377) The Commission therefore considers that the reporting obligation on the execution of Hy2Use is fulfilled.

4. CONCLUSION

(378) In view of the above and in light of the notifications of the Member States, the Commission has decided:

- not to raise objections to the aid on the grounds that it is compatible with the internal market pursuant to Article 107(3)(b) TFEU.

If this letter contains confidential information which should not be disclosed to third parties, please inform the Commission within fifteen working days of the date of receipt. If the Commission does not receive a reasoned request by that deadline, you will be deemed to agree to the disclosure to third parties and to the publication of the full text of the letter in the authentic language on the Internet site: http://ec.europa.eu/competition/elojade/isef/index.cfm.

Your request should be sent electronically to the following address:

European Commission,
Directorate-General Competition
State Aid Greffe
B-1049 Brussels
Stateaidgreffe@ec.europa.eu

Yours faithfully,

For the Commission

Margrethe VESTAGER
Executive Vice-President

CERTIFIED COPY
For the Secretary-General

Martine DEPREZ
Director
Decision-making & Collegiality
EUROPEAN COMMISSION

ANNEX I

CLAW-BACK MECHANISM

The aid is capped in nominal terms by the notified and actual eligible costs. Member States will also ensure that the discounted value in 2022 terms of the aid (using the notified WACC as a discount factor) will not exceed the notified funding gap.

The claw-back mechanism will apply to those individual aid projects by the aid beneficiaries for which the notified aid amount, per Member State and per individual project, is above EUR 50 million.[59]

The basis for the claw-back mechanism will be *ex post* figures, which have been subject to annual approval by an independent auditor. For this purpose, separate analytical accounting will be required from the aid beneficiaries in the relevant Member State for their individual project or projects.

Letter of credit

Starting as from two years after the completion of the eligible R&D&I/FID-phase for such projects, respectively two years after the end of the construction phase in the case of infrastructure projects, and then, every year, until an "End date"[60], a test will be run ("test-run"). In each test run, a $Surplus_i$ for year "i" will be computed corresponding to the net present value, interest-adjusted to year "i" (using the notified WACC as an interest-adjustment rate[61]), of the actual audited post-tax cash flows (including Capex, State aid disbursements and additional benefits[62]; and excluding financing cash flows) from 2022 to year "i"[63].

---

59 The threshold of EUR 50 million of aid amount is to be understood in nominal terms. If the aid eventually disbursed to the aid beneficiary for an individual project is lower than EUR 50 million, also in nominal terms, the individual project will be relieved from the claw-back mechanism. In such case, the Member State disbursing the aid commits to inform the Commission of the occurrence of a lower than notified aid amount and of the inapplicability of the claw-back mechanism within 2 months after final disbursement of the aid.

60 The End date for the purposes of the claw-back mechanism is set at the year corresponding to the last year that has been considered in the notified funding gap analysis for the relevant individual project, regardless of the category (R&D&I and/or FID, infrastructure project). In the event of delays in the implementation of the individual projects compared to the notified schedule, the "End date" will be extended accordingly.

61 This means that for instance, for a test-run in 2027, a cash flow in 2022 will be multiplied by (1+WACC)^(5).

62 For the purpose of the claw-back mechanism, "additional benefits" mean: a) additional public financial contributions – including any other State aid measure or public funding - in relation to the same eligible costs of the individual project; b) additional revenues directly resulting from the individual project, such as sales of by-products or remuneration under balancing services; c) avoided costs directly resulting from the individual project. For example, explanations on how ETS (EU emissions trading scheme) costs were accounted for in the ex post figures of the project shall be provided by the aid beneficiary which shall, if applicable, also justify and account for underlying regulatory mechanisms leading to avoided costs under the ETS. In such a case, the aid beneficiary shall duly justify that this accounting methodology is consistent with the basic scenario and counterfactual scenario used for the determination of the notified funding gap.

63 For inputs and outputs for which a market price can be computed, if the ex post figures of the project, which have been subject to annual approval by an independent auditor, significantly differ from market prices, evidence shall be provided by the aid beneficiary to duly justify the gap between the market price and the figures of the project. In case of insufficient evidence, the relevant market price shall be used in the figures for the application of the claw-back mechanism.

$Surplus_i$, if it is positive, will be multiplied by an allocation ratio $ShareState_i$ defined as the lesser between 60% or the net disbursed State aid from 2022 to year "i" divided by the verified eligible costs from 2022 to year "i" (both expressed in nominal terms).

The claw-back mechanism only applies in case of positive net present values of cash flows after taking into account the actual State aid disbursements. No surplus can be generated by projects with negative net present value after State aid[64].

A letter of credit (by a reputable financial institution having investment grade rating from a first-rank rating agency) should cover the repayment obligation at the End date by the aid beneficiary, from the first test-run.

The secured amount guaranteed by the above-mentioned letter of credit should be at least equal to an amount ensuring that the two following principles are fulfilled:

1) The secured amount must never be negative (initial balance equal to zero);

2) The secured amount must, after each 5th test-run[65], correspond to the lower of the following, if positive:

   - the $Surplus_i$ multiplied by $ShareState_i$ (computed at that test-run)

   - The sum of the actual State aid disbursements between 2022 and that test-run expressed in terms of the year "i" of the test-period. For all the disbursements before that test-run, the discount factor will be the EU reference rate applicable to the Member State concerned according to the Commission's communication on setting the reference and discount rates[66] applicable at year "i", increased by 100 basis points, between the corresponding disbursement and year "i".

An amount equal to the final secured amount, after the last application at the End date, will be transferred to the Member State.

The application of the claw-back mechanism will be reported by the relevant Member State to the Commission within 1 month following completion of each test-run and after the End date.

Account with annual transfers

Alternatively, the Member State, instead of the letter of credit system described above, may opt for an account-based system. This system will apply exclusively if the two following conditions are both met: a) the account to be used for the purpose of applying the claw-back mechanism is not under the control of the aid beneficiary; and b)

---

64 In line with point 36 of the IPCEI Communication, according to which "The claw-back mechanism […] should apply only to those investments which reach, based on the ex post cash flow results and of State aid disbursements, a rate of return exceeding the beneficiaries' cost of capital." To be noted that the beneficiaries' cost of capital is taken into account since the net present value is computed using those beneficiaries' WACC as the discount factor.

65 This means that the letter of credit must be adjusted every 5 years or after every 5th test run.

66 OJ C 14, 19.1.2008, p. 6.

computations and transfers to/from the account by the aid beneficiary must take place once every year[67] until the End date.

The balance of that account should never be negative and no transfer by the Member State to the account shall take place at any time.

This account-based system must not be more favourable from the aid beneficiary perspective than the letter of credit system[68] and should ensure comparable results.

The annual application of the claw-back mechanism will be reported by the relevant Member State to the Commission within 1 month following completion of each test-run (e.g. for projects starting in 2023, first reporting on application of the claw-back mechanism in July 2024 and thereafter every July until the final application after the End date).

[67] Not later than in the first six months of the year following the year of implementation the project (e.g. for a project starting in 2022, by end June 2023 at the latest).

[68] Excluding the specific administrative costs of a letter of credit, as well as fees and deposit interests related to an account.

ANNEX II

TABLE OF ABBREVIATIONS

Abbreviation	Meaning
AC	Alternative current
AEL	Alkaline electrolysis
AEM	Anionic exchange membrane
CAPEX	Capital expenditure
CCU	Carbon capture and utilisation
CO_2	Carbon dioxide
DAC	Direct air capture
DC-DC	Direct current converter
DR	Direct reduction
EAF	Electric arc furnace
FRAND	Fair, reasonable, and non-discriminatory terms
GHG	Greenhouse gas
GW	Giga Watt
IP	Intellectual property
KPI	Key performance indicator
MW	Mega Watt
NPV	Net present value
OPEX	Operational expenditures
PEM	Proton exchange membrane
RES	Renewable energy sources
PtX	Power-to-X
PV	Photovoltaic
RES	Renewable energy sources
SMR	Steam methane reforming
SOE	Solid oxide electrolyser

SPV	Special purpose vehicle
TEN-E	Trans-European Networks for Energy
TRL	Technology readiness level
WACC	Weighted average cost of capital