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[Non-confidential version]
[The information in square brackets is covered by the obligation of professional secrecy][1]

Ministry of Trade, Industry and Fisheries
PO Box 8090 Dep
0032 Oslo
Norway

**Subject:** **Important Project of Common European Interest on Hydrogen Industry (Hy2Use) – Norwegian projects**

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[1] ESA notes that some of the information covered by professional secrecy is only so temporarily due to special circumstances. ESA will publish a second non-confidential version of this Decision at a later date.

ESA | EFTA Surveillance Authority



# 1 Summary

(1) The EFTA Surveillance Authority ("ESA") wishes to inform Norway that, having assessed the aid to Barents Blue Ammonia Plant ("Barents Blue") and TiZir Titanium and Iron AS ("Tizir") participating in an Important Project of Common European Interest ("IPCEI") (the " aid measures"), it considers that they constitute State aid within the meaning of Article 61(1) of the EEA Agreement and decides not to raise objections[2] to the measures, as they are compatible with the functioning of the EEA Agreement, pursuant to its Article 61(3)(b). ESA has based its decision on the following considerations.

# 2 Procedure

(2) On 17 December 2020, 22 EU Member States and Norway agreed on a "Manifesto for the development of a European "Hydrogen Technologies and Systems" value chain".[3] This manifesto recognises the importance of promoting cross-border collaborations and of working on large-scale joint investment projects, in order to

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[2] Reference is made to Article 4(3) of Part II of Protocol 3 to the Agreement between the EFTA States on the Establishment of a Surveillance Authority and a Court of Justice.

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

support the development and deployment of hydrogen technologies and systems,[4] 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 "EU") energy and climate targets, also in light of the EU Hydrogen Strategy.[5] On this basis, the signatories agreed to promote the realisation of Important Projects of Common European Interest ("IPCEI") on hydrogen.

(3) In this context, Norway and several EU Member States launched national calls for pre-selecting potential projects. Given the large interest from stakeholders and the variety of technologies and systems identified within the value chain, it was decided to design more than one potential IPCEI on hydrogen (together referred to as "IPCEI Hydrogen").

(4) Following the signing of the manifesto, Norway initiated a selection process to select potential Norwegian participants in the IPCEI. In this regard, on 18 December 2020 Norway launched a national call for expression of interest for direct participation in IPCEI Hydrogen. Twenty-six project descriptions were submitted by 1 February 2021. By the end of April, Norway had pre-selected five of these projects to be introduced to the formal European match-making procedure. In addition, Norway launched a national call for expression of interest for indirect participation in IPCEI Hydrogen on 12 April 2021, i.e. for participants/undertakings to connect their activities to IPCEI Hydrogen without being an aid awardee. Thirty-six companies expressed interest in indirect participation and were allowed to join the informal matchmaking procedure on the platform B2Match.

(5) 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 to the European Commission ("the Commission") their plans to participate in an IPCEI on Hydrogen Industry ("Hy2Use").

(6) On 31 August 2021, Norway pre-notified three projects to participate in Hy2Use to ESA. All pre-notifications were made on the basis of a common draft overall descriptive text (so-called "Chapeau" document) which was prepared taking into account the criteria of the IPCEI Communication.[6] It provides detailed information on Hy2Use, its components and the individual projects.

(7) On the following dates, the EU Member States notified State aid for the execution of Hy2Use to the Commission: Belgium on 24 August 2022, Austria, Italy and the

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[4] 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.

[5] 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.

[6] 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), see also ESA's Decision No 280/21/COL of 13 December 2021 amending the procedural and substantive rules in the field of State aid by introducing new Guidelines on 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 L 181, 7.7.2022).

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.

(8) On 26 August 2022, Norway notified[7] State aid for the participation of two Norwegian undertakings in Hy2Use: the Barents Blue project and the Tizir project (together referred to as the "Norwegian projects").[8] These two projects are part of the overall structure of Hy2Use and will collaborate with other undertakings in Hy2Use.

(9) ESA, pursuant to Article 109(1) of 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 the provisions of the EEA Agreement have been complied with by Norway. On the basis of Article 109(2) and Protocol 27 to the EEA Agreement, 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, ESA has cooperated with and consulted the Commission before adopting the present decision.

(11) Due to the parallel competence of ESA and the Commission, the present decision assesses the compatibility of the Norwegian projects, the Barents Blue project and the Tizir project. References to the other projects participating in Hy2Use are therefore limited to providing context or where necessary for ESA's assessment. For a detailed description of the remaining projects participating in Hy2Use, see the Commission's decision not to raise objections to the IPCEI on Hy2Use, adopted on 21 September 2022 (the "Commission's Hy2Use Decision")**.**[9]

## 3 Objectives and description of Hy2Use

### 3.1 Objectives of Hy2Use

(12) The 14 participating States in Hy2Use, hereunder Norway, (together referred to as the "participating 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 3.2.2), and by supporting the development of hydrogen technologies to be used in multiple industrial sectors (see section 3.2.3). Hy2Use, *inter alia*, seeks to contribute to reach the specific goals of the EU Hydrogen Strategy,[10] as well as the EU's objectives in reaching its decarbonisation targets, in particular the *European Green Deal* and the *REPowerEU Plan* (see paragraph (251)).

(13) The participating States intend to grant aid to the participating undertakings in Hy2Use with the aim of establishing infrastructure projects of great importance for

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[7] See Documents No 1309522, 1309522, 1309378 and attached annexes.

[8] The third Norwegian project initially pre-notified withdrew its application during the course of the procedure.

[9] State Aid SA.64631 (2022/N) Austria and others – *Important Project of Common European Interest on Hydrogen Industry (Hy2Use)*, (not yet published).

[10] 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.

the energy strategy of the EU and of developing innovative and sustainable technologies for the use of hydrogen in different industrial sectors. These go substantially beyond the current state-of-the-art. Hy2Use will thus bring together undertakings operating at different levels of the value chain.

(14) 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;[11]
b) boost the supply of renewable and low-carbon hydrogen, thereby reducing the 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 training 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.

(15) The following section describes Hy2Use as it has been presented by the participating States in the Chapeau document.

### 3.2 Description of Hy2Use

(16) 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.

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

#### *3.2.1 Description of the two TF*

(18) Both TFs of Hy2Use focus on key stages of the hydrogen value chain. Along this value chain, within and across both TFs, the participating undertakings will collaborate in order to adequately meet Hy2Use's objectives and overcome a number of identified challenges.

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[11] The "European hydrogen backbone" is an initiative jointly developed by European gas infrastructure companies 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/.

### *3.2.2 TF1 - Development of hydrogen generation and transport infrastructure*

(19) 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 ("TEN-E"),[12] 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 EU 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[13] compared to the conventional method based on fossil fuels) and indirectly (in the use of 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; and

- integrating innovative traceability systems for certifying renewable hydrogen.

(20) In order to achieve these objectives, all of the projects must overcome 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 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 renewable energy sources, whilst reducing concurrently downstream electricity grid congestion.

### *3.2.3 TF2 - Development of hydrogen technologies for industry applications*

(21) 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

[12] 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).

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

end-use sectors are: ammonia, metals, chemical, food, e-fuels and refineries, and cement and glass.

(22) 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.

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.

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.

(23) The main challenges, during both the R&D&I and FID phases, relate 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 the 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.

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

- in the ammonia sector, there is currently a lack of knowledge on how to develop a more efficient ammonia production method that can also ensure a renewable ammonia product;
- in the metals sector, the current technologies for decarbonised hydrogen heating are nascent and optimised control schemes for hydrogen-based direct reduced iron technology, for instance, need to be further developed;

- 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 needs to be avoided.

#### *3.2.4 Description of the participating undertakings in Hy2Use*

(25) All participating undertakings in Hy2Use are briefly described below. The Norwegian projects are described in more detail under sections 3.6 and 3.7:

- Barents Blue Ammonia Plant (“Barents Blue”)[14]

Barents Blue (Norway) is a joint venture (“JV”) that will be established to undertake the Barents Blue project. It will be owned by Horisont Energi AS (“Horisont Energi”), Vår Energi ASA (“Var Energi”) and Equinor ASA (“Equinor”) and will be active in the ammonia production sector. The Barents Blue project, which Barents Blue undertakes, involves the production of blue ammonia, i.e. ammonia produced with close to zero $CO_2$ emissions.[15]

- Tizir Titanium and Iron AS (“Tizir”)

Tizir (Norway) operates an ilmenite upgrading facility in Norway and produces high-value titanium slag and high-purity pig iron. Tizir is 100% owned by Eramet. The Tizir project, which Tizir undertakes, is an R&D&I project aimed at developing technology to replace coal with hydrogen as a reducing agent in their processes.

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

These undertakings (the Netherlands and France) produce and supply industrial gases (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.

- Bondalti ("Bondalti")

Bondalti (Portugal) is active in the chlor-alkalis ("PCA") productive sectors in the inorganic chemicals segment, and ailine and by-products ("PAD") in the organic

[14] This name is the proposed title of the JV and subject to final approval; the name of the future JV may therefore evolve at a later stage.

[15] Above 98% $CO_2$ capture rate.

chemicals segment. It produces chlorine, hypochlorite and non-integrated aniline, and sells aniline and mononitrobenzene ("MNB").

- Borealis Agrolinz Melamine GmbH ("Borealis")

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

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

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.

- 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 fertilisers for agriculture. Fertinagro's focus will be the development of new animal feed solutions.

- South Italy Green Hydrogen ("SIGHy")

SIGHy (Italy) is a 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 company 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 ("TfL")

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

- 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") 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 AB ("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 steel making value chain.

- H2ermes BV ("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 industrial scale.

- H2-Fifty BV ("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.

- Iberdrola ("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")[16]

MassHylia (France) is a JV owned by TotalEnergies (France) and ENGIE, 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 SpA ("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 A/S ("Ørsted")

[16] 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.

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")

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.

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

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.

- 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) focuses on the development, production, and sale of utility glassware and manufactures lead-free household crystal ware.

- 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 a food-tech SME which develops platform technologies for food ingredients and produces protein for human consumption by using hydrogen and air-captured $CO_2$.

- TITAN Cement S.A. ("TITAN")

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

- Uniper Benelux N.V. ("Uniper")

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

- VERBUND AG ("VERBUND")

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.

### 3.3 Governance of Hy2Use

(26) A governance structure will be set up for the implementation and monitoring of Hy2Use. This structure is summarised 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: Governance structure*

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

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

(28) 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 individual projects, as well as of the project 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 also be responsible for the annual reporting to the Commission. This reporting will take place on the basis of the information provided by the FG.

(29) In principle, the SB will meet twice a year, by 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.

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

(31) The GA will be organised once a year, gathering all participating undertakings and the representatives of the States including 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 for adopting decisions on any changes in the composition of the FG. In particular, the GA elects the chair and the deputy of Hy2Use as well as the coordinators of each TF (including their substitutes). These will be members of the SB. It will also designate a participating undertaking, 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.

(32) The FG is composed of the chair and 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. The FG will be in charge of the TF coordination, the annual reporting, the communication, the preparation of events, etc. It will drive the overall progress of the TF on a non-confidential basis to establish a permanent interface between private and public stakeholders, aiming to highlight the role and impact of Hy2Use.

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

(34) A Hy2Use meeting will take place once a year. The first meeting will take place at the latest one year following the approval of Hy2Use. The meeting will consist of 1) a dedicated session for the participating States, the Commission and the participating undertakings and 2) a public conference open to any interested party. The participating undertakings will present the main results of their works in the public conference.

(35) The Hy2Use website will include public information about Hy2Use and the participating undertakings. The website will also serve as the dissemination and interaction channel of Hy2Use, thus potentially engaging entities other than the participating undertakings. The website will for example list all spillover activities to which the participating undertakings have committed. 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 which 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 activities to which the participating undertakings committed. 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.

(36) The individual projects are also governed by funding agreements between the undertakings and the relevant funding authority. Such funding agreements impose requirements and obligations towards the administration of any individual project according to the rules established by the funding authority. The national funding authorities are in possession of the commitments of all participating undertakings. The PAB will be responsible for monitoring the completeness of the listings and the announcements of the committed spillover activities and knowledge dissemination.

## 3.4 Hy2Use as an Integrated Project

### *3.4.1 Introduction*

(37) Norway and the other participating States submit that Hy2Use is an integrated project within the meaning of paragraph 13 of the IPCEI Communication. The following section describes the main arguments presented. 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 Chapeau document. The two TF of the programme are not only complementary, but are mutually connected and significantly add value to each other in order to meet their separate objectives and those of Hy2Use as a whole. The sections below describe the complementarity of the two TF and how the Barents Blue project and the Tizir project are complementary to the other individual projects and significantly add value, in order to achieve the goals of Hy2Use.

(38) Two main outcomes are expected from Hy2Use. First, 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). Second, the demand for renewable and low-carbon hydrogen is expected to increase by technological innovations in different end-use sectors (scope of TF 2). The Barents Blue project and the Tizir project participate in TF 2.

(39) Each individual project is one constituent of Hy2Use, whereas collaborations amongst the participating projects aim to build up its integrated nature. The overall work plan is developed according to a model aimed at facilitating the generation of cross-border efforts towards common objectives.

### *3.4.2 TF 1: The significant added value and complementarity of the individual projects for the achievement of the goals of TF 1*

(40) TF 1 is divided into four main tasks and involves 20 individual projects by the following participating undertakings, namely Air Liquide FR, Air Liquide CurtHyl, Air Liquide ELYgator, Bondalti, EDP-A, EDP-LB, ENGIE Electrabel, ENGIE NL, Fluxys, H2-Fifty, HyCC, Iberdrola, MassHylia, Orlen, Ørsted, Petronor, P2X, Repsol, Shell, and Uniper. The tasks in TF 1 are:

1) the installation of large-scale electrolysis capacity to enable the generation of renewable and low-carbon hydrogen;
2) the connection of the newly built-up renewable and low-carbon hydrogen generation capacity to different transport and storage infrastructures;
3) the integration of renewable and low-carbon hydrogen, thereby ensuring the functionality of the energy system; and

4) the investigation into regulations, standards and safety issues for the use of hydrogen in large-scale electrolysers.

(41) The individual projects in TF 1 are complementary, as they are all designed in a common structure and programme in order to achieve the objectives of the TF, which are detailed in section 3.2.2.

(42) The significant added value of each individual project participating in TF 1 and the complementarity of the individual projects for the achievements of the goals of TF 1 are described and assessed in the Commission's Hy2Use Decision.

### *3.4.3 TF 2: The significant added value and complementarity of the individual projects for the achievement of the goals of TF 2*

#### 3.4.3.1 Main tasks

(43) TF 2 involves 17 individual projects, by the following participating undertakings: Barents Blue, Borealis, Endesa, ENGIE BE, Everfuel, Fertinagro, HDAB, NextChem, RINA-CSM, RONA, SardHy, SIGHy, Solar Foods, TfL, TITAN, Tizir and VERBUND.

(44) According to the participating 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.

(45) TF 2 is divided into two general main tasks, which are common to all sectors concerned. Each sector displays its own technical characteristics and is thus further sub-divided into additional tasks. The participating States submit that this overall division is important and adds 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.

(46) 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.

For R&D&I:

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.

For FID:

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

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

c) supplying 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.

(47) 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.

(48) 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. The Barents Blue project specifically aims at capturing 99% of the overall emitted $CO_2$ while retaining industry leading energy efficiency;

b) in the metals sector, the design and development of pilot plants and related components for the use of hydrogen (e.g. installing R&D&I modules for the production of direct reduction ("DR") of iron, thereby reducing the $CO_2$ emissions). The Tizir project specifically aims to prove that a fluid bed process for ilmenite can be scaled up to industrial level, with all product qualities intact, and to verify that this will significantly reduce the carbon footprint of the production;

c) for chemicals 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).

3.4.3.2 The significant added value of the Norwegian projects

(49) The Barents Blue project

The project aims to design and deploy a blue ammonia plant[17] in demanding artic conditions and of a scale comparable to current ammonia plants. Barents Blue plans to capture 99% of carbon emissions thanks to innovative and first-of-a-kind plant design. If successful, the project will demonstrate the feasibility of a truly innovative ammonia production value chain.

(50) The Tizir project

The project plans to develop a hydrogen based pre-reduction process for ilmenite, which means to replace coal with hydrogen in a fluid bed process. The hydrogen pre-reduction process is based on the […] technology,[18] which was originally developed as a Direct Reduced Iron ("DRI") technology.

Tizir's full project comprising development, testing and verification of the […] technology through two pilot installations and subsequent scale up, removing more than 80% of its carbon footprint, will be a major breakthrough for industrial application of the […] technology. It has never been applied to ilmenite processing and will as such be a fundamentally new process.

(51) The significant added value of the other individual projects participating in TF 2 are described and assessed in the Commission's Hy2Use Decision.

3.4.3.3 The complementarity of the projects in TF 2

(52) 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.

(53) The complementary character of the individual projects is illustrated by a number of collaborations within the TF, as explained in section 3.4.5.1. The collaborations entered into by the Norwegian projects are provided as an example.

*3.4.4 Description of the significant added value of each TF and complementarity between TF 1 and TF 2 for the achievement of the objective of Hy2Use*

(54) Norway and the other participating States submit that each of the two TF significantly adds value to and is complementary with the other to meet the objectives of Hy2Use.

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

[17] Based on capture and storage of $CO_2$ emissions.
[18] More details about the technology are available at […].

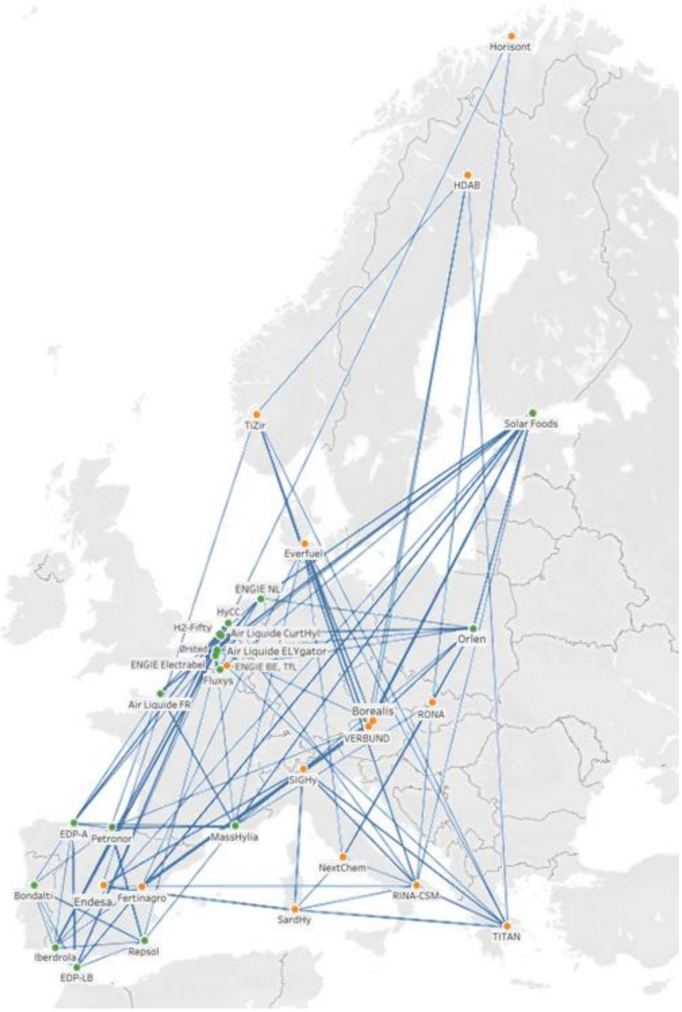


***Figure 1: Schematic representation of collaborations envisaged in Hy2Use***

(56) The figure illustrates the many collaborations between the two TF, illustrating the complementarity. Some examples of the collaborations between TF in which the Norwegian projects participate are described in section 3.4.5.2.

(57) More specifically, 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).

(58) Concerning the complementarity with TF 2, the renewable and low-carbon hydrogen generated by the 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.

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

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

#### *3.4.5 Collaborations within Hy2Use with respect to the relevant TF*

(61) In addition to the significant added value and complementarity of the individual projects within each TF, the participating undertakings have established strong collaborations within and across the two TF. These would not occur to this extent without Hy2Use, according to Norway and the participating States.

##### 3.4.5.1 Examples of collaborations intra TF

(62) There are a number of collaborations in TF 1. For example:

- 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 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 a blueprint on optimal reuse of existing power and water supply for the electrolyser; assessment and development of blueprint 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 permitting purposes 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 EU 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.

(63) There are also a number of collaborations in TF 2.

(64) Tizir specifically is strategically working on two different roadmaps for collaboration and dissemination of its results:

1. Collaboration across industries on technology development seeking to find the best solutions in terms of materials of construction, safety etc.
2. Dissemination of its R&D&I findings to other hard-to-abate industries, particularly the steel industry, enabling a green transition also in that sector. Tizir believes that its findings will make the […]-technology more attractive for this sector, allowing the replacement of the existing polluting processes.

(65) Tizir has the following collaborations with undertakings participating in TF 2:

- With RINA Consulting on developing and sharing common experience, standards and procedures regarding safe use of hydrogen in high temperature industrial production facilities. They will for example exchange information about materials of construction and process equipment. They will disseminate key outcomes together, with the aim of maximising spillover effects in the hard-to-abate industry value chains across Europe (iron/steel production industry being particularly likely to reap spinoff innovations). The partners will organise spillover sessions together to disseminate the results of the joint collaboration at least on a yearly basis.

- With TITAN Cement S.A on the possibility to use clinker with lowered carbon footprint and/or low carbon cementitious materials for cement production. They will also share experience, standards and procedures regarding safe use of hydrogen in high temperature industrial production facilities. The partners will organise spillover sessions together to disseminate the results of the joint collaboration at least on a yearly basis.

- […]

(66) Examples of other collaborations within TF 2 are:

- 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 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.

3.4.5.2 Examples of collaborations between TF 1 and TF 2

(67) Concerning the collaborations between TF 1 and TF 2, the following non-exhaustive list of examples demonstrate the complementarity of the TFs:

- Barents Blue will work with Air Liquide France Industrie and Air Liquide Industrie B.V on EU safety standards and norms and EU low carbon/renewable certification aiming to form the basis for a common European regulatory framework. The partners will exchange and share information on 1) safe operation practices of large-scale electrolysers and 2) the traceability practices and certification methods of low carbon and renewable hydrogen.

- […]

- MassHylia and Everfuel will exchange the results of their research activities on the flexible operation of large-scale 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.

### 3.5 Positive spillover effects generated by Hy2Use

(68) The participating States submit that Hy2Use will generate important dissemination and spillover effects of its results across the EEA. This dissemination will be made possible through:

a) the dissemination and spillover of results that are not protected by IP rights (see section 3.5.1);

b) the dissemination and spillover of results that are protected by IP rights (see section 3.5.2);

c) the dissemination and spillover of results during the FID (see section 3.5.3); and

d) the dissemination and spillover of results to other indirect partners[19] and to other sectors (see section 3.5.4)

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

(69) The individual project portfolios detail that each participating undertaking commits to and will participate in dissemination and spillover activities up until, and including, the final year of its individual project. The dissemination and spillovers expected by all participating undertakings on the EU side are described in the Commission's Hy2Use Decision. Enova[20] (the aid grantor for the Norwegian projects) will monitor the implementation of the dissemination and spillover commitments of the two Norwegian projects, which are detailed below.

### *3.5.1 Dissemination and spillover of results that is not protected by IP rights*

(70) Barents Blue and Tizir commit to disseminate knowledge and results that are not protected by IP rights to the scientific community and the industry in a number of ways. These are detailed below.

#### 3.5.1.1 Participation in external events

(71) Barents Blue and Tizir commit to participating in conferences and public presentations in the framework of established international events, during which they will disseminate knowledge and project results that are not protected by IP rights.

(72) The events captured by the dissemination activities of Barents Blue and Tizir cover a number of EEA States and the international arena, going beyond the participating States. Some of them bring together a number of different sectors. Many events are open to participants from all EEA States; some are provided in a hybrid format, which ensures a wide geographic coverage of the dissemination activities of the two undertakings.

(73) The project team of Barents Blue will actively engage in sharing the project results and lessons learnt with the industry, the scientific community and other relevant stakeholders. It will participate in expert working groups, webinars and conferences particularly within the hydrogen or ammonia value chain. Shared results will include achieved energy efficiency of the ammonia production, $CO_2$ capture rate, smart system design features and circular practices in the process, sustainable selection of materials and consumables as well as system safety design features.

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[19] Indirect partners are undertakings and organisations that do not directly participate in Hy2Use. Nevertheless, they hold collaboration agreements with one or more participating undertakings and they can therefore benefit from the various dissemination activities (e.g. knowledge dissemination of R&D&I and FID results or open access to laboratory facilities, etc.).

[20] https://www.enova.no/.

(74) Barents Blue plans to attend and give presentations at the following events:

| **Conference Title, Location**[21] | **Main topics addressed** |
| --- | --- |
| Fernley Energy Conference. *Oslo, Norway* | Gathers industry leading companies and investors globally to discuss clean energy and technology development in the field. The conference is hybrid.<br>The Barents Blue project will give the following presentation:<br>*Barents Blue project and clean ammonia related presentation* |
| Ammonia Energy Association. (AEA) | AEA is dedicated to the development of clean ammonia and new industries using clean ammonia. The Barents Blue project plans to give the following presentations at their events:<br>1. *Barents Blue project related activities presentation.*<br>2. *Ammonia as fuel in shipping.*<br>3. *New environmental standard for clean ammonia plants.* |
| NH3 Event. *Rotterdam, Netherlands* | Event organized by AEA in May 2022. Barents Blue gave a presentation of the project earlier in 2022. |
| Pareto Energy conference. *Oslo, Norway.* | Gathers industry leading companies and investors globally to discuss clean energy and technology development in the field. The conference is hybrid. The Barents Blue project will be presented. |

(75) Tizir plans to participate in the following events to disseminate results from their R&D&I activities:

| Conference Title, Location[22] | Main topics addressed |
| --- | --- |
| International Ferro Alloy Conference (INFACON) | The intention of INFACON is to stimulate technical interchange on all aspects of silicon/ferroalloy production. INFACON contributes to the exchange of research and development covering the major and most of the minor ferroalloys. In 2021, the conference was hosted by SINTEF, NTNU and FFF (The |

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

| | |
|---|---|
| | Norwegian Ferroalloy Producers Research Association), and organised in cooperation with the International Committee on Ferro-Alloys (ICFA). |
| The Minerals, Metals & Materials Society (TMS) | TMS2023 will present more than 90 symposia planned by all five TMS technical divisions and covering a broad range of topics related to minerals, metals, materials science and engineering. |
| Heavy Minerals Conference (HMC) | Forum for an exchange of technical knowledge concerning heavy minerals, including exploration, processing and product applications. Arranged by the Southern African Institute of Mining and Metallurgy. |
| Norsk Hydrogen Symposium. *Tyssedal, Norway.* | Yearly Hydrogen Symposium focuses on news concerning development of the Hydrogen industry in Norway. Tizir is a co-host. |
| International Foundry Trade Fair (GIFA). *Dusseldorf, Germany.* | GIFA is a leading trade fair for casting technology. |
| TZ Minerals International Pty Ltd (TZMI) Congress. *Singapore.* | The TZMI Congress is a yearly congress for the worldwide titanium dioxide industry, Singapore. |
| Pigment and Color Science Forum. | Pigment and Color Science Forum is a yearly conference for pigments (including $TiO_2$). |

(76) Both companies will increase both the frequency of their participation in such events, as well as the frequency of giving presentations, due to the commitments undertaken as part of Hy2Use.

#### 3.5.1.2 Dissemination and spillovers through the European collaborative R&D&I ecosystem

(77) Barents Blue and Tizir also commit to disseminating the results not protected by IP to the scientific community. To this end, they will collaborate with the scientific community and with indirect partners.

(78) Barents Blue and Tizir will finance and contribute to the creation or development of university or school chairs related to technologies developed under Hy2Use with a view to training future European scientists, experts, engineers, technicians and operators.

(79) Barents Blue together with its dissemination partners will host dedicated transnational meetings and workshops of companies, start-ups, students and university professors. Barents Blue will select 1-2 universities for longer collaboration focusing on clean ammonia topics related to sustainable production

methods, safety, energy efficiency and reduced carbon footprint. The undertaking aims to finance 4-6 PhDs and 10-15 Master's Theses ("MT").

(80) Concerning the Tizir project, the following indicative list of research technology organisations ("RTOs") will benefit from the dissemination results of the project, demonstrating an increase compared to the undertaking's target value absent Hy2Use:

| Institution | Scope of the Funding/Collaboration | Financed University Chairs **within** Hy2Use | Financed University Chairs **without** Hy2Use |
|---|---|---|---|
| Norwegian University of Science and Technology (NTNU) | • Gas/solids hydrogen reduction processes<br>• Melting behavior hydrogen decarbonised reduced solids | 2 PhDs | 1PhD |
| Norwegian University of Science and Technology (NTNU) | • PhD support<br>• Pre-reduction ilmenite<br>• Smelting technology | 5 MT | 2 MT |
| Høgskulen på Vestlandet | Life Cycle Analysis (an analysis of the environmental impact of an activity over its lifetime) – Reduction using coal vs. H2 | 2 MT | 0 |

3.5.1.3 Participation in clusters and other initiatives

(81) The results of the Barents Blue project and the Tizir project will also be disseminated through the clusters, consortia and other dissemination initiatives.

(82) Barents Blue specifically will participate in the following clusters:

| Cluster | Description |
|---|---|
| European Clean Hydrogen Alliance | EU driven project portfolio of clean hydrogen projects. |
| Ammonia Energy Association | Dedicated to the development clean ammonia and new industries using clean ammonia. |
| Energi i Nord | Norwegian Hydrogen Cluster in North Norway. |

(83) Barents Blue also plans to also arrange for a number of open days for interested partners, members of the Ammonia Energy Association, the press and politicians.

(84) Tizir plans to participate/participates in the following clusters:

| Cluster | Description |
|---|---|
| SFI (Center for Research based Innovation) 2015 – 2023 | Cluster of industrial participants (aluminum, ferro alloys, slag/iron), research institutes (SINTEF, Norce, FFF) and a university (NTNU). Hosted by NTNU. |
| SFI (Center for Research based Innovation) 2023 – 2027 (for application) | For application but will build on the same platform. |
| Reduced $CO_2$ Emission in metal production 2018-2022 | Cluster of industrial participants (Ferro Alloys, Slag/iron), research institutes (SINTEF, FFF) and university (NTNU).<br>Hosted by SINTEF. Partly funded by NRC. |

(85) In addition, Tizir plans to support FME HYDROGENi in Trondheim, Norway. FME HYDROGENi is a consortium consisting of about 50 industry partners, 8 R&D partners and about 30 international associated R&D institutions – which are expected to deliver research and innovation to accelerate the realisation of Norway's hydrogen roadmap ambitions for 2030 and 2050. FME HYDROGENi will cover the entire value chain of hydrogen, seeking to foster technologies for green and blue hydrogen and ammonia for energy, mobility and hard-to-abate industries.

#### 3.5.1.4 Dissemination and spill-overs through publications in scientific journals

(86) Over the course of Hy2Use, Barents Blue and Tizir plan to disseminate their research results in various scientific peer-reviewed journals, many of which have a European or world-wide scope.

(87) Barents Blue aims to publish its findings widely. Its dissemination activities will include publications by the Master's and Phd students financed as part of the project. Publications are expected in several journals, for example the International Journal of Hydrogen Industry that aims to provide a central vehicle for the exchange and dissemination of new ideas, technology developments and research results between scientists and engineers. Barents Blue aims to have a minimum of 5-10 publications in journals over the course of Hy2Use. Many of these will be in cooperation with its suppliers and/or academia.

(88) Tizir on the other hand aims to have 1-2 publications per year (in total) in the following scientific journals:

| | |
|---|---|
| ISIJ International | Peer-reviewed monthly publication of the Iron and Steel Institute of Japan. |

| | |
|---|---|
| Metallurgical and Materials Transactions B | An archival, peer-reviewed, bi-monthly publication that is uniquely focused on the processing science and engineering of metals and materials. The journal publishes original research and reviews. |
| Canadian Metallurgical Quarterly | Publishes research on all aspects of metallurgy and materials science, including minerals processing and physical metallurgy. |
| Steel Research International | Journal providing a forum for the publication of high-quality manuscripts in areas ranging from process metallurgy and metal forming to materials engineering as well as process control and testing. The emphasis is on steel and on materials involved in steelmaking and the processing of steel. |

3.5.1.5 Training events

(89) Barents Blue and Tizir have committed to organising educational academic dissemination through dedicated training of professionals and researchers. These activities follow up on the development of the new hydrogen technologies and aim to strengthen the skills of those involved and to maintain competitiveness in the hydrogen market.

(90) Barents Blue plans the following activities:

- apprentice trainee opportunities in the Barents Blue production facilities;
- engineering and Master's students performing assignments with topics related to the Barents Blue project, including site visits;
- PhD assignments on topics relevant for the Barents Blue ammonia plant where the student can visit the plant and work hands-on with the process;
- process operator training for operators for the Barents Blue ammonia plant; and
- regular events for industry experts from the Energy and Ammonia Association, including plant visits and presentations.

(91) Tizir will continue to be a co-host of the yearly symposium, Norsk Hydrogen Symposium.

*3.5.2 Dissemination and spillover of knowledge that is protected by IP rights*

(92) Barents Blue and Tizir have committed to the dissemination of the IP-protected results achieved under Hy2Use. This dissemination will be carried out in different ways. As a matter of principle however, both undertakings will disseminate the IP-protected results owned by them as a result of their projects on fair, reasonable, and non-discriminatory terms ("FRAND").

(93) The partners in the Barents Blue project plan to distribute the knowledge gained so that replication of the blue ammonia production gained in the project is made possible. The novel elements developed as part of the project will be owned by

Barents Blue, with perpetual, world-wide user-rights provided to the Engineering, Procurement, Construction ("EPC") supplier performing the work or *vice versa* (depending on the contractual arrangements). This way, the suppliers of the project can use the developed IP to deliver similar solutions to other customers in other locations, ensuring dissemination of knowledge protected by IP rights. This is expected to happen on FRAND terms. Barents Blue will share operational results from the emission free ammonia plant based on the Haldor Topsoe technology. Similar concepts, based on the expected findings of the Barents Blue project, are already being developed in Russia and the United States.

(94) Tizir will share certain results with its direct and indirect IPCEI Hy2Use partners on a royalty-free basis (details to be defined between the IPCEI partners based on negotiation and agreement). Other access rights will be subject to agreement between the owner and buyer. […]. Findings within the project related to the […] process will be taken care of in a commercial context to assure availability in the market for all other actors, including direct and indirect partners to the IPCEI Hy2Use. General R&D findings will be published in peer reviewed publications.

*3.5.3 Dissemination and spillover effects in FID*

(95) Barents Blue will disseminate the results during the FID phase in several ways, leading to spillover effects among the participating undertakings in Hy2Use but also beyond them, involving indirect partners and society in general.

(96) Concretely, the realisation of the Barents Blue project at industrial scale requires close cooperation with many actors, including SMEs and local suppliers. A close collaboration with RTOs and SMEs will be necessary to scale-up technologies from laboratory to industrial scale. The Barents Blue project and its partners will share knowledge and publish project results from the FID phase in order to facilitate the potential for replication. As a member of the Ammonia Energy Association, the Barents Blue project is actively involved in standardisation work concerning green and blue (hydrogen and) ammonia.

(97) Furthermore, the blue ammonia produced on site at the Barents Blue ammonia plant will be offered on a non-discriminatory basis to interested off-takers. The plant might also be upscaled in the near future. The first plant will enable the production of approximately 1 million tonnes of blue ammonia and the aim is to increase production capacity to 3 million tonnes of blue ammonia. This expected increase in capacity will not only lead to additional $CO_2$-savings, but will also create more local jobs, enhance the transfer of technical know-how and multiply the positive spillover effects of the project.

*3.5.4 Dissemination and spillover effects to other indirect partners and to other sectors*

(98) The participating undertakings have committed to disseminating knowledge and results arising from their individual portfolios with other undertakings, organisation and sectors outside Hy2Use, through their involvement in collaborations with 170 indirect partners.

(99) Indirect partners are undertakings and organisations that have not submitted an individual project within Hy2Use. They nevertheless hold collaboration agreements with one or more participating undertakings of Hy2Use and can therefore benefit

from the various dissemination activities (e.g. knowledge dissemination of R&D&I and FID results or open access to laboratory facilities, etc.).

(100) Hy2Use is expected to generate spillover effects to other industrial sectors. Hydrogen as material and energy carrier will be urgently needed by all 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.

(101) ESA mentions the following collaborations between the Norwegian projects and indirect partners as examples of such spillover effects.

(102) The Barents Blue project has a number of indirect partners with whom they will cooperate on a range of subjects. They will *inter alia* collaborate with:

- Motor Oil Hellas Group (Greece) on developing bunkering solutions for the EU shipping industry, hereunder exchanging information on implementation of Carbon Capture and Storage ("CCS"), safety features and the potential application of novel technologies both in the production of hydrogen and also in storage, transport and bunkering.
- Port of Rotterdam (the Netherlands) on establishing a transport corridor from the Barents Blue ammonia plant to the Port of Rotterdam for commercialisation of the clean ammonia towards the maritime bunker market and the industrial market in Nordrhein Westfalen, Germany.
- Copenhagen Infrastructure Partners (Denmark) towards the development of a pan-European value chain for green bunker fuel for the shipping industry.
- Several partners, […] EURO FPV (Portugal) and Helen (Finland), on topics such as developing efficiency, safety and sustainability in large-scale hydrogen projects, e.g., applying safety in the early design phase, holistic barrier thinking, circular practices, noise and light pollution considerations and links to surrounding society.
- With Air Liquide France and Solaria Energías Renovables S.L. (Spain) on safety standards and norms and low carbon/renewable certification.
- Euro FPV (Portugal) on exploring the prospect of the Barents Blue project assisting them in the development of a green ammonia plant close to the Sines Port, and furthermore cooperation on shipping and marketing of the green ammonia.

(103) According to the Norwegian authorities, the knowledge and know-how gained in building the Barents Blue Ammonia Plant is expected to bring benefits also to other sectors. As 60-70% of blue and green ammonia plants are the same, the technology and know-how can benefit the clean ammonia sector in general. Bringing a large-scale pure hydrogen fired heater for production of steam and power can benefit a number of sectors. Using ammonia fired engines in ammonia transport vessels and $CO_2$ transport vessels may also benefit the transition of the maritime sector to clean fuels. Barents Blue will also spread the knowledge and know-how gained related to a more sustainable, environmentally friendly and circular system design. This may

benefit other sectors in the chemical industry. Finally, the Norwegian authorities have described that the CCS part of the project will be open for third party use, thereby aiding other undertakings towards decarbonisation.[23]

(104) Tizir has focused on the potential spillover effects of developing processes based on the […] technology also for the iron/steel sector. The ilmenite and steel industry face similar challenges to develop processes where hydrogen can replace the current use of fossil raw materials. Due to the similarities between the smelting operations in the two sectors, the Tizir project will make the […]-technology more interesting and accessible also for the steel industry. Tizir has a number of indirect partners in the steel industry (ArcelorMittal Eisenhuttenstadt, ArcelorMittal France, Thyssenkrupp and Salzgitter Flachstahl), with whom they will cooperate on the implementation of hydrogen as replacement of carbon/coke in the metallurgical industry in Europe.

## 3.6 The Barents Blue project

### *3.6.1 Beneficiary*

(105) The Barents Blue project is part of TF 2 of Hy2Use. The project was created by the Norwegian clean energy company Horisont Energi in 2020, and has been developed since 2021 by Horisont Energi, together with Vår Energi and Equinor through a cooperation agreement.

(106) Horisont Energi is an undertaking incorporated in August 2019 to establish industry-scale production of clean hydrogen and ammonia. It intends to provide a secondary use of the required carbon storage infrastructure by delivering carbon storage services to the European market, both targeting fossil $CO_2$ and biogenic $CO_2$, i.e., carbon removal. The undertaking is headquartered in Sandnes, Norway. Equinor is an international energy undertaking. Equinor's portfolio of projects encompasses oil and gas, renewables and low-carbon solutions. It is headquartered in Stavanger, Norway. Vår Energi is a Norwegian oil and gas undertaking.

(107) Horisont Energi is currently the designated operator of the project, which is in the pre-FEED phase. Towards the end of pre-FEED phase, Horisont Energi, Equinor and Vår Energi will establish a JV structure, named the "Barents Blue Ammonia Plant", to operate the Barents Blue project.[24] This will occur before Q1 2023, and no later than the final investment decision, following a successful decision to initiate the FEED phase of the project. Barents Blue will be established either as a Norwegian limited liability company (*Norwegian: aksjeselskap – AS*) or as a Norwegian partnership (*Norwegian: ansvarlig selskap – ANS or selskap med delt ansvar – DA).* The three partners will be shareholders (owners) in this JV/SPV. Current envisaged equity distribution will be 40%/30%/30% (Horisont Energi/Equinor/Vår Energi).

(108) Consequently, the beneficiary of the measure is Barents Blue.

### *3.6.2 Description of the project*

[23] CCS activities are subject to the CCS Directive (Directive 2009/31) and require a separate assessment to ensure conformity with the said Directive from an internal market perspective. The present decision is without prejudice to any future assessment of ESA.
[24] The Norwegian authorities have stated that the project cooperation is not subject to competition authority notification or approval.

(109) The Barents Blue project involves the production of blue ammonia, i.e. ammonia produced with close to zero $CO_2$ emissions, [25] which is defined as an end use of hydrogen. The project is a first of a kind deployment of three interlinked parts:

1. A novel and sustainable ultra-low carbon blue hydrogen production and ammonia synthesis plant with natural gas, clean water and renewable electricity as feedstock;
2. An offshore carbon injection and storage facility for own use, but also for storage of $CO_2$ from third parties directly connected to the $CO_2$ compression system of the clean ammonia plant;
3. Ammonia transport vessels to ship clean ammonia to off-takers on the European continent.

(110) Under Hy2Use, public funding is granted to the first part, i.e. the hydrogen production and ammonia synthesis plant. The other two parts are needed to achieve a complete project and value chain, but are not part of the eligible scope and costs of Hy2Use. However, as described below, all parts are relevant to the assessment of the project and influence its economic viability.

(111) The overall objective of the project is to develop and implement a blue ammonia production plant system design delivering an overall $CO_2$ capture rate of above 99%. The objective is that it will be environmentally friendly and sustainable ammonia according to the best available safety, technology and efficiency standards, minimising the impact on the local environment. The Barents Blue project will produce about 190 000 tonnes of blue hydrogen per year, which will be synthesised into approximately one million tonnes of blue ammonia. The production plant will be located in Finnmark, Northern Norway.

(112) The choice of location for the Barents Blue project was influenced by the fact that Equinor has a natural gas plant at Melkøya, Norway. The Barents Blue project will be connected to this plant. The Melkøya plant has a targeted revision stop in […], which will be used to connect the Barents Blue project to the Melkøya plant.

(113) Its successful deployment will contribute to the TF 2 target in Hy2Use to cut the $CO_2$ emissions for the production of blue ammonia.

(114) The Barents Blue project consists of five work packages (“WPs”): WP1 - System design; WP2 – Engineering; WP3 – Construction; WP4 – Commissioning; and WP5 - Spill-over and Dissemination. These work packages entail an R&D&I phase and a FID phase.

| Project phase | Start date | End date | WP |
|---|---|---|---|
| R&D | 2022 | 2022/2023 | 1, 2, 5 |
| FID | 2022/2023 | 2025 | 3, 4, 5 |

*Table 2: Work packages in R&D&I and FID phase.*

#### 3.6.2.1 The R&D&I of the Barents Blue project

##### 3.6.2.1.1 Technological background and current state-of-the-art

[25] Above 98% $CO_2$ capture rate.

(115) Norway has stated that decarbonisation of existing ammonia production is important for it to reach its climate targets. Also, increased clean ammonia production beyond the limited existing production is needed for new opportunities for decarbonisation in other markets, through carbon-free marine fuel, carbon-free base load power and the use of clean ammonia as a clean hydrogen carrier. To achieve this, the production of blue ammonia needs to be realised.

(116) According to the Norwegian authorities, grey ammonia plants are the third biggest emitting sector within the industry sector, which is the largest emitting sector globally. In 2018, ammonia plants globally emitted 500 million tonnes of $CO_2$.[26] Therefore, given the current state-of-the-art, ammonia production is a $CO_2$ emissions intensive sector.

(117) The Norwegian authorities state that ammonia production in Europe is based on the sourcing of gas from the "dry gas" network, or on deliveries of LPG, LNG or similar products to storage facilities close to the ammonia plant sites. Moreover, existing producers of ammonia mainly use steam methane reforming ("SMR") technology, which uses tubular reformers as the main reformer. SMR technology is very mature and cost effective, but there is a limited ability to capture the $CO_2$ emissions from such plants. In addition, these plants experience methane slippage, thus emitting methane together with the $CO_2$. Most ammonia facilities in the world (using gas) are based upon the use of a variant of this technology.

(118) Furthermore, $CO_2$ capture from the syngas flow in SMR plants is a part of every plant design, as pure hydrogen and nitrogen is the feed for the ammonia synthesis loop. Autothermal Reformer ("ATR") technology is used in SMR facilities as a secondary reforming process. Large-scale ATR units are currently used in methanol and gas to liquid production, and large-scale ammonia synthesis based upon the Haber-Bosch process with capacities up to 3300 tonnes of ammonia/day exists as state-of-the-art.

(119) To achieve the high capture rate of 99% envisaged in the Barents Blue project, ATR technology needs to be applied. Any external power withdrawn from the grid also needs to be renewable. A combination of single stage, large scale ATR and ammonia synthesis loop does not exist in operation today.

(120) The Barents Blue project has identified several technologies as key for the realisation of such a novel plant. All of these technologies must be qualified, first through the R&D&I and FID phase before being be ready for commercial use.

(121) The single unit large scale ATR technology from Haldor Topsoe ("SynCOR Ammonia"), has been selected as one of the core technologies for the envisaged clean ammonia plant design.

(122) SynCOR Ammonia for large scale hydrogen production with the ultra-low steam-to-carbon (S/C) ratio of 0.6 has been available from about 2003-2004 following technology qualification work performed by Topsoe. A major breakthrough occurred in 2006 when the first such large scale SynCOR Ammonia plant was set up in

[26] The Royal Society Policy Briefing (2020) - Ammonia: zero-carbon fertiliser, fuel and energy store.

Qatar,[27] with a capacity to make 17,400 bpd[28] of diesel. This SynCOR Ammonia plant generated sufficient hydrogen to hypothetically be able to produce more than 6,000 MTPD[29] of ammonia. This was however not verified at the time.

(123) Several other SynCOR Ammonia plants were built around this time period and SynCOR Ammonia is currently the preferred technology for production of syngas for Fischer Tropsch processes (the chemical process for GTL). Recently, the SynCOR concept was expanded to also cover methanol production.

(124) Until recently, the lack of an appropriate catalyst for high temperature water-gas shift reaction prevented use of the SynCOR Ammonia for ammonia production. However, the many advantages of the SynCOR Ammonia process make it the most energy efficient technology in the marketplace today for large-scale chemical plants. Its application facilitates significant improvements in ammonia production costs compared to existing technologies.

(125) This technology has nevertheless not yet been put into commercial operation. Haldor Topsoe has spent significant resources and time developing the SynCOR Ammonia technology. Now, the Barents Blue project will use the technology developed and integrate it into a novel large scale clean ammonia plant with an ultra-low carbon footprint, very low freshwater use and very low energy consumption.

##### 3.6.2.1.2 R&D&I activities

(126) Specific R&D&I challenges need to be solved in order to go beyond state-of-the-art for clean ammonia production and achieve the project's objectives. These challenges relate both to the design of the clean ammonia production plant and to the design of the $CO_2$ capture system (the latter falling outside the aided project), and are detailed below.

(127) The R&D&I activities in WP1 and WP2 (R&D&I phase), as well as WP3 and WP4 (FID phase), are planned to get the technology beyond the state-of-the-art, solving the specific technical challenges.

(128) Specifically, the following technologies require R&D&I work:

- Fired heaters (syngas or hydrogen fuelled) removing almost 100% of the $CO_2$ emissions from this particular system;
- $CO_2$ capture system enabling above 99% $CO_2$ capture rate;
- Ammonia storage (rock cavern);
- Auxiliary boiler (hydrogen fuelled) to allow starting and shutting down the plant with hydrogen or syngas as fuel;
- The ammonia cracker. Installing this system allows for easier and more efficient storage of hydrogen;
- How water from the ammonia synthesis process can be cleaned and reused in a circular system;
- Remote operation system and fully automated plant;
- Clean plant system design;

[27] Gas to liquid plant – producing diesel from gas.
[28] Bpd – barrels per day.
[29] MTPD – metric tonnes per day.

- New system integrations such as integrating the cracking system into the plant to allow efficient start-up and shut-down, reintroducing treated produced water into the process water system, etc.;
- New winterisation strategy and design to maximise the use of waste heat sources rather than electricity;
- Modularisation of the clean ammonia process to minimise the impact on the local site during the plant development phase;
- Ammonia engine to allow back-up power to be provided from a clean source of energy;

(129) These technologies, central to the achievement of the objectives of the Barents Blue project, will be developed as part of the Barents Blue project as detailed in the table below.

[…]

*Table 3: R&D activities overview in R&D&I phase and FID phase (numbered references in the table refer to internal project classification)*

(130) In order to establish parameters that determine when the R&D&I phase of the project is completed, the Barents Blue project relies on a number of KPIs that define the level of maturity needed for the different components/technologies.[30] Once these KPIs are achieved, the project can move on to the FID phase.

3.6.2.2 The FID phase of the Barents Blue project

(131) The FID phase of the Barents Blue project focuses on the planning and implementation of the first-in-kind modern emission free ammonia plant with integration of $CO_2$ capture. The FID activity follows on from the R&D&I phase (see section 3.6.2.1.2 above), and itself contains important R&D&I elements (see table 3).

(132) The FID phase consists of building and equipping the planned ammonia facility, and maturing and testing the underlying technologies developed in the R&D&I phase.

(133) Completing the activities listed above in table 3 concludes the FID phase. The conclusion of the FID phase is therefore dependent on achieving several KPIs. These KPIs are:

- All technologies matured to TRL 8;
- All prefabricated modules successfully positioned and connected, and verified to accommodate all stresses and forces in full scale operation;
- Energy efficiency verified through full scale operation. Verifying also all waste heat recovery schemes and applications, electrical power and steam uses;
- The full plant has been shown to be able to meet 100 % production capacity (design values);
- Automation strategy for a fully automated clean ammonia plant successfully tested and commissioned;

[30] These KPIs are detailed and listed in the project portfolio of the Barents Blue project, see Document No 1309384.

- System design functionality verified by achieving above 99% overall $CO_2$ capture rate in full scale with a steady-state operation;
- The ammonia rock cavern storage is successfully commissioned and partly filled with ammonia;
- The first shipment of clean ammonia is successfully loaded onto an ammonia transport vessel from the ammonia rock cavern storage.

(134) The FID phase does not include any commercial sales. Once the KPIs are met, the FID phase of the project will be concluded, and the project moves on to commercial production (expected in late 2025). The commercial phase (mass production) of the project is therefore clearly separated from the FID phase, and no costs related to the commercial phase will be compensated.

### *3.6.3 Principle of "do no significant harm"*

(135) The Norwegian authorities have stated that the Barents Blue project complies with the principle of 'do no significant harm' within the meaning of Article 17 of Regulation (EU) 2020/852 (the "Taxonomy Regulation").[31]

(136) In this regard, the Norwegian authorities have explained that a third party performed an assessment of the current clean ammonia design before Barents Blue applied for aid, in order to document its compliance with the EU Taxonomy and the delegated acts describing hydrogen and anhydrous ammonia manufacturing. The assessment concluded that the project is compliant with the technical criteria of the EU Taxonomy delegated acts and the principles contained in Article 17 of the Taxonomy Regulation. This third-party assessment is also being audited by DNV[32] to provide quality control of the assessment. The audit is expected to be finished Q3 2022.

(137) Specifically, the assessment shows that the manufacturing of hydrogen and anhydrous ammonia under the project complies with the life cycle greenhouse gas emissions savings requirement of 70% relative to a fossil fuel comparator of 94g $CO_2$e/MJ. Moreover, the conclusion of the assessment is that the project otherwise meets the 'do no significant harm' criteria.

### *3.6.4 Aid amount and form of aid*

(138) The total amount of aid granted to Barents Blue for the realisation of the Barents Blue project is NOK 482 million in nominal terms (approximately EUR 46,8 million).

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[31] 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). The Act has been incorporated into the EEA Agreement at point 31p of Annex IX (Financial services) by Joint Committee Decision No 151/2022 of 29 April 2022, whose entry into force is pending the lifting of constitutional requirements. ESA notes that Guidelines may refer to certain EU policy instruments and to certain EU legal acts that have not been incorporated into the EEA Agreement and/or have not entered into force in the EEA EFTA States. With a view to ensuring uniform application of State aid provisions and equal conditions of competition throughout the EEA, ESA will generally apply the same points of reference as the Commission when assessing the compatibility of aid with the functioning of the EEA Agreement, see also preamble to ESA's Decision No 280/21/COL of 13 December 2021 amending the procedural and substantive rules in the field of State aid by introducing new Guidelines on 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 L 181, 7.7.2022).

[32] DNV Business Assurance Norway.

NOK 75 million is allocated for the RDI phase, while NOK 407 million is allocated for the FID phase.

(139) The form of aid is a grant. The Norwegian authorities have stated that a grant, and not a repayable advance or a loan, is the appropriate State aid instrument in this case, due to the high risk associated with both the R&D&I and the FID phase of the project and the positive externalities taking into consideration the substantial spillover effects expected due to the commitments to disseminate results. A grant is also considered necessary to close the funding gap of the project.

### *3.6.5 Eligible costs*

(140) The eligible costs of the Barents Blue project are the costs that are necessary to carry out the R&D&I and FID part of the project. The R&D&I phase occurs in 2022-2023 and the timeframe for the FID phase is from 2023 to 2025 (see table X). The full lifetime of the Barents Blue project, i.e. the R&D&I, FID and mass commercialisation phase is estimated at [25-35] years i.e. until […]. This timeline was determined based on industry standards, which suggest the normal life of industrial plants is around 25 years before significant reinvestments are required. Furthermore, in the recently published "Fourth unbundling package" of the Gas directive, the EU stated that there should be an end to long term gas contracts in 2049.

(141) The Norwegian authorities have provided a breakdown of the total and eligible costs of the Barents Blue project.[33] Only the share of capex attributed to FID phase (three years) is included as eligible costs (depreciation costs).

| | Construction of buildings/ laboratory etc. | Capex Costs | Personnel Costs | Sub contract Costs | Material, Supplies and Others | Total Costs |
|---|---|---|---|---|---|---|
| R&D activities: | […] | […] | […] | […] | […] | […] |
| FID activities (eligible and non-eligible costs: | […] | […] | […] | […] | […] | […] |
| FID activities (eligible costs) | […] | […] | […] | […] | […] | […] |
| Sum | […] | […] | […] | […] | […] | […] |

[33] More detailed breakdown is provided in the Barents Blue project portfolio, see document 1309384.

*Table 4. Eligible costs (R&D&I and First Industrial Deployment). Figures are represented in millions of NOK.*[34]

### *3.6.6 Counterfactual*

(142) The Norwegian authorities submit that the relevant counterfactual in the absence of aid is the abandonment of the project, i.e. the absence of the project.

(143) The Norwegian authorities explain that without aid the project will be delayed for at least […] years. This delay will change the basis for the economic assumptions and other important conditions that need to be in place for the project to be carried out. Taken together, this will in all likelihood lead to the cancellation of the entire project.

(144) In support of this statement, the Norwegian authorities point out that the Barents Blue project is not planned as a conventional ammonia project. The standard development model for ammonia projects is to perform concept studies and then prepare for an EPCI[35] bid directly afterwards. This is both time and cost effective, due to the standardised nature of conventional plant solutions. This conventional approach is not possible for the Barents Blue project as an entirely new ammonia plant technology is being developed, requiring an extensive R&D&I phase. The additional time and cost required to get to the final investment decision following the R&D&I phase is significant and entails a much higher risk compared to conventional ammonia projects.

(145) State aid is therefore necessary to reduce the risks inherent in the Barents Blue project. According to the Norwegian authorities, the normal accepted level of uncertainty/risk at the investment decision is +/-20%. The State aid allows the project to accept about 10% of additional risk at investment decision compared to conventional projects.

(146) The risks inherent in the R&D&I and FID phase are not unique to the Barents Blue project. The European Clean Hydrogen Alliance arranged a round table in July 2021 that identified many of these “pain points”.[36] The round table pointed to “technological risk during process scale-up to commercial size” as one of several key “pain points”.

(147) Conversely, if no State aid is awarded to the Barents Blue project, Norway submits that the risk will be deemed too high for the necessary private financing to take place. Therefore, without any risk reduction in the form of aid, the project would be delayed until a conventional approach can be adopted by the project, i.e. when no R&D&I or FID is needed. This would cause a significant delay, which is highly likely due to the following factors:

- A technology provider, has to perform corresponding R&D&I and FID phases in order for the clean ammonia technology system to become available at a conventional risk level. This is expected to take about 4 years, provided the R&D&I phase is initiated immediately.

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[34] With respect to the terminal values at the end of first industrial deployment phase in November 2025.

[35] “Engineering, Procurement, Construction and Installation” bid.

[36] European Clean Hydrogen Alliance (ECH2A) Round Table Clean Hydrogen in Industrial Applications (RT3).

- The project would not be realised as part of the IPCEI Hydrogen value chain, and will have to wait until a more mature business environment exists for the new clean ammonia product. The first certification schemes for green hydrogen and ammonia have just recently been published and even though the first project has been through certification[37], customers' knowledge and trust in these are not yet established. This results in asymmetric information between the producer and its customers.
- Any delay at all will hinder the project from using a […]. This implies that any substantial delay in the decision to initiate the R&D&I phase will lead to […] years' delay in the overall project schedule.

(148) It is not likely that the plant will be built based on current ammonia plant standards or in smaller scale, i.e. no less ambitious project is considered by Barents Blue.

(149) The Barents Blue project is designed to adhere to high standards regarding sustainability and environmental impact[38] and therefore, only the realisation of a blue ammonia plant is considered as an option, i.e. production of "grey" ammonia is not a possibility, according to the Norwegian authorities.

(150) Moreover, the plant size has been designed in such a way that the ammonia production optimally benefits from economies of scale. About 1-2 million tonnes of $CO_2$ can be injected in a subsea $CO_2$ injection well per year,[39] corresponding to about 1 million tonnes of blue ammonia production. A smaller scale plant would not be a realistic option, as this is not financially feasible due to the corresponding large unit cost for sequestration of the $CO_2$.

(151) If the project suffers a delay of […] years, it is highly likely that the project will not be realised, due to several factors:

- The Melkøya plant started up in 2007[40] and will be 25 years old in 2032. Before 2032, Melkøya needs to perform project development work for all modifications required to prolong the technical lifetime of the plant with an additional 25 years. […].
- Power deficiency in Northern Norway is predicted from 2026.[41] Currently, the Barents Blue project has been able to secure the required power for the project,[42] but if the project is delayed, this power would potentially be sold to another project and the Barents Blue project would not have the required power to realise the project.
- There is a limited number of industrial sites in the area where the Barents Blue project is planned to be located and more and more projects are being introduced. The project currently has an agreement with the municipality for the selected site.[43] If the project is delayed for a longer period, it is likely that the rights to the site would be lost. The current agreement is valid for nine

[37] https://www.ammoniaenergy.org/articles/oman-mega-project-receives-green-certification/.
[38] https://www.horisontenergi.no/wp-content/uploads/2022/02/Advanced-Biofuels-Conference-Barents-Blue-Horisont-Energi-22-September-2021.pdf.
[39] https://www.osti.gov/biblio/1064414/.
[40] Document No 1309526.
[41] https://www.itromso.no/nyheter/i/mrj24g/nord-norge-vil-gaa-i-kraftunderskudd-innen-2026-naa-vil-troms-kraft-bygge-flere-vindturbiner.
[42] Document No 1309508.
[43] Document No 1309510.

months after the end of the permission process (2023), and a decision to use the site must be taken within nine months. Loss of the site would require a new site to be developed, the concept to be updated, the permit process to be restarted, etc.

- The Snøhvit gas field has a finite volume of gas. The production from the gas field will decline just after 2035 with production being about halved in 2050, and with a large decline to about zero in 2055. If the project is delayed until 2030, then the amount of gas to be decarbonised is substantially less.

(152) The Norwegian authorities consequently argue that absent State aid to close the project's funding gap (see section 3.6.7), the project will effectively be delayed to 2030 at least, which in turn reduces the economic viability and fundamentally alters the main assumptions of the project, leading to a high probability of abandoning the project altogether. No alternative projects, such as a less environmentally ambitious or smaller scale project, are considered an option.

*3.6.7 Funding gap*

(153) The Norwegian authorities have submitted calculations demonstrating that the Barents Blue project has a funding gap. The funding gap refers to the difference between the positive and negative cash flows over the lifetime of the investment, discounted to their current value on the basis of an appropriate discount factor reflecting the rate of return necessary for the beneficiary to carry out the project, notably in view of the risks involved. The funding gap for the Barents Blue project amounts to NOK -482 million.

(154) In the funding gap analysis submitted for the Barents Blue project, all relevant expected costs and benefits over the lifetime of the project are considered. Moreover, all relevant underlying assumptions are explained and a detailed breakdown of the revenues, such as calculations of the cost of sales and unit price, are provided.[44]

(155) For estimating the funding gap, the Barents Blue project uses a project specific discount rate based on the Weighted Average Cost of Capital ("WACC") methodology. This is due to the fact that the Barents Blue project is carried out by Barents Blue, which will be a new undertaking. Therefore, the WACC of its owners is not considered relevant. The WACC formula and the input parameters used to calculate the project WACC are listed below.

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

  - Equity/debt ratio = 80%
  - Risk free rate $r_f$= 3%
    - Normalised long-term risk-free interest rate commonly used in Norway according to PwC/NFF survey.
  - Equity Beta β = 1.79
    - Chemical industry beta according to Innovation Fund[45] (ref. table "European Market Segment Betas").

[44] Document No 1314136.
[45] Innovation Fund Call document Annex B: V3.1 – 23.04.2020, Appendix 2.

- Equity Risk Premium ERP = 5.2%
  - ERP according to Innovation Fund document (ref. table “Market Risk per Country”).
- Debt Premium DP = 1.75%
  - The project will have a relative low debt ratio with potential favorable terms if successful in securing loan or guarantees from the EIB or other national finance institutions (i.e., Export Credit Norway - EksFin).
- Tax rate T = 22%
  - Ordinary Norwegian corporate tax rate.

(156) Based on the parameters above, the Barents Blue project applies a nominal WACC of […] in its funding gap analysis.

*3.6.8 Limitation of distortion of competition and trade*

(157) The Norwegian authorities submit that the global ammonia market is a highly consolidated market, as the top five ammonia suppliers (Yara, Trammo, Kock, Ameropa and Nutrien) alone account for 60% of the global ammonia seaborne trade. The global ammonia market amounts to approximately 185 million tonnes of ammonia produced per year, with around 20 million tonnes produced in Europe. The prevailing product on the current market is grey ammonia, while blue and green ammonia represent a minor part of current ammonia production.

(158) The agricultural industry dominates the demand in the global ammonia market, with an estimated market share of more than 80%. In this context, ammonia is used primarily in fertilisers, and its consumption has only increased over the years, driving its use in the agricultural market during 2020-2025.

(159) The global ammonia market is expected to register a compound annual growth rate (“CAGR”) of greater than 5% during the 2020-2025 period. Apart from the agricultural industry, the demand for ammonia is increasing in (chemical) industries such as pharmaceuticals, paper and pulp as well as food and oil.

(160) Global ammonia capacity is expected to grow 4% over the next four years, with positive demand growth expected in all regions. In the long term, based on historical growth rates for both the agriculture and industrial segments, the annual grey ammonia market could grow by 97 million tonnes by 2050, representing a growth of 53% compared to global production in 2019.

(161) The Barents Blue project expects the market for carbon free ammonia to increase more than the underlying total ammonia market, as companies are required to decarbonise their value chain both for legislative and reputational reasons. This is evidenced by the increasing price of EU carbon permits. However, as with any new production processes in a commodity industry, the key is to produce profitably compared with the current, established production technology. Currently blue ammonia is not able to compete with grey ammonia on cost.

(162) Currently, the Norwegian authorities expect that 24 small and large blue ammonia projects, including Hy2Use, could be realised worldwide by 2026/27 with a potential annual production of about 15.2 million tonnes.[46] Additionally, 50 small and large

[46] Ammonia Energy Association clean ammonia project overview.

green ammonia projects are expected to be realised by 2027, providing a total of about 18.5 million tonnes of clean ammonia.[47] This amounts to a production of about 33 million tonnes of clean ammonia.

(163) The Barents Blue project aims at producing 1 million tonnes of ammonia annually, potentially expanding production to 3 million by 2030. The global market share of Barents Blue of the clean ammonia market is therefore expected to be around 3.2-9.7% in the years 2025 to 2030, provided that other clean ammonia projects materialise. Looking at the EEA market share, Barents Blue would have approximately 4-11% of the market, provided that only 6 million tonnes of new clean ammonia enters the EEA market within 2027. However, according to the Norwegian authorities, these estimated market shares should be viewed in light of the fact that clean ammonia directly competes with grey ammonia. The Barents Blue Ammonia Plant's market share of the global and EEA overall ammonia market will therefore be considerably lower.

(164) As regards the strengthening or creation of market power, the Norwegian authorities state that the prevailing product on the current market is grey ammonia and it is not expected that the more expensive blue ammonia will dominate the market in the near future. On the contrary, clean ammonia will have to compete with grey ammonia. Moreover, as the already large market for ammonia is expected to grow further in the future, the Norwegian authorities state that any incentives given to the Barents Blue project will not unfairly strengthen or create market power.

(165) A total amount of 185 million tonnes of ammonia are produced annually in the global ammonia market. Even at full capacity, the Barents Blue project will be a relatively small player in this market. The project will have to compete with well-established global market players, which currently have competitive advantages over the project in terms of existing supply and logistics chains as well as well-established customer relationships.

(166) As regards distortions of dynamic incentives, the Norwegian authorities contend that, due to the immature technology and the significantly higher cost for the production of blue ammonia, the dominant ammonia production in the near future is likely to be grey. Therefore, incentives for blue ammonia are required to guarantee a level playing field until circular and sustainability requirements have become obligatory and corresponding extra costs are factored into the market price for ammonia.

(167) The Norwegian authorities state that a certain first mover advantage is in general often an inherent part of funding demonstrations of new technologies. However, the participation in Hy2Use sets strong requirements for the aid beneficiaries to collaborate with other companies with the purpose of sharing knowledge and securing spillover effects from their projects. The core technology development in the Barents Blue project will be made available and will therefore reduce the barriers for competitors (see section 3.5.2).

(168) Finally, the Norwegian authorities submit that State aid under Hy2Use does not influence the Barents Blue project's choice of location. The Barents Blue project is by nature placed at Markoppneset in Troms and Finnmark County. The choice of

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[47] Ibid.

location is due to the access to natural gas from Equinor's plant at Melkøya. Thus, there is no risk that the State aid to facilitate the Barents Blue project will lead to a subsidy race in the EEA.

## 3.7 The Tizir project

### *3.7.1 Beneficiary*

(169) Tizir Limited is a vertically integrated zircon and titanium undertaking which owns the Grande Côte mineral sands mine in Senegal in addition to the beneficiary undertaking, Tizir. The latter is an ilmenite upgrading facility in Norway that commenced operations in 1986.

(170) At the Norwegian plant, Tizir upgrades ilmenite to produce a high-value titanium slag, primarily sold to pigment producers, and a high-purity pig iron (a valuable co-product) that is sold to ductile iron foundries.

(171) Eramet owns 100% of Tizir Limited. Eramet is a leading global producer of alloying metals, particularly manganese and nickel and high-performance special steels and alloys, used in industries such as aerospace, power generation and tooling. It employs approximately 13 000 people in 20 countries, and is part of Euronext Paris Compartment A and is listed on the MSCI index. The Norwegian branch of Tizir had 220 employees in 2020.

### *3.7.2 Description of the project*

(172) Since its start-up in 1986, Tizir has used a state-of-the-art process for smelting ilmenite to produce titanium slag and high purity pig iron. The plant, located in Tyssedal, Norway, is the only plant in Europe using such a process. Outside China[48], only eight plants worldwide use this technology.

(173) The production process at the plant in Norway involves a two-stage process:

- Pre-reduction in a rotary kiln; and
- Smelting in an electric furnace.

(174) In the pre-reduction process, ilmenite is pelletised and pre-reduced with coal, before the pre-reduced pellets are fed to the smelting furnace. This process emits approximately 326.000 tonnes of $CO_2$ annually.

(175) The Tizir project is an R&D&I project aimed at developing a concept for a future full-scale plant that will reduce the emissions of the current plant by at least 238 000 tonnes of $CO_2$ annually. This will be achieved by replacing the rotary kiln with a fluidised bed based pre-reduction plant using hydrogen as a reducing agent. The hydrogen pre-reduction process on which the project is based is the […] [49] […].

(176) The project[50] has the following structure:

[48] Information on the processes used, number of plants and production volumes in China is not available, according to the Norwegian authorities.
[49] […].
[50] Please note that the expressions "entire project" and "overall project" throughout the document refer to the aided and notified R&D&I phases of the Tizir project (WP2 and WP3) as well as its full-scale implementation (WP4). The latter is not is not covered by this notification.

| R&D&I phase | FULL SCALE | PRODUCT |
|---|---|---|
| WP2: Pilot plant (2022–2023) | WP4: $H_2$ facility, balance of plant (2026–2028 ) | Increased production of $TiO_2$ slag and high purity pig iron |
| WP3: Upscaled pilot plant (2024–2025) and impact study (2025) | WP 4: Hot charging (2032) | Increased production of $TiO_2$ slag and high purity iron |

*Table 5: Work packages of the Tizir project.*

(177) The Norwegian authorities note that only WP2 and WP3 are being supported under Hy2Use. The possible future full-scale implementation (WP4) will not be aided as part of Hy2Use.

(178) The objective of WP2 and WP3 is to verify that the […] process can be used as an alternative process for pre-reducing ilmenite by using hydrogen. The planned R&D&I project has two phases. The first phase involves implementing a pilot installation in […] (WP2). The […] pilot will be a stand-alone installation under simulated industrial conditions. The second phase (WP3) involves the building of a system prototype demonstration in an operational environment i.e. an upscaled pilot, scale of 1/100, at Tizir's plant in Tyssedal ("demonstration plant"). The demonstration plant will be integrated with continuous delivery of hydrogen from a third party supplier to verify real industrial operations. If successful, an investment decision to implement the process at full scale can be taken (WP4).

(179) The most important milestones of the Tizir project are detailed in the table below:

| Milestone | Name | WP(s) | Due | Means of verification |
|---|---|---|---|---|
| **M0** | Project kick-off | WP1 | **M1** | |
| **M1** | Pilot built | WP2 | **2023** | Ready for operational test |
| **M2** | Test period and assessment performed | WP2 | **2024** | Recommendation to build upscaled pilot plant |
| **M3** | Upscaled pilot plant built | WP3 | **2026** | Ready for operational test |
| **M4** | Small scale hydrogen plant installed | WP3 | **2026** | Ready for supply |
| **M5** | End test period upscaled pilot plant – […] | WP3 | **2028** | Recommendation to build large scale plant |
| **M6** | Large scale plant ready for test | WP4 | **2032** | Plant ready for test |
| **M7** | Hydrogen plant installed | WP4 | **2032** | Ready for supply |
| **M8** | Hydrogen storage installed | WP4 | **2032** | Full commercial operation |
| **M9** | Start full scale production | WP4 | **2033** | Full production, decision decommissioning |
| **M10** | Hot feeding to furnace implemented, increased capacity | WP4 | **2033** | Increased production capacity achieved |

*Table 6: List of milestones in the project.*

(180) According to the Norwegian authorities, the main innovation to be achieved during the R&D&I phase is to prove that the […] process can be scaled up to industrial level for ilmenite with all product qualities intact, verifying that the technology will reduce the carbon footprint significantly in the process, by using a new hydrogen based pre-reduction process in ilmenite processing.

(181) The Norwegian authorities note that the first and only plant which implemented the […] process was not reliable, which ultimately led to its closure and prevented the wider adoption of the process in the DRI industry.[51] Currently, the application of the […] process on ilmenite is at TRL 5.

(182) As stated in table 6 above, the R&D&I of the Tizir project is split into two distinct work packages, WP2 and WP3.

(183) WP2 involves building a pilot plant with a production capacity of […]. The building of the plant will be carried out at […]. The pilot will be tested for approximately […] hours, and the results will be tested and verified by a third party to assure the quality of the work. The pilot test will carry the technology through TRL 6 and allow for a scale up to a demonstration plant (WP3).

(184) The demonstration plant in WP3 will have […] of total production capacity at about […], and a hydrogen feed of approximately […]. The demonstration plant will be tested over a period of […] to verify that all process stages work properly, the challenge being to assure that all process stages perform in line with technical and safety requirements.

(185) The demonstration plant will be considered successful, indicating the end of WP3, if the following KPIs are met:

- […]

(186) Once all KPIs related to WP2 and WP3 are achieved, Tizir will evaluate whether or not to invest in a full implementation of the new pre-reduction process.

### *3.7.3 The principle of "do no significant harm"*

(187) The Norwegian authorities have stated that Tizir project complies with the principle of 'do no significant harm' within the meaning of Article 17 of Regulation (EU) 2020/852 (the "Taxonomy Regulation").

- As regards climate change mitigation, the project is not expected to lead to significant GHG emissions. When the project has been fully implemented, a substantial reduction of GHG emissions is expected (see paragraph (185)). Further, any hydrogen production within the project complies with the life cycle greenhouse gas emissions savings requirement of 70% relative to a fossil fuel comparator of 94g $CO_2$e/MJ.

- As regards climate change adaption, a neutral or slightly positive effect is expected for the R&D&I part of the project. The full-scale project, including

[51] A description of this first application of the process is included in the project portfolio of the Tizir project, see Document No 1309512.

WP4, is expected to give a substantial positive effect on future climate by substantially reducing consumption of coal – and replacing such coal with green hydrogen as a reductant in a metallurgical process.

- As regards the sustainable use and protection of water and marine resources, consumption of water will be reduced when implementing a new process using hydrogen compared to the present process where pre-reduction takes place with coal in a rotary kiln. Locally there are resources of water used for hydroelectric power generation. The water for power generation can be re-used as feed for the electrolyser. The project does not use ground water.

- As regards the circular economy, the project is expected to give a basis for an improved situation when the full-scale implementation is carried out. During WP2 and WP3, intermediate products and possible waste will be channelled through the existing production line.

- As regards pollution prevention, the project is not expected to lead to increase in emissions of pollutants into air, water or land.

- As regards protection and restoration of biodiversity and ecosystems, the project is not expected to be detrimental to the good condition and resilience of ecosystems or to the conservation status of habitats and species. Moreover, the project is not located in a protected natural area.

#### *3.7.4 Aid amount and form of aid*

(188) The total amount of State aid for the Tizir project is NOK 261 million (approximately EUR 25.3 million).

(189) The aid is in the form of a direct grant. The Norwegian authorities have argued that other instruments, such as loans or repayable advances, are not more appropriate instruments, as this is a R&D&I project facing great economic and technological risks and is subject to positive externalities due to its spill-over effects. In this regard, the Norwegian authorities point to the real possibility that the conclusion after the R&D&I phase is to abandon further investments, i.e. there is a possibility that all investments in the R&D&I phase must be regarded as sunk. Grants reduce the financial risk in case of project failure and improve the low profitability of the project as compared to the counterfactual scenario.

#### *3.7.5 Eligible costs*

(190) The eligible costs of the Tizir project are costs borne in WP 2 and WP3. They are:

| R&D budget (MNOK) | Construction of buildings/ laboratories etc | Machinery and equipment | Person nel Cost | Sub contract Cost | Material, Supplies, etc. | Total Cost |
|---|---|---|---|---|---|---|
| R&D WP 2 Pilot plant | | […] | […] | […] | | […] |
| R&D WP 3 Upscaled pilot | […] | […] | […] | […] | […] | […] |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sum | […] | […] | […] | […] | […] | […] |

*Table 7: eligible costs of WP2 and WP3.*

(191) More specifically, the eligible costs are:

- **Construction of buildings/laboratories:** Relates only to costs for the construction of the demonstration plant including the feeding system, raw material handling, exhaust gas cleaning, material handling, buildings as well as assembly and adaptation of the facility.
- **Machinery and equipment**: Necessary to complete the […] pilot plant and the demonstration plant. Includes […], gas handling, etc.[52]
- **Personnel:** Own personnel employed by Tizir and Eramet who work on the project. The demonstration plant requires 5 shift arrangements that must be staffed in addition to staffing the current facility.
- **Subcontracting costs:** Measurements, development work, possible conversions, etc.
- **Materials, supplies, etc.:** Raw materials, hydrogen, nitrogen and electricity. Only operating costs inextricably linked to the realisation of the WP2 and WP3, and limited to the duration of WP 3, are eligible.

### *3.7.6 Counterfactual*

(192) According to the Norwegian authorities, Tizir has the following options for its future operations:

1. Continuing with the current, well proven and operational process (the "base case scenario"); or
2. Developing a new process using hydrogen to replace coal in the pre-reduction step (the Tizir project).

(193) As regards the base case scenario, the Norwegian authorities contend that the conventional process is based on a proven technology and is therefore a reliable and predictable process, manufacturing products of high quality and with a steady demand on the market. Therefore, adhering to the existing production method, using coal as a reductant is a viable business strategy.

(194) When Tizir originally applied for aid under Hy2Use, the base case of Tizir was that it would mainly follow a standard operational procedure, i.e., maintenance and minor upgrading of the current pre-reduction plant.

(195) Later, in June 2021, a new 10-year Strategic Plan for Tizir was issued by its owner, Eramet.[53] In this plan, Eramet describes the updated intended base case scenario for the Tizir plant, which would entail the execution of a group of investments, titled "Integrity & Capacity Assessment ("ICA") that aim to "de-bottleneck" the current production process.

[52] The Norwegian authorities have confirmed that, due to the size of the pilot and demonstration plants of WP2 and WP3, they do not have a commercial value for the production at Tizir. Consequently, their lifetime is limited to the planned operational campaigns, i.e. testing.

[53] Document No 1309445.

(196) The Strategic Plan states[54] that operational excellence has already led to a production increase from 188 kt in 2019 and 199 kt in 2020 to a P2-2021 production rate at 213 kt of slag. However, additional supporting investments are needed to be able to increase production to higher levels. […]

(197) The ICA project has been split into two scenarios, each consisting of many small projects and a few larger projects:

- ICA 230 to reach […].
- […].

(198) The base case scenario for the next 10 years of operations at Tizir in Tyssedal is therefore continued operations according to the ICA 230-concept, with a base production of […]. The ICA 230 project has officially been approved by Eramet and will be implemented in spring 2023 as part of the planned periodic shutdown.[55] The financial analysis of the base case scenario compared to the Tizir project indicates that the former is more profitable, unless external financial support to the project is given. The base case scenario is therefore considered the counterfactual scenario.

(199) Furthermore, the Norwegian authorities state that as Tizir is part of the Eramet group, it is subject to the decision-making and commitment processes of Eramet.[56] Eramet needs to approve capital investments like the Tizir project. The Norwegian authorities have submitted internal documentation, including internal communication between Eramet and Tizir, showing that Eramet would not invest in the Tizir project in the absence of State aid.[57] It would instead opt for the base case scenario.

### *3.7.7 Funding gap*

(200) The funding gap of the project has been calculated by viewing the expected NPV of the investment in the aided project as compared to the counterfactual scenario.

(201) In its calculations, Tizir has provided detailed revenue projections, based upon an operational period of 15 years (i.e. cash flow until year 2043).[58] The financial model includes numerous assumptions which have an impact on the calculated cash flows/financial assessment.

(202) The calculated cash flow difference between the counterfactual scenario and the aided scenario has been discounted based upon the most recent WACC for Tizir,[59] which is continuously benchmarked internally in the Eramet group. The WACC is also analysed and updated annually by an external and independent party (Duff & Phelps). The most recent WACC was set at the end of year 2020, and is […].[60] The

[54] Ibid, page 3 and page 6.
[55] Document No 1309455.
[56] Document No 1309443.
[57] Documents No 1309449 and 1309453.
[58] Enova as a rule accepts that a 15-year lifetime is the standard for installations that run every day, around the clock, all year round. According to the Norwegian authorities, empirical evidence generally supports the view that significant maintenance and upgrading is required for installations to run more than 15 years.
[59] Tizir financial development and projects are continuously benchmarked internally in the Eramet group, which includes significant mining and smelting activities.
[60] The Duff and Phelps report detailing the most recent WACC, see Document 1309455.

Norwegian authorities submit that this WACC is in line with the normal required rate of return in the sector.[61]

(203) The funding gap of the Tizir project has been calculated to be NOK -501 million.

*3.7.8 Limitation on distortion of competition and trade*

(204) Tizir's product suite comprises of titanium feedstock, mainly titanium dioxide slag. It also produces high-purity pig iron, which is a valuable co-product of the ilmenite upgrading process. Titanium feedstock have physical and chemical properties which make them suitable for a wide range of industrial and domestic applications.

(205) Tizir produces and sells titanium dioxide slag to customers in Europe, North America and Asia, with a market share of approximately […] of the world's production of slag. Over 90% of mineral titanium feedstock goes to industry that produces titanium dioxide ($TIO_2$) pigment, while the rest goes to titanium metal and welding wire industry. The largest consumer of $TIO_2$ pigment is the paint industry.

(206) In 2021, the demand for titanium dioxide feedstock was estimated to be approximately 8.33 million tonnes ($TIO_2$-units) worldwide.[62] In Europe the demand was approximately 1.26 million tonnes.

(207) As a co-product in the production of titanium oxide slag, high-purity pig iron is produced by Tizir for customers mainly in Europe. Tizir's share of the world's high-purity pig iron production is approximately […].[63]

(208) The Norwegian authorities note that no change in market shares is expected by the end of Hy2Use, as only pilot and demonstration activities are planned. The State aid will not affect Tizir's market position by strengthening or maintaining its market power, whether in the $TiO_2$ market, or in the pig iron market, since no aid is granted for the potential investment in a full scale upgrade of the plant. Consequently, the Norwegian authorities contend that neither the market structure as such, nor Tizir's behaviour in the market, will be altered as a result of the aid.

(209) However, the Norwegian authorities acknowledge that Tizir's R&D&I investment and the potential future industrial investment in implementation of the hydrogen pre-reduction process is innovative and as such technologically strategic. The new technology in the demonstration project may therefore possibly provide Tizir with a first mover advantage when it comes to introducing new reduction technology. A certain first mover advantage will in general often be an inherent part of funding demonstrations of new technologies. However, the Norwegian authorities submit that such an advantage is outweighed by the positive effects of the verification of a vastly more environmentally friendly furnace technology and its introduction to the market. This is particularly the case when the technological innovation achieved through the Tizir project will be disseminated to the market (see section 3.5).

(210) Therefore, the Norwegian authorities assert that the expected positive effects of the Tizir project outweigh any possible negative effects.

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[61] Document No 1309457.
[62] Document No 1309462.
[63] Document Nos 1309407 and 1309409.

### 3.8 Aid granting authority national legal basis

(211) For the Norwegian projects, the granting authority is Enova, which is a State enterprise fully owned by the Norwegian State through the Ministry of Climate and Environment.[64]

(212) The national legal basis for aid from Enova is the assignment letter from the Ministry of Climate and Environment to Enova SF for 2021. The assignment letter states that Enova is given the responsibility for administering the Norwegian participation in the IPCEI, see Chapter 3 of the assignment letter.[65]

### 3.9 Transparency and cumulation

(213) The Norwegian authorities have committed to complying with the transparency and publication requirements of paragraph 48 and 49 of the IPCEI Communication.

(214) The State aid received pursuant to the measures, can be cumulated with other State aid, provided that the total amount of public funding granted to the same eligible costs does not exceed the most favourable funding rate laid down in the applicable EEA rules.

### 3.10 Claw-back mechanism

(215) In order to further ensure that the aid within Hy2Use is kept to the minimum necessary, the participating States have in their notification committed to introducing a claw-back mechanism, pursuant to paragraph 36 of the IPCEI Communication. However, in line with previous case practice,[66] the claw-back mechanism will apply to participating undertakings having a notified aid amount, per individual project, above EUR 50 million. Since the aid for each Norwegian project is below EUR 50 million, this particular claw-back mechanism does not apply to them.

(216) However, according to a sensitivity analysis carried out by Enova, small variations in the purchase price of natural gas and in the sales price of ammonia can have an impact on the net present value estimate of the project. Therefore, Enova has introduced a specific claw-back mechanism for the Barents Blue[67] project as follows. Three years after start of production, the beneficiary must demonstrate the funding gap using updated cash flow projections. The re-estimated funding gap will be based on the historical actual investment cost (i.e., including cost overruns) and incorporate new information regarding prices of natural gas and ammonia. If the allocated aid exceeds the re-estimated funding gap, the excess amount will be subject to a claw-back.

## 4 Presence of State aid

### 4.1 Introduction

(217) Article 61(1) of the EEA Agreement reads as follows: “Save as otherwise provided in this Agreement, any aid granted by EC Member States, EFTA States or through

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[64] See further information on Enova’s website at: https://www.enova.no/.
[65] Document No 1309412.
[66] SA.54794 (2019/N) and others - Important Project of Common European Interest (IPCEI) on Batteries, paragraph 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), paragraph 316 (not yet published).
[67] Enova did not introduce a specific claw-back mechanism for the Tizir project.

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 Contracting Parties, be incompatible with the functioning of this Agreement."

(218) The qualification of a measure as aid within the meaning of this provision requires the following cumulative conditions to be met: (i) the measure must be granted by the State or through State resources; it must (ii) confer an advantage on an undertaking; (iii) favour certain undertakings (selectivity); and (iv) threaten to distort competition and affect trade.

### 4.2 Presence of state resources

(219) The measures are financed with funds stemming from the Norwegian state budget and are granted by Enova, a public authority. The measures therefore involve State resources and are imputable to Norway.

### 4.3 Conferring a selective advantage on an undertaking

(220) The aid measures in the form of direct grants to Barents Blue and Tizir will relieve them from costs that they would have had to bear. By contributing to the financing of their R&D&I and/or FID activities with funds that would not have been available under normal market conditions, the aid measures confer an economic advantage to the aid beneficiaries over their competitors. These measures are granted only to Tizir and the Barents Blue Ammonia Plant and the funding is not available to all undertakings in a comparable situation. The aid measures are therefore selective.

### 4.4 Effect on trade and distortion of competition

(221) Barents Blue will be active in the ammonia production sector, while Tizir already operates in the metal refinery sector. These sectors are open to intra-EEA trade in terms of supply and demand. Therefore, the measures may affect trade between EEA States. By reinforcing or creating the beneficiaries' position in their respective sectors, the measures are liable to distort competition by conferring on each beneficiary a selective advantage compared to their competitors.

### 4.5 Conclusion

(222) Consequently, ESA considers that the public resources granted to Barents Blue and Tizir in the form of direct grants for the R&D&I and FID activities as described within the framework of Hy2Use qualify as State aid within the meaning of Article 61(1) of the EEA Agreement.

## 5 Individual aid

(223) ESA notes that the aid is not granted on the basis of a scheme.[68] The aid is therefore individual aid.

## 6 Lawfulness of the aid

(224) Pursuant to Article 1(3) of Part I of Protocol 3 to the Agreement between the EFTA States on the Establishment of a Surveillance Authority and a Court of Justice ("Protocol 3"): "The EFTA Surveillance Authority shall be informed, in sufficient time to enable it to submit its comments, of any plans to grant or alter aid. […] The State

[68] See Article 1(e) of Part II of Protocol 3 to the Agreement between the EFTA States on the Establishment of a Surveillance Authority and a Court of Justice.

concerned shall not put its proposed measures into effect until the procedure has resulted in a final decision."

(225) The Norwegian authorities have notified the measures and have yet to let them enter into force. They have therefore complied with the obligations under Article 1(3) of Part I of Protocol 3.

# 7 Assessment of the aid measures

## 7.1 Introduction

(226) In derogation from the general prohibition of State aid laid down in Article 61(1) of the EEA Agreement, aid may be declared compatible if it can benefit from one of the derogations enumerated in that Agreement. The Norwegian authorities invoke Article 61(3)(b) of the EEA Agreement as the basis for the assessment of the compatibility of the aid measures.

(227) Article 61(3)(b) of the EEA Agreement provides that ESA may declare compatible "aid to promote the execution of an important project of common European interest or to remedy a serious disturbance in the economy of an EC Member State or an EFTA State".

(228) Therefore, it is appropriate to consider first whether the notified measures relate to such a project. These general eligibility criteria are assessed in section 7.2. Second, it needs to be considered whether the criteria for declaring the aid compatible with the internal market are met. The compatibility criteria are assessed in section 7.3.

(229) Guidance for the analysis of the compatibility with the internal market of State aid to promote the execution of IPCEIs is laid down in ESA's IPCEI Communication.[69] ESA will assess whether the two notified projects satisfy the conditions laid down in the IPCEI Communication, following its structure.

(230) ESA notes that the IPCEI Communication may refer to certain EU policy instruments and to certain EU legal acts that have not been incorporated into the EEA Agreement. With a view to ensuring uniform application of State aid provisions and equal conditions of competition throughout the EEA, ESA will generally apply the same points of reference as the Commission when assessing the compatibility of aid with the functioning of the EEA Agreement.[70]

## 7.2 Eligibility criteria

(231) In order to be eligible for aid under Article 61(3)(b) of the EEA Agreement, 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.

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[69] Adopted by ESA's Decision No 280/21/COL of 13 December 2021 amending the procedural and substantive rules in the field of State aid by introducing new Guidelines on 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 L 181, 7.7.2022).

[70] See also the preamble to ESA's Decision No 280/21/COL of 13 December 2021 amending the procedural and substantive rules in the field of State aid by introducing new Guidelines on 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 L 181, 7.7.2022).

### *7.2.1 Definition of a project*

(232) According to paragraph 13 of the IPCEI Communication, ESA 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.

(233) ESA considers that Hy2Use is an integrated project for the reasons explained below. This conclusion is in line with the conclusion of the Commission in its Hy2Use Decision.

(234) ESA finds that Hy2Use is designed in such a way as to contribute to the common objectives, formulated by the participating States and undertakings, as described in section 3.1. 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. This aim is planned to be achieved by integrating all 37 individual projects in a common programme aiming at the same objective.

(235) The activities of the individual projects are combined in a coherent systemic approach in two TF that constitute the individual but interlinked components of Hy2Use.

(236) Specifically, ESA considers that Hy2Use integrates the individual projects based on a coherent systemic approach. The presence of this coherent systemic approach is illustrated by the fact that the participating States prepared a common programme that resulted in the design of the Chapeau document. ESA notes that the Chapeau document includes an overall work plan aimed at facilitating cross-border efforts towards common objectives.

(237) In particular, ESA notes that the common programme established in the Chapeau document includes the definition of overall objectives at the level of Hy2Use (see section 3.1), articulated in specific objectives at the level of the two TF (see sections 3.2.2 and 3.2.3), to be implemented and monitored under a common governance structure (see section 3.3).

(238) 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 in order to achieve the overall objectives of Hy2Use.

(239) As described in section 3.4, the individual projects participating in Hy2Use are complementary to each other and significantly added value for the achievement of Hy2Use's objectives. In particular, ESA notes that:

- the different individual projects in TF 1 will deliver infrastructure (notably large-scale electrolysers and transport infrastructure) that 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 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.

- For the Norwegian projects, they contribute to the deployment of an emission free blue ammonia plant (Barents Blue) and developing a new hydrogen based production process for titanium slag and pig-iron to replace coal in the pre-reduction process (Tizir). The complementarity of the Norwegian projects to the other individual projects in Hy2Use is demonstrated by the number of collaborations in which they participate, including intra TF, with TF 1 and with indirect partners.

(240) Furthermore, in order to ensure the coherent implementation of Hy2Use, the participating States will establish a common governance structure, as described in section 3.3, under a SB, which will have the task of reviewing the progress and the results of Hy2Use and of proposing changes if necessary, giving specific attention to the benefit to European society. The Commission will be represented in the SB as an observer.

(241) Therefore, in view of the above, ESA concludes that Hy2Use qualifies as an integrated project within the meaning of the IPCEI Communication, as its individual projects and TF are inserted in a common programme, aiming at the same objective and are based on a coherent systemic approach. Furthermore, the 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 EU. ESA finds that the Norwegian projects are part of the integrated project.

#### *7.2.2 Common European Interest*

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

(a) General cumulative criteria

<u>Important contribution to the EU's objectives and the objectives of the EEA Agreement</u>

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

(244) One of the key areas of cooperation under the EEA Agreement is environmental protection, as reflected in Articles 1 and 73 to the EEA Agreement. In this context many of the climate-related policy instruments set out to deliver on the European Green Deal, including the climate neutrality target, are incorporated into the EEA Agreement. Norway has agreed with the EU, its Member States and Iceland to cooperate in reaching their 2030 greenhouse gas (GHG) emission reduction targets. Examples of such instruments include the Emissions Trading System (ETS), the binding 2030 targets of Norway, Iceland and the EU Member States to reduce emissions in sectors outside the ETS, and efforts in the land use, land use change and forestry sector. Norway has enshrined its target of becoming a low emission society by 2050 in the Norwegian Climate Change Act.[71]

(245) Hydrogen has been identified as an essential instrument tool to reach the climate targets, both by Norway and by the EU.

(246) Norway has in its roadmap "the Green Industrial Initiative"[72] identified hydrogen as one of the priority areas and committed to develop a value chain for the production, distribution and use of hydrogen produced with no or low emissions, and to contribute to developing the hydrogen market in Europe.

(247) On the EU side, European Climate Law[73] 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.[74] Further, the Commission has adopted a communication presenting its long-term vision for a climate-neutral economy by 2050.[75] 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.

(248) 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.[76] 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

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[71] https://lovdata.no/dokument/NL/lov/2017-06-16-60.

[72] https://www.regjeringen.no/contentassets/1c3d3319e6a946f2b57633c0c5fcc25b/roadmap_the-green-industrial-initiative_singlepages_web.pdf.

[73] 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.

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

[75] 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.

[76] 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.

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.

(249) In the context of the EU Hydrogen Strategy, the European Clean Hydrogen Alliance[77] was launched on 8 July 2020 to support the large-scale deployment of clean hydrogen technologies by 2030. It brought together renewable and low-carbon hydrogen production, demand in industrial, mobility, transport and other sectors as well as hydrogen transmission and distribution.

(250) 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 climate and environmental challenges, amongst other things.[78] The *Resilience and Recovery Facility ("RRF")* for Europe constitutes a centrepiece of the Next Generation EU.[79] 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. Some projects in Hy2Use will be partly funded by the RRF.

(251) 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.[80] The *REPowerEU Plan* and the March 2022 *REPowerEU* Communication[81] include, in addition to alongside measures that to 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. The hydrogen-related measures contain, in particular, the objective of increasing the use of renewable hydrogen in the EU up to 20 million tonnes by 2030, as well as foresees supporting for the development of an integrated gas and hydrogen infrastructure, hydrogen storage facilities and port infrastructure.

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

[78] 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.

[79] Regulation (EU) 2021/241 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).

[80] 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.

[81] 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.

(252) All of the above initiatives supplement the Commission's Communication that sets out a European Green Deal.[82] The aim is to transform the EU into a climate-neutral society, where economic growth is decoupled from resource use.[83]

(253) ESA considers that Hy2Use will contribute to fulfilling the objectives laid down in the various EU/EEA initiatives mentioned above by:

- bringing together in an integrated project composed of 37 individual projects to be implemented in 14 EEA States, with more than 170 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;
- 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.

(254) 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 EEA's dependency on fossil energy imports.

(255) 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.[84] The *SET Pla*n was revised in 2015 to help achieve the EU'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

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[82] 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.

[83] 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.

[84] Communication from the Commission, Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation, C(2015) 6317 final, 15.9.2015.

and low-carbon hydrogen and by reducing the cost of hydrogen materials and components.

(256) ESA further notes that Hy2Use will contribute to the *Innovation Union European Strategy,* the *EU Renewed Agenda for Research and Innovation*[85] and the *new ERA for Research and Innovation*.[86] 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 Europe;
- contribute to the transfer of hydrogen-related knowledge to new or improved applications and different output sectors;
- 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.

(257) Particularly, it is expected that Hy2Use will trigger significant R&D&I and FID investments.

(258) ESA finds that Hy2Use will deliver on its overall objectives (see paragraph (12)). In addition, the project will contribute significantly to fostering R&D&I, especially through the substantial investments undertaken by the participating undertakings. The numerous collaborations within Hy2Use will further contribute to ensuring R&D&I cooperation across the EEA, as well as facilitating cooperation between the industry and the RTOs.

(259) As regards the contribution of Hy2Use to the New Industrial Strategy for Europe,[87] ESA 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 participating States, to job creation by creating approximately 26 000 direct jobs in total over its implementation. The Barents Blue project specifically is estimated to create between 15-30 direct jobs, while the Tizir project estimates the direct job creation at 60.

(260) Based on the foregoing, ESA concludes that Hy2Use contributes in a concrete, clear and identifiable manner to one or more Union/EEA objectives and has in

[85] 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.
[86] 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.
[87] 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.

particular a significant impact on sustainable growth and value creation across the EEA.

Important market or systemic failures

(261) According to paragraph 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.

(262) Concerning the Norwegian projects, ESA notes, first, that both projects will contribute to addressing a market failure in the form of negative environmental externalities by developing technologies that are necessary for a more efficient use of hydrogen in industry applications, thereby reducing 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 a direct or indirect health hazard to society. The role of policy intervention is to reinforce the incentives to shift towards using less polluting technologies. Absent State aid, undertakings would likely not have the incentive to invest in less polluting technologies.

(263) The Norwegian projects seek to address the negative environmental externalities by:

- developing a fully automated, winterised and modularised blue ammonia plant in demanding conditions with an ultra-low carbon footprint (capture 99% of carbon emissions) to decarbonise the current grey ammonia production. Potential applications of the blue ammonia can also facilitate decarbonisation of other sectors such as marine transport and power generation (the Barents Blue project); and
- developing a hydrogen pre-reduction process to replace the use of coal in the metallurgical industry, with the potential to also replicate and develop the technology for use in other hard-to-abate industrial sectors (the Tizir project).

(264) Second, the Norwegian projects are expected to provide positive externalities through their innovation efforts and knowledge dissemination 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. Both Barents Blue and Tizir have committed to the extensive dissemination of knowledge and results, detailed in section 3.5. In the presence of positive externalities, the social rate of return on the R&D&I investment made by the undertakings is higher than the undertakings' private return from the R&D&I investment.

(265) 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 fully funded privately, even though the overall benefits of that project justify the investment from a societal perspective. This is for example the case for the two Norwegian projects. The presence of positive externalities lead to the underinvestment (or underproduction), from a social perspective, in renewable energy technologies such as the ones developed by Barents Blue and Tizir. This justifies the need for State intervention that can ensure

a level of investments in renewable hydrogen technologies closer to a socially optimal level.

(266) The innovation efforts in the two Norwegian projects are expected to create benefits, going beyond the benefits for the aid beneficiaries themselves, by creating jobs and training opportunities along the different levels of the hydrogen value chain, 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. Together with the other projects in Hy2Use, these serve to create a new and bigger market for the auxiliary industry associated with the hydrogen market.

(267) ESA also specifically notes the following expected positive externalities for the two Norwegian projects.

- First, building the first large scale modularised blue ammonia plant based on an ultra-low carbon footprint, circularity and energy efficiency can lead to positive externalities in a number of sectors. 60-70% of the facilities for blue and green ammonia plants are the same, meaning that many of the technological findings will be available through the suppliers and can be reused to develop new clean ammonia projects. Second, the sustainable, circular practices developed may be reused in other chemical industrial sectors. Third, use of ammonia fired engines in ammonia transport vessels and for $CO_2$ transport vessels contributes to bringing this new technology to market, thereby accelerating the transition to clean fuels (the Barents Blue project).

- Proving the new pre-reduction process to replace coal may make the […] technology more attractive also for the steel industry, particularly considering the commitments to disseminating knowledge and results and the collaboration between Tizir and large actors in the steel sectors (the Tizir project).

(268) Third, the integrated, coordinated and simultaneous nature of all 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 undertakings to simultaneously invest in the new technology.

(269) When the profitability of various projects is interdependent and they are not able to coordinate and invest simultaneously, multiple actors may end up underinvesting. 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 this market failure to be addressed.

(270) The coordination problems that Hy2Use seeks to address are for example:

- <u>Coordination problems relating to investing and ramping up of production</u>: 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 new technologies 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.

(271) 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 all the participating states in Hy2Use to support hydrogen related projects.

(272) The presence of asymmetric information may lead to a situation where innovators may face difficulties convincing investors of the prospects of their projects, thereby increasing the cost of or even limiting access to capital to fund the projects. ESA and the Commission's assessment of Hy2Use relies on a transparent, public, open process of individual project selection together with the explicit joint commitment by all participating undertakings to contribute to projects in Hy2Use. This specifically contributes to addressing this market failure by reducing information asymmetry and providing regulatory certainty.

(273) The projects in Hy2Use may also be hampered by asymmetric information between those investing in environmentally-friendly technologies and their potential customers, due to the lack of appropriate certification methods and standards to differentiate between products. As companies are not fully able to monetarise their investments, they may end up underinvesting.

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

- the residual risks pertaining to the hydrogen technology itself and the fragmented set of information around its specific deployment for heavy duty applications 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;

- given the high cost and the irreversibility of an investment in a large-scale electrolyser system, undertakings potentially willing to adopt this technology remain reluctant to invest in an unproven technology. However, technology suppliers 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 stymied because of the asymmetry of information between technology suppliers and their potential customers. Hy2Use will help overcome this by providing the State aid necessary to trigger investments in innovative technologies for industrial processes;

- the Barents Blue project particularly aims to address the coordination problem of lack of transparent and clear criteria for “clean ammonia” by selecting collaboration partners. Together, they will seek to develop and promote higher standards for clean ammonia such as sustainability, circularity, environmentally-friendliness and plant safety. They will also work towards developing a certification for clean ammonia.

<u>EEA States involved</u>

(275) The IPCEI Communication, paragraph 16, further requires that at least four EEA States shall ordinarily be involved. The notified Hy2Use involves 14 EEA States: Austria, Belgium, Denmark, Finland, France, Greece, Italy, the Netherland, Norway, Poland, Portugal, Slovakia, Spain and Sweden.

<u>Open procedure for EEA States</u>

(276) On 17 December 2020, 23 EEA States signed a joint manifesto in which they committed to launch an IPCEI on hydrogen. In line with paragraph 17 of the IPCEI Communication, the signatory States invited all other interested EEA States to join this initiative. Therefore, ESA concludes that the eligibility condition of ensuring a genuine opportunity for all interested EEA to participate in the IPCEI, laid down in paragraph 17 of the IPCEI Communication, is fulfilled.

<u>Positive spillover effects generated by Hy2Use</u>

(277) As required by paragraph 18 of the IPCEI Communication, an IPCEI must benefit the European economy or society via positive spillover effects. According to the IPCEI Communication, "the benefits of the project must be clearly defined in a concrete and identifiable manner" and "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) that are clearly defined in a concrete and identifiable manner."

(278) The IPCEI Communication requires for spillover effects to be identified at all of the following levels: beyond the EEA State ("economy or society in the EEA"); 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"). This is assessed at an individual project level.

(279) ESA observes that the Norwegian projects incorporate different dissemination activities, ranging from awareness to exploitation of results, which ensure that the findings of the two projects can be translated into new findings and market opportunities. These commitments are detailed in section 3.5 and they consistently go way beyond what the undertakings would do absent Hy2Use (particularly

demonstrated by Tizir's business as usual and the target values of Barents Blue) and are expected to lead to significant spillover effects in other countries and sectors.

(280) As regards spill-over effects for the non-IP protected results of R&D&I and FID activities, the Norwegian authorities have provided an extensive list of activities (described in section 3.5.1), illustrating that the results of the two projects will be disseminated to the whole scientific community and will be of wider relevance and application to different economic sectors. For example, ESA recognises that involvement in conferences and events as speaker, contributor or participant 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 of the hydrogen value chain, (undertakings, RTOs, universities, etc.), as they provide an opportunity to exchange the specific results produced by each individual project and the technological advancements achieved. Moreover, the establishment of collaborations with numerous and varied indirect partners (see section 3.5.4), as well as the close communication and connection to clusters, professional trade associations and other intermediary bodies contribute positively to spreading the results and knowledge acquired as part of Hy2Use (see section 3.5.1.3). ESA for example notes the commitments undertaken by Barents Blue to disseminate knowledge on more sustainable, circular and environmentally friendly plants through its collaborations and dissemination commitments.

(281) ESA also notes the significant effort to be undertaken by Barents Blue and Tizir in spreading and sharing knowledge and results by publication in peer-reviewed journals and by increasing links with the academic world, including through direct collaborations for the implementation of Hy2Use, but also through extensive sponsorship of PhD and Master's students' degrees, as well as through long term collaborations with academia (see section 3.5.1.4). This is particularly important in order to ensure that the knowledge and project results 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 general effort is also enhanced by the lifelong learning initiatives undertaken by the Barents Blue project, such as apprentice trainee opportunities, process operator trainings etc.

(282) As regards spillover effects for IP-protected results of R&D&I (see section 3.5.2), the Norwegian authorities have explained the dissemination activities and the commitments undertaken by Barents Blue and Tizir to spread their results as widely as possible to interested parties, e.g. SMEs or RTOs, to the scientific community and across economic sectors i.e. through non-exclusive licensing based on FRAND conditions. Dissemination of IP-protected results is also expected through the suppliers to the Norwegian projects. For example, the suppliers to the Barents Blue project will prove their technology through this first large-scale blue ammonia plant and can use the technology and know-how to offer clean ammonia plants (blue and green) to other customers, making clean ammonia plants an off-the-shelf product. Thus, ESA considers that the IP-protected results will not only benefit the two undertakings generating those results.

(283) Through access on FRAND terms, it can be expected that interested parties will be able to exploit the results 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.

(284) As far as particular spillover effects of FID activities in the Barents Blue project, ESA considers that, on the basis of the information provided by the Norwegian authorities (described in section 3.5.3), the project is expected to provide access to next generation hydrogen technologies as well as sustainability and circularity practices and know-how to other interested undertakings and RTOs that wish to develop new knowledge and applications. These parties will benefit from early access to the latest technologies available and may thus be able to reduce the development time of their own technologies and processes. Similar effects are expected in the deployment of a coal free reduction process for the steel industry following the Tizir project, although its FID phase falls outside the Hy2Use aided project.

(285) ESA therefore considers that the benefits of the Norwegian projects are clearly defined in a concrete and identifiable manner. The benefits of supporting these projects are not limited to Barents Blue and Tizir, but go beyond the aid beneficiaries' own sectors and extend to the wider economy and society. Undertakings in other economic sectors are expected to benefit and improve their own equipment, materials and processes, develop new product applications and designs and acquire specific skills and know-how as a consequence of their dissemination efforts. Finally, ESA notes that Enova will monitor the correct implementation of the commitments of Barents Blue and Tizir to ensure compliance.

(286) In view of the above, ESA finds that this eligibility condition is satisfied, in accordance with paragraph 18 of the IPCEI Communication.

<u>Co-financing by the aid beneficiaries</u>

(287) As required by paragraph 19 of the IPCEI Communication, the project must involve important co-financing by the aid beneficiaries. ESA notes that the financing needs for the implementation of the participating EU projects are more than double the aid notified by the participating EU States The total financing need for the implementation of the Norwegian projects specifically is NOK 16 billion (approximately EUR 1.6 billion) in total, and the aid granted to the two projects, NOK 743 million (at EUR 72,1) covers only a fraction of the overall costs.

<u>"Do no significant harm" ("DNSH") principle</u>

(288) Paragraph 20 of the IPCEI Communication requires the State to provide evidence of whether the project complies with the principle of 'do no significant harm' within the meaning of Article 17 of the "Taxonomy Regulation, or other comparable methodologies.

(289) Article 17 of the Taxonomy Regulation defines what constitutes 'significant harm' for the six environmental objectives covered by the Taxonomy Regulation:

- 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 on 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;

- 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 EU interest.

(290) In order to assess compliance with paragraph 20 of the IPCEI Communication, ESA required Norway to provide evidence that demonstrates the compliance of the Norwegian projects with the requirement to do no significant harm to the above-mentioned six environmental objectives of the Taxonomy Regulation.

(291) Concerning climate change mitigation, the Norwegian authorities have provided evidence that shows that the Norwegian projects, to the extent that they consist 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 $CO_2$e/MJ. Moreover, the Norwegian projects lead to very significant $CO_2$ emissions savings in general (see paragraphs (109) and (174)).

(292) Concerning climate change adaption, the Norwegian authorities provided evidence that no negative effects are foreseeable. An independent assessment of the climate effects of the Barents Blue project has been carried out, concluding that the project has positive effects for climate change adaption (see paragraph (136)). The Tizir project involves only R&D&I activities and is as such expected to have a neutral or slightly positive effect on climate change adaption (see paragraph (187)).

(293) Concerning the sustainable use and protection of water and marine resources, the Norwegian authorities provided evidence that both Norwegian projects are not located in protected areas. The independent assessment performed for Barents Blue concluded that the project would not threaten the sustainable use of water and marine resources. For Tizir, the use of water will be reduced when implementing a new process using hydrogen compared to the current process. Furthermore, the

Norwegian projects are subject to environmental impact assessments when required by legislation or regulation.

(294) Concerning the circular economy, neither project is expected to cause significant harm. An independent assessment of the climate effects of the Barents Blue project has been carried out, concluding that the project has positive effects for the circular economy. During the operation of the Tizir project, intermediate products and possible waste will be channelled through the existing production line.

(295) Concerning pollution prevention, neither project leads to an increase in emissions of pollutants into air, water or land. Moreover, both projects remain subject to environmental impact assessments, where required by legislation or regulation.

(296) Finally, ESA considers it unlikely that the activities carried out under the Norwegian projects will have a significant negative impact on the protection and restoration of biodiversity and ecosystems. Neither of the projects will be located in a protected area and both remain subject to environmental impact assessments, where required by legislation or regulation.

(297) In view of the above, ESA concludes that Norway has sufficiently demonstrated compliance with paragraph 20 of the IPCEI Communication.

Conclusion

(298) Based on all of the above considerations, ESA considers that the general cumulative criteria for eligibility of Hy2Use and the Norwegian projects for aid under Article 61(3)(b) of the EEA Agreement are met. The Commission has reached the same conclusion in respect of the other participating projects in its Hy2Use decision.

(b) General positive indicators

Involvement of the Commission in the design

(299) The Commission facilitated the emergence of Hy2Use and helped enhance coordination between the EEA 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 EEA States interested in participating in Hy2Use. This is consistent with paragraph 21(a) of the IPCEI Communication.

Involvement of the Commission in the governance

(300) As described in detail above under section 3.3, the governance structure of Hy2Use involves the Commission through participation in the SB. This is consistent with paragraph 21(c) of the IPCEI Communication.

Important collaborative interactions

(301) The Norwegian authorities provided detailed information (see section 3.4.5) describing how the Barents Blue and Tizir projects will engage in important collaborative interactions with their partners, including partners active in other sectors.

(302) ESA also takes note of the number of collaborations within each and across the two TF at the level of Hy2Use, as illustrated in the table below and figure 1. These are

substantial in terms of the number of partners, including cooperation within and across the TFs, and involve undertakings of different sizes. ESA also takes note of the numerous collaborations with indirect partners, and the collaborations with indirect partners established by the Barents Blue project and the Tizir project in particular (see section 3.5.4).

| TF | Number of collaborations intra TF | Number of collaborations inter TF |
|---|---|---|
| **TF 1** | 36 | 36 |
| **TF 2** | 31 | |
| **Total** | 67 | 36 |

***Table 9: Summary of the different inter and intra TF collaborations***

(303) ESA considers that the level of collaborations within Hy2Use and the Norwegian projects specifically are in line with paragraph 21(d) of the IPCEI Communication.

Co-funding or co-financing from an Union fund

(304) ESA acknowledges that some of the participating States will be using 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 from Union funds is consistent with paragraph 21(e) of the IPCEI Communication. The Norwegian projects do not involve any such financing.

Significant strategic dependency

(305) ESA acknowledges that Hy2Use furthers the EU's policy of decreasing its dependency on fossil energy imports and providing energy security. This is consistent with paragraph 21(g) of the IPCEI Communication.

(306) In view of all of the foregoing, ESA considers that, based on section 3.2.2 of the IPCEI Communication, five out of seven general positive indicators, in accordance with paragraph 21 of the IPCEI Communication, are met.

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

(307) All individual projects within TF 2 comprise either or both R&D&I and FID activities. For the Norwegian projects, Tizir comprises R&D&I activity, while Barents Blue comprises both R&D&I and FID activity.[88]

(308) Paragraph 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 the light of the state-of-the-art in the sector concerned.

(309) According to paragraph 23 of the IPCEI Communication, projects comprising 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.

[88] For details regarding the other participating undertakings in Hy2Use, see the Commission's Hy2Use Decision.

(310) Further, paragraph 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.

(311) ESA verified that both the Barents Blue project and the Tizir project have a well-defined and documented research programme regarding the innovations brought forward. ESA, along with the Joint Research Centre ("JRC"), conducted a technical assessment of both projects to determine whether the projects comply with the innovation requirements as laid out in the IPCEI Communication.[89]

(312) In particular, the innovative nature of the Barents Blue project and the Tizir project was analysed taking into account the following specific principles and parameters.

(313) For their R&D&I activities:

- State-of-the-art: ESA compared all product and process innovations of each participating Norwegian undertaking against the state-of-the-art on the market at global scale (see sections 3.6.2.1and 3.7.2);
- Innovation: as regards the technical assessment of the innovative nature of each Norwegian project, ESA 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 (see sections 3.6.2.1.2 and 3.7.2);
- Technical process/approach: Both participating Norwegian undertakings were asked to provide a clear description of the technical process/approach needed to reach the innovation targets. In this context, ESA assessed the type of technology used, the challenges encountered by each participating undertaking and the means chosen to overcome those challenges;

(314) For the FID phase of the Barents Blue project:

- Norway described the testing, sampling and upscaling processes implemented by the Barents Blue project during the FID and explained how they differed from mass production and normal commercial activities (See section 3.6.2.2). ESA examined whether the FID contains important R&D&I activities, going beyond the above-mentioned processes (i.e. testing, sampling and upscaling) but instead including an optimisation of innovation developed in the R&D&I phase; and
- ESA further assessed the duration of the FID of the Barents Blue project, the criteria determining its start and end period, and the scale of the FID.

(315) Based on the information provided by Norway and following an assessment against the relevant factors listed above, ESA considers that the R&D&I and FID activities

[89] The JRC is the Commission's science and knowledge service.

carried out by Barents Blue and Tizir 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 ESA identified as part of its assessment are described below.

(316) As regards the R&D&I activities of the Tizir project (see section 3.7.2):

- Tizir's full project comprising development, testing and verification of […] technology through two pilot installations and subsequently scaling this up to plant, removing more than 80% of its carbon footprint, will be a major breakthrough for industrial applications of the […] technology. The process has never been applied to ilmenite processing and will as such be an innovative and fundamentally new process.
- The demonstration plant will run over a period of […], which is crucial to document overall robustness of the technology for full scale implementation and will serve as input to invest in the new plant with an acceptable level of technical and financial risk.
- The project aims to bring the TRL of the relevant technologies from TRL5 to TRL7.

(317) As regards the R&D&I and FID activities of the Barents Blue project (see sections 3.6.2.1 and 3.6.2.2):

- The project consists in designing, testing and building an innovative blue ammonia plant able to capture 99% of its emissions. The scale, scope and technological solutions envisaged by the project are unprecedented and constitute a first-of-a-kind action. Elements of a large-scale $CO_2$ transport chain towards the chosen sequestration locations will also be partially put in place by the project.
- The technical expertise recruited by the project and the clarity of the project technical vision bode well for its successful implementation. However, the project's final goal is considered extremely ambitious.
- If fully successful in its entirety (including $CO_2$ transport and sequestration), the project will demonstrate the feasibility of a truly innovative ammonia production value chain.
- The project aims to bring the relevant technologies to TRL8.

(318) Based on the above, ESA considers that the content of the Barents Blue project and the Tizir project that are part of Hy2Use satisfy the specific criteria set out in paragraphs 22 to 24 of the IPCEI Communication.

### *7.2.3 Importance of Hy2Use*

(319) 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.

(320) ESA considers Hy2Use to be an important project meeting the quantitative and qualitative requirements set out in section 3 of the IPCEI Communication, based on its assessment of the Barents Blue project and the Tizir project and taking into consideration the corresponding assessment of the other individual projects in

Hy2Use done by the Commission in its Hy2Use Decision. ESA underlines the following specific elements assessed in the previous sections:

- Hy2Use represents an important contribution to Union's objectives;
- Hy2Use is designed to overcome important market or systemic failures;
- 14 EEA States participate in Hy2Use;
- All EEA States were given the opportunity to participate in Hy2Use;
- Hy2Use generates positive spillover effects (see section 3.5 for the spillover effects generated by the Barents Blue project and the Tizir project);
- Hy2Use involves important co-financing by the aid beneficiaries (see paragraph (287) concerning the private financing involved in the Barents Blue project and the Tizir project);
- Hy2Use complies with the principle of "do no significant harm" (see paragraphs (289) to (298) on how the Barents Blue project and the Tizir project complies with the DNSH principle);
- The Commission was involved in the design of Hy2Use;
- The governance of Hy2Use involves the Commission;
- Hy2Use involves important collaborative interactions;
- Hy2Use involves co-funding or co-financing from a Union fund;
- Hy2Use addresses a significant strategic dependency; and
- The infrastructure projects in Hy2Use (TF1) are of great importance for the energy strategy of the EU (see the Commission's Hy2Use Decision) and the projects involving R&D&I and FID meet the innovativeness requirements of the IPCEI Communication (see paragraphs (307) to (318) concerning how the Barents Blue project and the Tizir project meet the innovativeness requirement);

(321) In addition, ESA acknowledges the considerable level of risks, hereunder technological and financial, inherent in the Norwegian projects. The hydrogen technologies developed by Barents Blue and Tizir are currently at an early stage of their development, which entails a number of technological as well as other risks.

(322) In the Barents Blue project, the completion of FEED engineering of the full plant system design and the integration of all new technologies, which are still at an early stage of their development, involves a high degree of technological risk. The different components will require further validation, optimisation and upscaling, in order to be operational (see section 3.6.2.2). This carries the risk of delays and cost overruns that can jeopardise the effective implementation of the project.

(323) In addition, the Barents Blue project also faces regulatory risks due to the need to secure all necessary permits, supply risks due to the need to establish gas purchase agreements and risks related to establishing ammonia sales agreements in line with project expectations.

(324) There is also a significant technological risk in the Tizir project due to the need to prove the robustness of the […] production process for ilmenite, including the safety of the new process (see section 3.7.2). The project may also face supply risks as it necessitates either the installation of an electrolyser or purchasing hydrogen on the market in order to feed the new process. At the same time, the manufacturing of electrolysers depends on the availability of certain critical raw materials with low abundancy, (e.g. iridium, platinum, scandium or yttrium) and these may be subject to shortage.

(325) The deployment of the innovative technologies envisaged in the Barents Blue project and the Tizir project also entail economic and financial risks, considering that the investment amounts are significant, while the hydrogen market remains uncertain and under development.

(326) In light of the duration of the Norwegian projects, changes in operating conditions as well as unexpected events may occur while the projects are ongoing. For example, the economies of the Tizir project are highly sensitive to changes in *inter alia* quota prices, free quotas and $CO_2$ compensation, and the regulatory environment regulating those is expected to change in the near future. The fulfilment of the initial schedule of the two projects, as well as their construction and operational costs, are also subject to a degree of uncertainty.

(327) Finally, Barents Blue and Tizir will also face strategic and organisational risks in implementing their projects. The implementation period of Hy2Use and their individual projects will be lengthy, and numerous changes of the projects' operating conditions are very likely to occur. The planned collaborations and synergies with multiple different stakeholders from various sectors are expected to entail challenges. 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 and to achieve the overall objective of Hy2Use in simultaneously rolling out demand and supply in the hydrogen market. Any delay may therefore jeopardize the effective implementation of Hy2Use, and of the Barents Blue project and the Tizir project specifically.

#### *7.2.4 Conclusion on the eligibility of Hy2Use*

(328) In view of the above, ESA considers that Hy2Use meets the eligibility criteria of the IPCEI Communication. This is in line with the Commission's conclusion in its Hy2Use Decision. ESA also find that the Norwegian projects are part of the integrated project, Hy2Use.

### 7.3 Compatibility criteria

(329) When assessing the compatibility with the internal market of aid to promote the execution of an IPCEI on the basis of Article 61(3)(b) of the EEA Agreement, paragraph 27 of the IPCEI Communication requires ESA to take into account a number of criteria, as elaborated upon below. Paragraph 28 of the IPCEI

Communication also requires ESA to carry out a balancing test to assess whether the expected positive effects of the aid outweigh the possible negative effects.

(330) Having regard to the conclusion that, for the reasons set out in section 7.2 above, Hy2Use as an integrated project fulfils the eligibility criteria set out in section 3 of the IPCEI Communication, ESA considers that the presence of a market failure or important systemic failure, and the contribution to a common European interest, can be presumed for the Barents Blue project and the Tizir project, in line with paragraph 29 of the IPCEI Communication.

(331) ESA analysed the compatibility criteria for the Barents Blue project and the Tizir project, as set out below.

#### *7.3.1 Necessity of the aid*

(332) According to paragraph 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 should only be possible on a smaller scale, with a more narrow scope, or not with sufficient speed, or in a different manner that would significantly restrict its expected benefits. Footnote 26 thereto requires that the aid application must precede the start of the works, which is either the start of construction works on the investment or the first firm commitment to order equipment or other commitment that makes the investment irreversible, whichever is the first in time.

(333) According to paragraph 31 of the IPCEI Communication, Norway should provide ESA 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.

(334) As regards the Norwegian projects, ESA verified that the related applications for aid were submitted to Norway before the start of any work. Therefore the formal incentive effect criterion, as required by the IPCEI Communication footnote 26, has been met.

(335) Moreover, the Norwegian authorities have submitted information demonstrating that the aid has a substantive incentive effect for both aid beneficiaries, i.e. that the aid will induce the aid 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.

(336) The counterfactual scenario may consist in the absence of an alternative project, where evidence supports that this is the most likely counterfactual, or in an alternative project considered by the aid beneficiaries in their internal decision-making. To demonstrate the credibility of the counterfactual scenario presented by Barents Blue and Tizir, the Norwegian authorities provided relevant internal documents (see sections 3.6.6 and 3.7.6).

(337) In general, Norway and the other participating States have underlined that absent the aid, the development of a competitive, innovative and sustainable ecosystem for hydrogen would not take place. The innovations envisaged by the integrated

project would not be made available to European consumers, as each participating undertaking would have focussed on its own road map absent Hy2Use.

(338) As regards the Barents Blue project specifically, the Norwegian authorities have argued that without aid, the project will be delayed, which will change the basis for the economic assumptions and other important conditions that need to be in place for the project to be carried out. Taken together, this will in all likelihood lead to the cancellation of the entire project.

(339) In support of this statement, the Norwegian authorities have pointed to the fact that the Barents Blue project is not planned as a conventional ammonia project, but rather a novel and inherently risky project, requiring extensive R&D&I. This raises the level of risk of the project for private investors. In the absence of State aid, the basis for private investment in the project radically changes at this point in time.

(340) The Norwegian authorities point to three factors that will cause a delay of the project in absence of State aid.

(341) First, without aid, the undertakings behind the project will have to wait for market conditions to improve to make the investment in the project less risky. This would include waiting for other players on the market to develop the technology. Second, if no aid is granted, the Barents Blue project will not participate in Hy2Use and will have to wait until a more mature business environment for blue ammonia exists. Third, the project depends on a targeted revision stop at Melkoya in […]. If the project is not underway before that time, it will have to be delayed to the next revision stop, in […] (see paragraph (147). ESA finds that, taken together, these factors demonstrate that a significant delay of […] years is inevitable in the absence of aid.

(342) The Norwegian authorities have then submitted that such delay will, de facto, lead to the cancellation of the project. This is due to the fact that a delay alters the underlying economic assumptions of the project and undermines a number of basic parameters for the deployment of the project such as secure access to power, real estate and natural gas, which cannot be guaranteed in four years' time (see paragraph (151)).

(343) According to the evidence produced, ESA finds that absent aid, the project will be significantly delayed. This delay will in turn have a significant effect on the economic factors that apply to the project, which may lead to private investors cancelling their investment. In this scenario, the project, as described in this decision, will most likely be cancelled. ESA also finds that, absent aid, the beneficiary would not invest in a "grey" alternative, i.e. a project with less ambitious technological and environmental goals and that a smaller plant would only decrease the economic viability of the project further.

(344) Therefore, ESA concludes that the counterfactual for the Barents Blue project is the absence of a project, in line with paragraph 31 of the IPCEI Communication.

(345) In the absence of an alternative project, as defined in paragraph 31 of the IPCEI Communication, ESA verified that the aid was necessary to induce the change of the behaviour of the aid beneficiary, i.e. that the aid did not exceed the actual isolated funding gap of the project, in line with paragraph 32 of the IPCEI

communication. Specifically, ESA verified that that the aid brings the Barents Blue project to a sufficient degree of profitability, corresponding to the project's weighted average cost of capital ("WACC") (see section 3.6.7).

(346) As regards the Tizir project, the Norwegian authorities have submitted that the counterfactual scenario is to continue normal operations at the Tizir plant, while making incremental changes through investments such as ICA230, i.e. the base case scenario.

(347) The Norwegian authorities have provided internal documents and communications that demonstrate that Tizir's parent company, Eramet, has approved carrying out the ICA230 project,[90] but has made it clear that it will not invest in the Tizir project, in the absence of aid.[91]

(348) In line with paragraph 31 of the IPCEI Communication, ESA concludes that the counterfactual for the Tizir project is the base case scenario, as described by Norway.

(349) Consequently, as the Norwegian authorities have demonstrated that Tizir faces a clear choice between carrying out either the aided project or an alternative without aid, ESA has compared the expected NPV of the two alternatives facing Tizir, in line with paragraph 34 of the IPCEI Communication (see section 7.3.2.2 below).

(350) Further, in its assessment of the eligible costs of the Norwegian projects, ESA verified that the list of submitted costs did not include costs that the undertakings would anyhow incur, such as costs linked to already existing laboratories in which research would have been conducted anyhow or facility and personnel costs which the undertakings would have had to bear even without participating in Hy2Use.

(351) Therefore, ESA considers that the Norwegian authorities have sufficiently demonstrated that the aid to Barents Blue and Tizir does not subsidise the costs of that the undertakings would anyhow incur and do not compensate for the normal business risks of the aid beneficiaries.

(352) Moreover, ESA has verified that, absent the aid measures, Barents Blue would refrain from developing blue ammonia at this time, while Tizir would continue operations based on its current, well proven operational process e.g. the base case scenario.

(353) Consequently, and considering that the aid measures enable Barents Blue and Tizir to pursue very ambitious projects that would not have been pursued in the absence of Hy2Use and the aid granted by Norway, ESA concludes that the notified aid measures are necessary to induce the change in behaviour of the aid beneficiaries.

#### *7.3.2 Proportionality of the aid*

(354) According to paragraph 32 of the IPCEI Communication, in the absence of an alternative project, ESA will verify that the aid amount does not exceed the minimum necessary for the aided project to be sufficiently profitable. The minimum necessary can for example be to make it possible to achieve an internal rate of return

[90] Document No 1309447.
[91] Documents No 1309449 and 1309453.

corresponding to the sector or firm specific benchmark or hurdle rate. Normal rates of return required by the beneficiaries in other investment projects of a similar kind, their cost of capital as a whole or returns commonly observed in the industry concerned may also be used for this purpose.

(355) According to paragraph 34 of the IPCEI Communication, where it is shown, for example by means of internal documents, that the aid beneficiary faces a clear choice between carrying out either an aided project or an alternative one without aid, ESA will compare the expected net present values of the investment in the aided project and the counterfactual project. According to paragraph 33 of the IPCEI Communication, the maximum aid level should be determined with regard to the identified funding gap and to the eligible costs. The aid could reach up to 100% of the eligible costs, provided that the aid amount does not exceed the funding gap.

7.3.2.1 Assessment of eligible costs

(356) The assessment of the eligible costs takes account of the fact that the Tizir project contains only R&D&I, while the Barents Blue project contains both R&D&I and FID.

7.3.2.1.1 R&D&I costs

(357) In its assessment of the eligibility of the costs for the R&D&I project of Tizir and the R&D&I phase of the Barents Blue project, ESA verified that the projects contain R&D&I activities of major innovative nature, going substantially beyond the state-of-the art in the respective sectors. This verification was based on the nature of the activities to be performed, the technology challenges and risks to be overcome and the duration of each activity, as demonstrated by both undertakings.

(358) ESA verified that a high innovation level will be reached for both Norwegian projects and that the activities are not limited to merely facilitating an incremental evolution of technologies already existing on the market (see paragraphs (307) to (318)). In this regard, ESA finds that the technological and environmental ambitions of the Barents Blue project are unprecedented and constitute a first-of-a-kind action, and that if Tizir succeeds in developing hydrogen based pre-reduction of ilmenite, replacing coal with hydrogen in a fluid bed process, it would be a major break-through in this sector and may have spillover effects also for other similar smelting processes (for example in the steel industry).

(359) Therefore, supported by an assessment by the JRC, ESA verified that the R&D&I, described in sections 3.6.2.1.2 and 3.7.2, takes the technologies beyond the current global state-of-the-art, in accordance with paragraph 22 of the IPCEI Communication.

(360) Moreover, ESA confirms that all the R&D&I costs for the Barents Blue project and the Tizir project are in line with the costs types listed in the Annex to the IPCEI Communication. Specifically, the eligible costs of the R&D&I phase of the Barents Blue project are subcontracting costs and personnel, falling under points (f), (g) and (h) of the Annex. Furthermore, the eligible costs of the Tizir project (R&D&I costs exclusively) are the construction of laboratories, machinery and equipment, personnel and subcontracting costs, and materials and supplies, in line with points (b), (d), (f), and (h) of the Annex.

(361) These costs, for both projects, are limited to the duration of the respective R&D&I phases of these projects.

7.3.2.1.2 FID costs in the Barents Blue project

(362) To determine whether the FID costs included in the Barents Blue project are eligible, ESA verified that the claimed 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”; [92]

b) do not relate to “regular upgrades without an innovative dimension of existing facilities and the development of newer versions of existing products”; [93]

c) consist in “the upscaling of pilot facilities, or [to] the first-in-kind equipment and facilities covering the steps subsequent to the pilot line including the testing phase and bring batch production to scale”;[94]

d) do not correspond to mass production or to commercial activities; [95]

e) relate to the capital and operating expenditures ("CAPEX" and "OPEX"), as long as the industrial deployment follows on from an R&D&I activity and itself contains an important R&D&I component which constitutes an integral and necessary element for the successful implementation of the project. [96]

(363) Activities were only considered eligible where they relate to the introduction of processes that transfer the R&D&I performed in the R&D&I phase to FID and only to the extent that the work is critical for the functionality of the resulting production process, i.e. they require additional R&D&I work even after the R&D&I phase. ESA found that the FID activities in the Barents Blue project allow for the development of a blue ammonia production process which is of fundamentally innovative nature (see paragraph (315)). It does not consist of mere regular upgrades of existing facilities or a development of newer versions of already existing technology.

(364) This phase includes additional important R&D&I components to be carried out (see paragraph (133)) that are indispensable for the successful commissioning of the new plant. ESA, supported by an external assessment of the JRC, checked this against the most up-to-date publicly available information (including scientific and technical literature journals, corporate technical scientific publications, patents, etc.).

(365) In relation to the important R&D&I component, ESA finds that the Norwegian authorities provided an adequate demonstration of the important R&D&I activities in the FID phase of the Barents Blue project, which constitutes an integral and

[92] Paragraph 23 of the IPCEI Communication, first sentence.
[93] Paragraph 23 of the IPCEI Communication, second sentence.
[94] Paragraph 24 of the IPCEI Communication, first sentence.
[95] Paragraph 24 of the IPCEI Communication, first sentence.
[96] Point (g) in the Annex to the IPCEI Communication. The wording of the IPCEI Communication implies that the 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 what are eligible FID costs.

necessary element for the commissioning of a blue ammonia plant able to capture 99% of its emissions (see section 3.6.2.2). Mere engineering work accompanying normal activities of FID was not considered an eligible cost for the required R&D&I in the FID phase. The Norwegian authorities demonstrated that the planned important R&D&I during the FID is necessary to solve outstanding technological roadblocks and to bring the various associated technologies to TRL 8 (see paragraph (133)).

(366) The FID phase in the Barents Blue project corresponds to the phase when it starts testing the new production method outside the lab and the pilot line, including the testing phase and bringing batch production to scale, in line with paragraph 24 of the IPCEI Communication. The technologies developed during the R&D&I phase of the project require further maturation in the form of design, simulations and testing. This is for example the case for processes related to the integration of the ammonia plant with carbon capture, emissions, the plant modularisation, the automation and control system, the total system integration and the winterisation of the plant. This validation process is specific to the developed hydrogen technology, aiming to enable the preparation of a stable production process in the mass production phase. During the ramp-up period, given that the production processes are put in place for the first time, complications that require adjustments, optimisation or redesigning part of the production process are expected to occur.

(367) ESA has also verified that no R&D&I costs after the conclusion of FID (end date in line with the IPCEI Communication) are included. For cost items that are depreciated over several years, ESA verified that only depreciation costs until the end of the FID phase are included in the eligible costs. The aid beneficiary has demonstrated that the depreciation periods used correspond to good accounting practice. No operating costs were included as eligible costs.

(368) ESA verified that the activities taking place during the FID phase correspond to FID activities and not mass production or commercial activities in quantitative or qualitative terms.

(369) ESA first examined the KPIs for identifying the moment in time when the blue ammonia plant reaches a stabilised mass production and moves from the FID phase to mass production. These KPIs include that: all technologies must be matured to TRL 8, the plant must be able to meet production capacity requirements; and the 99% $CO_2$ capture rate has been verified (see section 3.6.2.2). Any costs relating to production occurring after the KPIs have been met are not included as eligible costs.

(370) Therefore, ESA confirms that the planned FID activities of the Barents Blue project:

a) correspond only to the testing, sampling and upscaling activities;
b) include only activities that still require significant R&D&I effort;
c) correspond only to a limited output volume; and
d) do not cover mass production or commercial activities

(371) Moreover, ESA confirms that all the eligible costs claimed for the FID of the Barents Blue project are covered by the categories listed in the Annex to the IPCEI Communication. Specifically, the eligible costs of the FID phase of the Barents Blue

project are: the costs of instruments and equipment; of the acquisition (or construction) of buildings, infrastructure and land; of personnel; and the capital expenditure to the extent and for the period used for the project. When relevant, these costs are limited to the depreciation costs corresponding to the life of the project, as calculated on the basis of good accounting practice. These costs therefore fall within the categories listed in points (b), (c), (f) and (g) of the Annex to the IPCEI Communication.

(372) Against this background, ESA finds that the notified FID phase of the Barents Blue project and its corresponding costs complies with the IPCEI Communication.

7.3.2.1.3 Conclusion

(373) ESA finds that the costs notified by Norway in relation to both the Tizir project and the Barents Blue project are eligible under the IPCEI Communication.

7.3.2.2 Assessment of funding gaps

(374) ESA reviewed the funding gap calculations provided by Norway in detail, verifying the main assumptions in those calculations, as explained below.

(375) The funding gap is equal to the difference between the NPV of the IPCEI project (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 WACC of the beneficiary.

(376) ESA assessed the funding gap of both projects at the level of each aid beneficiary. This assessment entailed:

a) first, ensuring that each project calculated the funding gap as the difference between the NPV of their IPCEI project and the NPV of their counterfactual scenario; and
b) second, reviewing and verifying the funding gap assumptions.

(377) Regarding the funding gap calculation, ESA verified that the Norwegian authorities provided a realistic factual scenario, as well as a realistic counterfactual scenario, for the Norwegian projects. This is essential to the correct calculation of the funding gap.

(378) ESA reviewed and verified the funding gap assumptions for both the factual and counterfactual scenarios for each project. Particular scrutiny was applied to the net cash flows and the WACC assumptions.

(379) ESA also assessed and ensured that the projections of Barents Blue and Tizir include all of the net cash flows expected to be generated from their respective investments. To this end, ESA verified that these figures, included in the funding gap analysis of each project:

a) are comprehensive;
b) accrue over the entire mass production phase and span over the expected life-cycle of the respective hydrogen technology; and

c) lead to a profit margin in line with the market during the mass production phase.

Barents Blue

(380) According to the calculations of the Norwegian authorities, the funding gap of the Barents Blue project is NOK – 482 million.

(381) ESA finds that the counterfactual scenario for Barents Blue is that, absent aid, the project will not be undertaken (see section 7.3.1).

(382) The funding gap analysis of Barents Blue includes all relevant expected costs and benefits over the lifetime of the project, i.e. [25-35] years (i.e. cash flows until […]). Moreover, all relevant underlying assumptions are explained and a detailed breakdown of the revenues, such as calculations of the cost of sales and unit price, are provided. The analysis shows that the project has a positive cash flow from mass production onwards, and has projected positive EBIT during that phase.

(383) Second, ESA verified that the applied WACC of […]:

a) Is calculated by applying the formula below:

$$WACC = \frac{E}{D+E} \times (rf + \beta \times ERP) + \frac{D}{D+E} \times (rf + DP) \times (1-T)$$

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

b) Is appropriate for the project envisioned;

c) Has verified that the parameters of the WACC formula are in line with external benchmarks.

(384) ESA notes that the project will be undertaken by a newly established joint venture between three partners active in different sectors (see section 3.6.1). The Barents Blue project therefore uses a project specific WACC as a basis for the calculation of the funding gap.

(385) In this respect. ESA considers that the detailed breakdown of the WACC parameters, provided by Norway, is sufficient to demonstrate that the WACC applied to the project is appropriate, particularly since it has been calculated from the bottom up using external benchmarks for the relevant parameters.

(386) Consequently, ESA finds that Barents Blue has calculated its funding gap in line with the IPCEI Communication and the notified aid amount of NOK 482 million does not exceed the identified funding gap in relation to the eligible costs.

Tizir

(387) According to the calculations of the Norwegian authorities, the funding gap of the Tizir project is NOK – 501 million.

(388) The counterfactual scenario for Tizir is that absent aid, it would continue business as usual (see section 7.3.1). As it faces a clear choice between carrying out the Tizir project and continuing business as usual, making incremental investments, the funding gap is calculated by comparing the expected net present values of the investment in the aided project and the counterfactual in line with the IPCEI Communication, paragraph 34.

(389) ESA concludes that the Norwegian authorities have provided comprehensive and detailed projections, based upon an operational period of 15 years (i.e. cash flow until year 2043). This project lifetime was determined based on empirical evidence indicating that significant maintenance and upgrading would be required for the installation to run for longer than 15 years.[97] The analysis is based on the assumption that investments for full scale production will be made, and shows that the project as a whole would lead to a profit margin in the mass production phase.

(390) Tizir applies its own internal WACC, which is analysed and updated annually by an independent party (see paragraph (202)). Tizir has provided external evidence that demonstrates that the WACC they use is in line with the WACC of comparable undertakings in the sector.[98] Therefore, ESA concludes that the WACC applied is appropriate.

(391) Consequently, ESA finds that Tizir has calculated its funding gap in line with the IPCEI Communication and the notified aid amount of NOK 261 million does not exceed the identified funding gap in relation to the eligible costs.

Claw-back mechanism

(392) While the claw-back mechanism, described above in section 3.10, does not apply to the Norwegian projects, due to the fact that the aid amounts are below the EUR 50 million threshold, the Norwegian authorities apply a specific claw back mechanism to the Barents Blue project, which provides further reassurance of compliance with the proportionality requirement (see paragraph 36 of the IPCEI Communication).

Cumulation

(393) The State aid received pursuant to the measures, can be cumulated with other State aid, provided that the total amount of public funding granted to the same eligible costs does not exceed the most favourable funding rate laid down in the applicable EEA rules in line with paragraph 35 of the IPCEI Communication.

Conclusion

(394) ESA finds that the aid to be granted by Norway is proportionate.

#### *7.3.3 Prevention of undue distortions of competition and balancing test*

##### 7.3.3.1 Appropriateness

(395) According to paragraph 42 of the IPCEI Communication, Norway should provide evidence that the proposed aid measures constitute the appropriate policy instrument to address the objective of the projects.

[97] The lifetime of the project assumes that Tizir invest in WP4 after the R&D&I phase.

[98] See document 1309457.

(396) ESA finds that State aid is the appropriate policy instrument to support Hy2Use, and necessary to induce the Barents Blue project and the Tizir project. Due to the exceptional size of Hy2Use and the synergies it requires from its partners, the goals of Hy2Use and the coordination problems inherent in the current hydrogen sector cannot be met without financial state support. In the absence of State aid, the participating undertakings would focus on their own programmes, to the detriment of innovation, whose spillover effects benefit the EEA as a whole.

(397) ESA considers that other policy instruments are inappropriate alternatives to State aid in this case. The use of regulation and mandatory pollution standards, or the use of pricing mechanisms and environmental taxes to implement the objectives of Hy2Use, would not lead to the same outcome as the proposed measures.

(398) In this respect, ESA also notes that the regulatory environment and environmental pricing mechanisms are accounted for in the business case and funding gap analysis of the projects. Nonetheless, there exists a funding gap, which demonstrates the need for State aid (see sections 3.6.7 and 3.7.7).

(399) ESA finally finds that the payment of direct grants constitutes the appropriate instrument in view of the high financial and technological risk inherent in the Norwegian projects. The use of direct grants limits the potential financial losses in case of project failure and the low expected profitability induced by the relevant spillover effects. ESA further notes that Enova will monitor the correct implementation of the Norwegian projects and the commitments undertaken by Barents Blue and Tizir, which will ensure the appropriateness of the aid measures (see section 7.3.6).

(400) ESA consequently concludes that Hy2Use and the measures in favour of Barents Blue and Tizir are appropriate to address their objectives.

7.3.3.2 Identification of the potential risks of distortions of competition

(401) According to paragraph 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 the EEA 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 the undertakings in the markets concerned, as well as any risks of market foreclosure and dominance (paragraphs 44 and 45 of the IPCEI Communication).

(402) The assessment of potential distortions to competition was carried out taking into account the particularities of the sectors, the undertakings and the TF concerned. Both projects were assessed individually, following a consistent approach. The Norwegian authorities provided detailed information and reasoning on the absence of undue distortions to competition in relation to the Norwegian projects.

(403) First, ESA screened the Norwegian projects based on their in the markets affected by Hy2Use. In particular, ESA screened them based on a uniformly available metric on European production (the "PRODCOM" statistics on the production of manufactured goods). ESA 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. Further, ESA requested

and received 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.[99] Based on this information, ESA assessed the share of European production, as a proxy for horizontal market shares, of Barents Blue and Tizir.

Barents Blue

(404) After completing the Barents Blue project, Barents Blue aims to enter the ammonia market, in which it is not currently active. Following a successful implementation of the project, the Barents Blue Ammonia Plant will produce 1 million tonnes of blue ammonia annually, with a potential to expand production to 3 million tonnes annually at a later stage. As the beneficiary does not currently produce ammonia, this production will be the result of Hy2Use and the aid from Enova.

(405) As previously stated, the global production of ammonia amounts to approximately 185 million tonnes per year. In that context, and even at full capacity, Barents Blue will be a small player in the global market, with a 0.5-1.6% share.

(406) The demand for ammonia in the EEA, on the other hand, is approximately 20 million tonnes per year. No European country is among the main producers of ammonia in the world, and Europe imports ammonia.[100] It is estimated that this market will grow in the next few years, and that the total demand for ammonia in the EEA could reach 26 million tonnes in 2027. If those predictions materialise, Barents Blue would represent approximately 4-11% of the EEA ammonia market.

(407) The clean ammonia market is still developing and is expected to grow in the coming years. Multiple blue ammonia projects are being considered globally, with a potential annual production of about 15.2 million tonnes worldwide by 2027.[101]

(408) Additionally, many green ammonia projects are expected to be realised by 2027, providing a total of approximately 18.5 million tonnes of green ammonia.[102] The Barents Blue project will therefore produce a sizable share of all clean ammonia globally, or approximately 3-9%. As the clean ammonia market is under development, Barents Blue's share of the production of clean ammonia in the EEA is still uncertain, but is likely to be substantial, particularly in the first years of production.

(409) However, ESA notes that the prevailing product on the ammonia market today is grey ammonia. Even if all foreseeable plans for blue/green ammonia production materialise, clean ammonia will represent a relatively small share of the worldwide production of ammonia. Barents Blue will have to compete with well-established global grey ammonia market players. These currently have a number of competitive advantages, such as existing supply and logistics chains as well as well-established customer relationships. Moreover, as the already large market for ammonia is

[99] ESA did not request figures at the NACE level for the Barents Blue project, as it is a new undertaking with no existing market share.
[100] The top five producers of ammonia are: China, Russia, India, USA and Indonesia.
[101] The numbers are based on a clean ammonia project overview done by the Ammonia Energy Association.
[102] Ibid.

expected to grow further in the future, ESA considers that any incentives given to the Barents Blue project will not unfairly strengthen or create market power.

(410) A first mover advantage is often an inherent part of funding demonstrations of fundamentally new technologies and production processes, which is also the case for the Barents Blue project. However, Barents Blue has committed to collaborate with other undertakings, and to extensive dissemination of the knowledge and results from the project, so that replication of the plant is made possible (see sections 3.4 and 3.5). Moreover, the technology developed in the Barents Blue project will available on FRAND terms, which will reduce the barriers for competitors. In fact, similar concepts, based on the expected findings of the Barents Blue project, are already being developed in Russia and the United States, according to the Norwegian authorities. Therefore, ESA considers that it is highly unlikely that the aid to Barents Blue will have a foreclosure effect on the market, as competitors will be able to implement a similar technology on their own, provided the technology works.

Tizir

(411) Tizir already operates in the metals sector. As described in section 3.7.1, Tizir mainly produces titanium dioxide slag and high purity pig iron. The markets for titanium dioxide slag and high purity iron are global. The analysis shows that Tizir holds approximately […] global market share for the former and […] for the latter.

(412) The Norwegian authorities have noted that no direct change in market shares is expected for Tizir due to the aid measure, as the measure finances only the R&D&I phase. Nevertheless, Tizir's R&D&I investment and the potential future industrial investment in implementation of the hydrogen pre-reduction process is strategic. The new technology in the demonstration project may therefore provide Tizir with a first mover advantage, as certain first mover advantage will often be an inherent part of funding demonstrations of new technologies. Furthermore, following the R&D&I phase, Tizir may opt to implement a full scale project, which would lead to increased production. Therefore, ESA finds that the aid can at least potentially have the effect of improving Tizir' share on the markets it operates on. However, the technological innovation achieved through the Tizir project will be disseminated to the market (see section 3.5) and Tizir has committed to making IP protected results available on FRAND terms. ESA therefore considers it highly unlikely that the aid to Tizir will have a foreclosure effect on the market, nor unfairly strengthen market power, as competitors will be able to implement a similar or the same technology on their own, provided the technology works.

#### 7.3.3.3 Balancing test

(413) Following the assessment described above, ESA 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 the Norwegian projects to addressing well-defined market failures (see paragraphs (261) to (274)) as well as the objective of common European interest (see paragraphs (243) to (260)). Furthermore, the potential negative effects in terms of foreclosure are likely to be minimal and in any event mitigated by the participating undertakings' commitments to disseminate their R&D&I results (see section 3.5) and to unconditionally license IP protected results of the funded projects based on FRAND terms (see section 3.5.2). Moreover, in

view of the fact that the hydrogen sector remains nascent and is expected to expand significantly, ESA considers that the risk of overcapacity is limited.

(414) The analysis of the detailed information available to ESA, therefore, leads to the conclusion that the risks of foreclosure, dominance and overcapacity are likely to be outweighed by the positive effects of the Barents Blue project and the Tizir project.

#### *7.3.4 Transparency*

(415) The Norwegian authorities have confirmed that the aid awards, as well as all related information as specified in paragraph 48 of the IPCEI Communication, will be published in the national transparency register.

(416) Therefore, the measure fulfils the transparency requirements specified in paragraphs 48 and 49 of the IPCEI Communication.

#### *7.3.5 Conclusion on compatibility*

(417) Based on the assessment under the IPCEI Communication, ESA concludes that the notified aid measures in favour of Barents Blue and Tizir are compatible pursuant to Article 61(3)(b) of the EEA Agreement.

#### *7.3.6 Reporting*

(418) According to paragraph 52 of the IPCEI Communication, the execution of the project must be subject to regular reporting.

(419) As notified by Norway and the participating States, the execution of Hy2Use will be subject to annual reporting by the participating undertakings and the participating 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;

- second, Norway will provide annually a summary report (of the undertakings' execution of their activities) to ESA. 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 paragraphs (28)), will report annually to the Commission on the progress of Hy2Use (including through KPIs).

(420) ESA therefore considers that the reporting obligation for Norway is fulfilled.

## 8 Conclusion

(421) On the basis of the foregoing assessment, ESA considers that the proposed aid measures in favour of Barents Blue and Tizir constitute State aid within the meaning of Article 61(1) of the EEA Agreement. Since ESA has no doubts that the measures

are compatible with the functioning of the EEA Agreement pursuant to its Article 61(3)(b), it has no objections to the implementation of the measures.

(422) If this letter contains confidential information which should not be disclosed to third parties, please inform ESA by **28 October**, identifying the confidential elements and the reasons why the information is considered to be confidential. In doing so, please consult ESA's Guidelines on Professional Secrecy in State Aid Decisions.[103] If ESA 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 on ESA's website: http://www.eftasurv.int/state-aid/state-aid-register/.

For the EFTA Surveillance Authority, acting under Delegation Decision No 068/17/COL,

Yours faithfully,

Arne Røksund
President
Responsible College Member

Melpo-Menie Joséphidès
Countersigning as Director,
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*This document has been electronically authenticated by Arne Roeksund, Melpo-Menie Josephides*

[103] OJ L 154, 8.6.2006, p. 27 and EEA Supplement No 29, 8.6.2006, p. 1.