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

Subject:

State Aid SA.55855 (2020/N) – Austria
State Aid SA.55840 (2020/N) – Belgium
State Aid SA.55844 (2020/N) – Croatia
State Aid SA.55846 (2020/N) – Finland
State Aid SA.55858 (2020/N) – France
State Aid SA.55831 (2020/N) – Germany
State Aid SA.56665 (2020/N) – Greece
State Aid SA.55813 (2020/N) – Italy
State Aid SA.55859 (2020/N) – Poland
State Aid SA.55819 (2020/N) – Slovakia
State Aid SA.55896 (2020/N) – Spain
State Aid SA.55854 (2020/N) – Sweden

Important Project of Common European Interest on European Battery Innovation (EuBatIn)

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

Son Excellence Monsieur Jean-Yves Le Drian
Ministre de l'Europe et des Affaires étrangères
37, Quai d'Orsay
F - 75351- PARIS

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

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

Seiner Exzellenz Herrn Heiko MAAS
Bundesminister des Auswärtigen Amts
Werderscher Markt 1
D - 10117 Berlin

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

dr. sc. Gordan GRLIĆ RADMAN
Ministar vanjskih i europskih poslova
Trg N.Š. Zrinskog 7-8, 10000 Zagreb
REPUBLIKA HRVATSKA

Κύριος Νίκος Δένδιας
Υπουργός Εξωτερικών
Βασιλίσσης Σοφίας 5
Grèce - 10671 Αθήνα

Excma. Sr. D.ª Arancha González Laya
Ministra de Asuntos Exteriores y de Cooperación
Plaza de la Provincia 1
E-28012 MADRID

Ulkoministeri Pekka HAAVISTO
Merikasarmi
PL 176,
FIN - 00161 Helsinki

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

Utrikesminister Ann Linde
Utrikesdepartementet
Arvfurstens palats
Gustav Adolfs torg 1
SE - 103 23 Stockholm

Excellencies,

1. PROCEDURE

(1) In November and December 2019, Austria, Croatia, Belgium, Finland, France, Germany, Italy, Poland, Slovakia, Spain and Sweden, followed in March 2020 by Germany (for two additional projects) and Greece (collectively "the Member States"), pre-notified their plans to participate in an Important Project of Common European Interest ("IPCEI")[1] on European Battery Innovation ("EuBatIn") on the basis of a common draft overall descriptive text (so-called "Chapeau" document) and of detailed information on the Project and its components/individual projects.

(2) The European Commission ("the Commission") requested and received complementary information from all the participating Member States and companies ("participating companies") during the period between December 2019 and December 2020.

(3) The Commission services took the initiative to organise high-level meetings at senior administrative level in order to enhance coordination between the Member States and ensure progress.

(4) These high-level meetings took place on 11 February 2020, 28 May 2020 and 9 September 2020. In addition, during the pre-notification stage several virtual meetings at technical level with the Member States and the participating companies took place.

(5) Austria, Croatia, Germany notified their participation to EuBatIn on 10 December 2020, Belgium, Finland, Poland and Slovakia, on 14 December 2020, France, Greece, Italy and Sweden on 15 December 2020 and Spain on 17 December 2020. All the Member States have individually notified the common Chapeau document and their planned aid measures.

(6) By letters accompanying each notification the Member States agreed to waive their rights deriving from Article 342 of the Treaty of the Functioning of the European Union ("TFEU") in conjunction with Article 3 of Regulation 1[2] and to have this Decision adopted and notified in English.

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[1] 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* ("the IPCEI Communication"), OJ C188/4, 20.06.2014.

[2] Council Regulation No 1 determining the languages to be used by the European Economic Community, OJ 17, 6.10.1958, p. 385.

2. OBJECTIVES AND DESCRIPTION OF EUBATIN

2.1. Objectives of EuBatIn

(7) By participating in EuBatIn, the Member States have agreed to ensure the environmental and social sustainability of batteries' production for automotive and non-automotive applications in order to among others fulfil EU's climate and sustainability goals and form, consequently, a sustainable European Union ("EU") battery production ecosystem.

(8) The participating Member States intend to grant aid to companies that will participate in EuBatIn, aiming at developing an innovative and sustainable battery value chain that goes substantially beyond the state-of-the-art. EuBatIn will bring together companies operating at different levels of the battery value chain[3].

(9) The overall objectives of EuBatIn are:

a. To research and develop innovative and sustainable battery materials, cells and systems for automotive and other key applications (and in different output sectors), unlocking the full technological potential of the battery value chain in Europe;

b. To significantly reduce the CO_2 footprint of battery cell production technologies and ensure consequent battery recycling and/or re-use in 2^{nd}-life application, thus, maintaining a circular material flow with high environmental and social standards;

c. To create a cost optimized battery value chain in Europe through standardisation as well as process innovation and optimization, leveraging on factory digitization, thus supporting the market penetration of e-mobility within Europe;

d. To support new jobs and growth through the development and strengthening of highly skilled staff, aiming to mitigate the social impact of the clean energy transition;

e. To coordinate battery-related activities across Europe in order to create an integrated EU battery ecosystem, thus meeting the goals of the European Battery Alliance and delivering on the ambition of EuBatIn to satisfy the EU's objectives (see section 3.3.2.2).

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[3] Batteries are made of cells, modules and battery systems. Cells are devices that produce electrical energy by means of an electro-chemical interaction between a negative (anode) and a positive (cathode) electrode, through an electrolyte. Modules, are a first-level assembly of multiple cells equipped with thermal management add-ons, sensors and low-level monitoring electronics. Battery systems are assemblies of multiple modules managed by an electronic control unit that is called battery management system ("BMS"). Such systems may entail ancillary equipment, such as complementary thermal management, fire-detection and suppression systems, remote communication and diagnostic appliances.

2.2. Description of EuBatIn

(10) This section describes EuBatIn as it has been presented by the Member States in their notification.

(11) EuBatIn is organised along four different work streams ("WS"):

- WS 1: raw materials and advanced materials;
- WS 2: battery cells;
- WS 3: battery systems; and,
- WS 4: recycling and sustainability.

(12) Within each of these WS, the participating companies will conduct both R&D&I and first industrial deployment ("FID") activities[4].

2.2.1. Differences between EuBatIn and the IPCEI Batteries approved on 9 December 2019

(13) On 9 December 2019, the Commission adopted a decision not to raise objections on the IPCEI Batteries involving 17 companies from seven Member States ("the 2019 IPCEI Batteries").[5] These companies are granted State aid to develop innovative projects beyond the state-of-the-art relating to the battery value chain.

(14) The two IPCEIs are complementary concerning their general structure with respect to the addressed WS. Both projects address the same value chain, targeting the same high-level common objectives strictly linked to the EU initiatives in climate protection, decarbonised mobility, sustainability and industrial policy. However, the two IPCEIs are distinct, as explained below.

(15) Due to its larger size, EuBatIn has a broader outreach both geographically as well as in its technical scope. By including additional Member States from the Southern and Eastern parts of the EU[6] (Greece, Croatia, Slovakia and Spain), EuBatIn fosters not only spillovers but also concrete direct participation and collaborations in these parts of the EU.

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[4] According to the Annex of the IPCEI Communication (footnote 1), FID refers to the upscaling of pilot facilities, or to the first-in-kind equipment and facilities, which cover the steps subsequent to the pilot line, including the testing phase, but excluding mass production and commercial activities.

[5] SA.54793 (2019/N) – Belgium, SA.54809 (2019/N) – Finland, SA.54794 (2019/N) – France, SA.54801 (2019/N) – Germany, SA.54806 (2019/N) – Italy, SA.54808 (2019/N) – Poland, SA.54796 (2019/N) – Sweden (not yet published). Six participating companies of the 2019 IPCEI Batteries are also participating companies of EuBatIn, namely BMW, Endurance, Enel X, Fortum, Keliber and Solvay. These six companies participate in EuBatIn with different individual projects and with distinct eligible costs.

[6] Czechia and Portugal have also declared their interest to participate in the broader ecosystem of EuBatIn.

(16) Further, the Member States participating in EuBatIn note that, although the value chain, and sometimes the type of application may be similar, the projects and the planned innovations are different. EuBatIn embraces different types of cell chemistry and employs alternative novel production processes, i.e. more flexible and energy-efficient like dry coating or battery cell formation procedures at reduced CO_2 footprint, aiming at diversified battery production for differentiated applications.

(17) Moreover, EuBatIn caters for ensuring a technological excellence for equipment manufacturers, which the 2019 IPCEI Batteries did not deal with. Current battery cell production lines are normally set up with equipment from many different machine suppliers due to the diverse cell production process. This leads to a wide range of different, specialised manufacturers supplying equipment for a cell production line. As a result, battery manufacturers, in order to reach an appropriate level of automation and cost-effectiveness, are confronted with the challenge of having to integrate and connect different machines from different equipment manufacturers that use different mechanical and software interfaces. EuBatIn with its implementation of equipment manufacturers' R&D&I and FID of Industry 4.0[7] and machine learning technologies, will ensure an efficient process offering a seamless technological excellence for such equipment manufacturers. Ultimately, this will lead to reduced upscaling costs and rates during operation, increasing at the same time the quality of the produced batteries that can be fully traced back.

(18) EuBatIn, furthermore, aims to support several small-scale projects also to enable penetration of highly innovative cell technology into smaller "niche" applications (that were not the main focus of the 2019 IPCEI Batteries), yet having a high potential for growth. This includes e.g. applications in water or airborne transport, medical devices, industrial applications and logistics, and marine applications. The latter applications will have an accelerating effect on decarbonisation efforts. The Member States expect significant synergies with the application field of stationary energy storage due to similar, in terms of cell chemistries, technological scope. Smaller-scale projects will also facilitate using different approaches for cell production and implementation of various cell designs tailored towards specific applications. Thus, the participating companies of EuBatIn argue that this "small-batch" approach and the large variety of application domains, provides added value in terms of applications not addressed in the 2019 IPCEI Batteries.

(19) EuBatIn furthermore is oriented towards all kinds of beyond state-of-the-art lithium-ion batteries ("LIB") technologies, including technologies exploring chemistries generating less environmental or social concerns (such as, in certain cases, the reduction or elimination of cobalt ("Co") and/or nickel ("Ni")). Also, EuBatIn will target all kinds of "next-generation" battery technologies, including non-LIB technologies, such as sodium ("Na")-ion batteries ("SIB") or non-caustic and non-toxic redox-flow batteries ("RFB"). Given the low technology readiness level ("TRL") of SIB, the focus of

7 Industry 4.0 (fourth industrial revolution) refers to the transformation of manufacturing and industrial practices through automation and data exchange, using modern smart technologies.

EuBatIn is on carrying out research activities concerning new and alternative materials, with the aim to eliminate any stumbling block that inhibits fast progress. Nevertheless, the inclusion of the RFB technology in EuBatIn will be an accelerator for the implementation of grid and house storage, or as a buffer system, considering that this system is often not limited by its size (as compared to LIB technologies that aim unavoidably for highest energy density). This variety in battery technology, which is specifically tailored for this application purpose is therefore presented by the Member States as a unique feature of EuBatIn. As a result, highly flexible and research-oriented production facilities will be developed that will provide cells customised to specific applications.

(20) Moreover, EuBatIn concentrates on achieving the high environmental and social standards of batteries' production. In this context, in comparison to the IPCEI Batteries, EuBatIn encompasses a higher number of efficient recycling solutions and addresses more the development of systems that foster the circular economy. In addition, the construction of necessary infrastructure is envisaged (e.g. for testing or disassembly) that will inevitably increase significantly the required processes to be undertaken therein (see recital (48)).

(21) Lastly, the broad application domains of EuBatIn focus not only on the mobility sector, but also cover the industrial/consumer sectors and the stationary energy storage. As the requirements for those applications differ significantly from those of the mobility sector, EuBatIn distinguishes between these three application domains in order to tailor the specific needs of electrochemical energy storages towards their requirements (see section 2.4.1).

2.2.2. Description of the WS of EuBatIn

(22) Each WS focuses on key stages of the whole battery supply chain, from raw and advanced materials, battery cells and systems and to recycling and sustainability. Along the supply chain, within and across each of these WS, the participating companies will play a strong role in collaborating among themselves in order to adequately meet the objectives set and challenges identified (see sections 2.2.3 to 2.2.6). The respective collaborations are explained and illustrated in section 2.4.3.

2.2.3. WS 1 - Raw and advanced materials

(23) The overall aim of this WS is to address the needs of cell/battery producers and original equipment manufacturers ("OEMs") for advanced battery materials meeting their cost, performance and sustainability targets.

(24) As regards raw materials, this WS aims at developing sustainable sourcing and innovative chemical processing of relevant battery anode or cathode raw materials (e.g. lithium ("Li"), Ni, manganese ("Mn"), etc.) from EU and third country sources, in order to fulfil high standards in terms of sustainability and CO_2 footprint, as well as health and safety. The focus will be on new generations of anode materials (new synthetic graphite and silicon ("Si") anode material types), as well as on alternative anode materials (e.g. intermetallic phases) and low Co-containing cathodes. In addition, research under this WS will be carried out in order to develop raw materials in the context of electrochemical energy storage (such as electrolytes for conducting salts and

their precursors) and efficient polyolefin based components (e.g. separators and battery housings).

(25) As regards the advanced materials, this WS aims at developing post-Li ("post-LIB") next generation battery technologies (Li or non-Li based). In particular, the focus will be on the development of innovative materials including all solid-state batteries ("ASSB"), Li-sulphur ("Li-S") and SIB, as well as innovative materials for RFB. In addition, novel precursor and refining processes for electrolytes and separators are developed to improve the lifetime of the battery cells.

(26) The challenges regarding raw materials for the R&D&I phase consist, as far as the anode materials are concerned, in identifying and assessing sufficient raw material sources, and mostly in adapting the downstream processes accordingly and optimizing them with regard to the costs and the desired performance of the anode materials. Replacing therefore the critical raw materials required on the anode side and using natural graphite or novel synthetic graphite alternatives constitutes an additional challenge with regard to feasibility, as well as economic and environmental aspects. On the cathode side, a shift to high-Ni cathode materials is expected to reduce the exposure to Co and further increase the energy density. Therefore, the main challenge for the R&D&I in EU mineral sourcing and processing is to secure the needed raw materials for the expected energy transition.

(27) Concerning the advanced materials, the main challenge for the R&D&I phase consist in establishing a close relationship with the battery cells' manufacturers to best match the materials' and cells' properties, discuss the required specifications and meet the environmental sustainability objectives (and health and safety standards), before transferring the results of the research onto the FID phase.

(28) As far as the challenges regarding the FID phase are concerned, these consist in developing innovative, energy-efficient (e.g. near-zero CO_2 footprint for production) and cost/performance optimised battery material production methods and tools to develop materials according to their required performance characteristics and processes.

2.2.4. WS 2 – Battery cells

(29) This WS focuses on both the R&D&I and FID for new and innovative battery cells. In particular, the main objective is to enable the development of next-generation LIBs by large-scale FID activities and a "pre-industrialization" (i.e. the development of all necessary processes, techniques and equipment that will enable production once the cell design is mature) of ASSB, Li-S and SIB for mobility and industrial/consumer applications. Further, FID activities of RFB, sodium nickel chloride batteries ("Na/NiCl2") and ultracapacitors are planned for mobility and stationary energy storage applications.

(30) This WS aims also at ensuring innovative production processes (including more energy efficient and sustainable processes), ambitious performance characteristics (referring to energy density, charging rate, cycling ability and safety), and functional targets of future electrified mass mobility and battery cell demand within the EU.

(31) The production processes mentioned above will allow the deployment of equipment for innovative and energy-efficient design and development, employing novel processes, such as dry coating or battery cell formation procedures to reduce the CO_2 footprint and match the European energy transition objectives.

(32) Another main objective of this WS is the digitization of battery design and development, where novel approaches in the context of Industry 4.0 and artificial intelligence ("AI") are considered.

(33) In the R&D&I phase, the main challenge for the battery and ultracapacitor cell design is to achieve a significant reduction of cell costs while improving the sustainability and performance characteristics, enabled e.g. by aligning cell parameters within a flexible range of similar requirements regarding cell chemistry, cell format and electrical design of the entire modules and battery packs.

(34) Another challenge would consist in the battery design targeting and achieving a significantly reduced CO_2 footprint of the entire battery value chain, leading to a reduction of the overall costs and an affordable sustainable electrification of mass transportation. In order to meet this objective, cell chemistry should focus on significantly reduced content of critical raw materials (particularly Co, as well as the usage of Li and other materials from sustainable sources, whereas 2^{nd}-life usage of batteries cells and end-of-life ("EoL") recycling capabilities will also be addressed.

(35) Finally, this WS will face the challenge of improving the safety and performance characteristics of LIB, such as energy density, cycling ability and internal resistance.

(36) Regarding battery and ultracapacitors cell production in the FID phase, the main challenge to reach cost-effectiveness and performance targets consists in achieving cost optimization and improving the manufacturing and equipment processes, including cell chemistry, cell housing, assembly and formation. Thus, energy efficiency of the production, process automation, factory digitization, big data management and utilization, traceability and standardisation of processes and parameters have to be adopted and further improved in order to produce novel battery generations that cover the full range of mobility, industrial/consumer and stationary energy storage applications.

(37) Reaching these cost-competitiveness and performance targets shall not be at the expense of targeting environmental sustainability objectives. Therefore, the planned innovations must inherently lead to lower energy consumption, a smaller carbon footprint, less production waste and a higher degree of recycling and re-use of raw materials and consumables.

2.2.5. WS 3 - Battery systems

(38) The aim of this WS is to develop, using Industry 4.0, key innovations for introducing the produced battery cells of WS 2 into battery packs and modules. The battery packs to be developed will focus on modular approaches for battery cells and therefore require a cell package design for the assembly of

LIBs. Thus, the battery disassembling process and the recycling process can be optimized with a standardized cell package design.

(39) Another aim is to improve the battery management system ("BMS") in terms of easy maintenance, control and support, also for next generation cells. Further, the battery packs and modules should be designed to meet the application requirements in terms of high fast charging, thermal management and safety, also by integrating the ultracapacitors into hybrid battery systems ("HBS"). Work will be performed on an integrated safety approach to allow for controlled heat and energy control in case of thermal runaways of single battery cells.

(40) In the field of energy storage battery systems, this WS aims for standardisation, modularity and connectivity, addressing also long cycle life, repurposing and the serving of multiple applications or locations, leading to significant reduction of the CO_2 footprint.

(41) For industrial/consumer applications, the successful development of novel battery systems needs to integrate the state-of-the-art results of the previous WS in order to address the relatively small volumes, the diverse requirement profiles and the high development costs of the produced battery systems (taking also into account the specific considerations of the industrial and production equipment manufacturers, the battery technology providers, the component manufacturers, the test partners and test equipment manufacturers).

(42) The main challenges in both the R&D&I and FID phases for automotive battery systems are to reduce the current CO_2 footprint, energy consumption and waste generated during assembly and production to ensure efficient and cost-effective battery systems.

(43) For energy storage applications, the stabilization of the electric power grid and the installation of additional grid services are becoming increasingly important for future storage technology, as these would require the establishment of energy storage systems ("ESS") to compensate for frequency fluctuations. For ESS the challenge is to enable it to test any battery in terms of technical parameters and real application and to issue a certificate valid at EU level.

(44) For automotive and non-automotive applications, a safe interconnection of individual cells of a complete storage system is crucial for the quality of the entire battery system. For this purpose, the integration of dry cleaning steps in the production to avoid potential failure mechanisms and the implementation of quality assurance systems to ensure battery health must be further developed.

(45) For industrial/consumer applications, the electrification of equipment may affect the whole design process. Market potential understanding and customization capability development are thus important complementary capabilities that are needed to fully exploit strong battery technology advancements.

2.2.6. *WS 4 - Recycling and sustainability*

(46) This WS aims to develop a process that ensures a circular material flow making battery cell manufacturers more independent from critical raw materials. Such a process would comprise highly efficient recycling solutions in compliance with sustainability and life cycle assessments for batteries in terms of tracking, collecting and dismantling of LIBs and post-LIBs until recovering of relevant metals (Co, Ni, Li, copper ("Cu"), carbon ("C"), etc.).

(47) This WS will also address the development of systems that foster the circular economy and the re-use of batteries for other 2^{nd}-life applications (e.g. sustainable BMS design for extra vehicular applications, such as Pack to Grid and Vehicle to Grid).

(48) Another focus is the construction, predominantly during the FID phase, of suitable and safe unloading, testing and disassembly infrastructure in the form of pilot plants. In this context, the development of the required processes, test routines and standardisation is significant.

(49) As a result of this WS, new, first-in-kind collection, dismantling, repurposing, recycling and refining processes will be developed, allowing to effectively recycle LIBs, HBS, ultracapacitors and other waste containing metals important for e-mobility.

(50) One of the challenges in the R&D&I phase consist in overcoming the standardisation issues regarding the creation of a circular material flow. The development of secondary material sources via re-engineered waste treatments for alternative sustainable supply chain and the establishment of guidelines for standardising and maximising re-use options of batteries will help address this challenge.

(51) In addition, regarding the challenge of the traceability/collection activities, the R&D&I phase will establish mechanisms favouring sustainable raw material production. Solutions and certification schemes for traceability should enable verifying the chain of custody, location and history of an item by documented identification.

(52) As far as the recyclability of batteries is concerned, the challenge under the R&D&I phase would be to examine the newly developed batteries (LIBs and post-LIBs, HBS and ultracapacitors) in terms of any modifications in their chemistry and structure that would also lead to changes of existing recycling processes and waste management systems. These activities must be coordinated with and integrated within the other WS.

(53) In the FID phase, concerning the creation of the circular material flow, the challenge would be to monitor the mine sites, engage all parties in the supply chain and retrieve, transfer and process all reliable information.

(54) As regards the re-use of batteries for other 2^{nd}-life applications, the challenge in the FID phase would be to carrying out an EoL battery status monitoring in order to find an optimal way of battery re-utilisation. In the same context, this phase will address the challenge of developing communication protocols and

design methodologies, which facilitate 2nd-life re-use channels and sustainable full cycle sustainable batteries.

(55) Finally, in reference to the pilot infrastructure that will be deployed during the FID phase, the challenge would be to redesign and implement the currently employed thermal pre-treatment before the mechanical treatment. This pyrolytic treatment will be implemented in a pilot plant, whereby site selection must take account of logistical and regulatory requirements.

2.2.7. Description of the companies involved in EuBatIn

(56) The figure below summarises the participating companies involved in each WS of EuBatIn. The projects of each participating company[8] under the different WS are described in more detail under section 2.4.1.

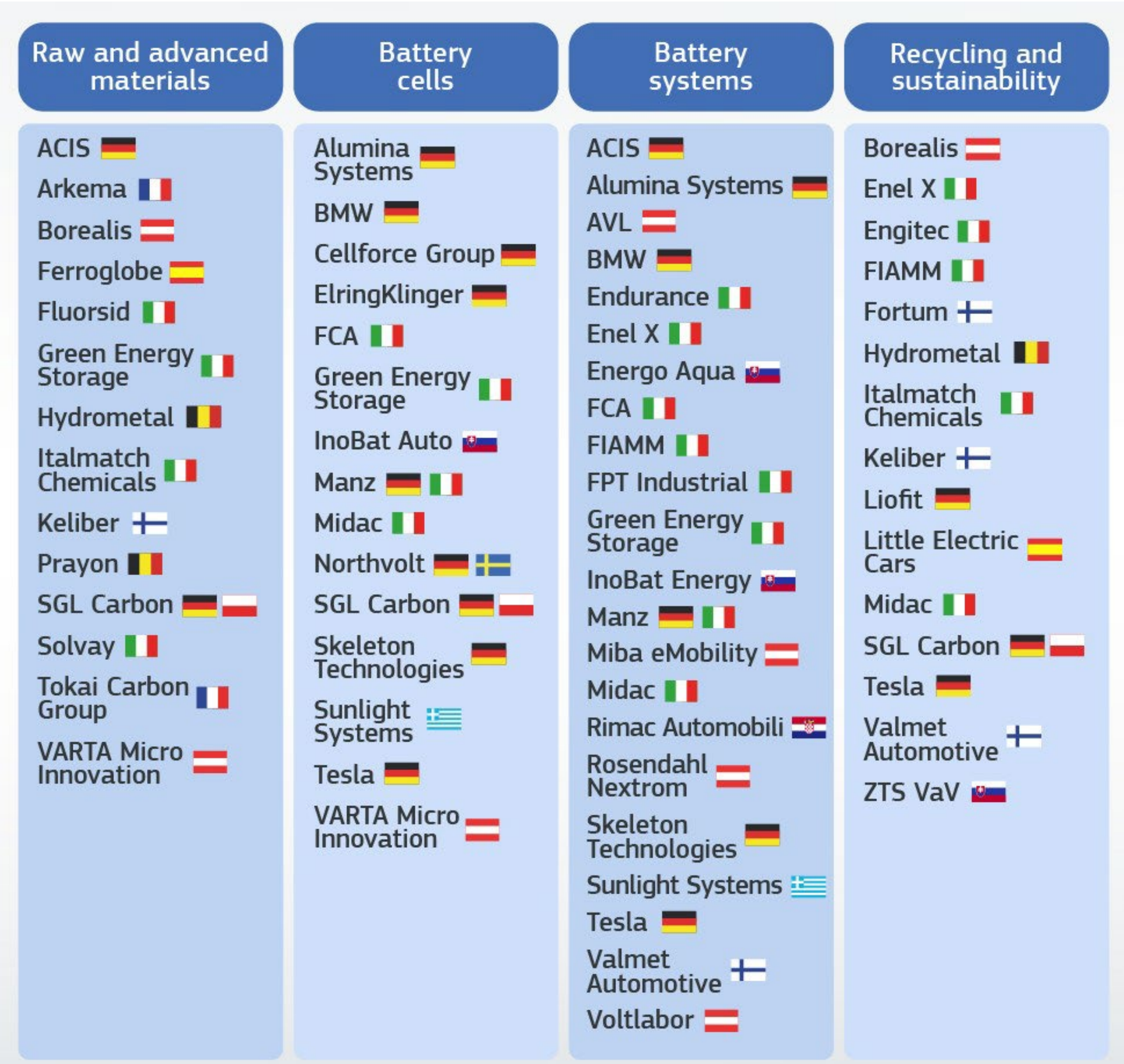

Figure 1: Overall structure of EuBatIn

[8] Four of these companies (InoBat, Manz, Northvolt and SGL) will participate in EuBatIn with separated individual projects implemented by different legal entities, bringing the total number of individual projects to 46.

(57) The participating companies are briefly described below:

1. ACI-systems GmbH ("ACIS")

ACIS (Germany) is a small or medium-sized enterprise ("SME") that specializes in developing innovative and sustainable energy and manufacturing solutions, focusing on developing projects for the production of Li raw materials, contributing thereby to the security of supply for the European battery industry and the expansion of electromobility. Through a joint venture with the Bolivian state-owned company Yacimientos de Litio Bolivianos, ACIS's aim is the sustainable extraction of Li and other raw materials.

2. Alumina Systems ("Alumina")

Alumina (Germany) is an SME active in the field of vacuum-tight ceramic-metal and ceramic-ceramic components for more than 30 years. It is also involved in the development, design and production of 3D printed ceramic parts and ceramic 3D printing processes, as well as in the field of Na/NiCl2.

3. Arkema Group ("Arkema")

Arkema (France) operates in the advanced materials segment of the battery and energy storage value chains, and is active in R&D&I and in the production and supply of elements in several of these technologies. Arkema's core activities are in fluorine chemistry and the multiwall carbon nanotubes, addressing various markets (composites, electronics and energy storage).

4. AVL List GmbH ("AVL")

AVL (Austria) is active in the development, simulation and testing of powertrain systems (hybrid, combustion engine, transmission, electric drive, batteries, fuel cell and control technology) for passenger cars, commercial vehicles, construction, large engines and their integration into the vehicle. AVL activities in the field of battery engineering are oriented in the view of battery modules and pack and vehicles integration.

5. Bayerische Motoren Werke AG ("BMW")

BMW (Germany) is the top-company of the BMW Group, an OEM of cars and motorcycles. The BMW Group production network comprises 30 production and assembly facilities in 14 countries. The company has a global sales network in more than 140 countries.

6. Borealis AG ("Borealis")

Borealis (Austria) is a provider of innovative solutions in the fields of polyolefin, base chemicals and fertilizers. Borealis operates in over 120 countries and its polyolefin manufacturing plants in Europe have 3.8 million t/y production capacity.

7. Tokai Carbon Group ("Tokai Carbon")

Tokai Carbon (France) develops highly demanding speciality graphite grades for different applications, leveraging R&D collaborative projects with customers and suppliers. Its particular focus lies in feedstock specialty graphite and aluminium electrolysis graphite.

8. Cellforce Group GmbH ("Cellforce")

Cellforce (Germany) is a consortium of several companies, which pursue common goals in the development of innovative battery cell production. The main partners are the companies […].

9. Endurance SpA ("Endurance")

Endurance (Italy) is a manufacturer of automotive components. It is a subsidiary of Endurance Overseas srl, which is the European holding company of the Endurance Group. Endurance is a leading supplier to European automotive OEM, focusing on engine and transmission components.

10. Enel X srl ("Enel X")

Enel X (Italy) is a subsidiary of the Enel Group. The latter is a global energy company and an integrated electricity and gas operator. Enel is active in 34 countries in the world, generating energy with a managed capacity of almost 90 GW (out of which 43 GW provided by renewable energy sources ("RES")), selling gas and distributing electricity across a network spanning approximately 2.2 million km, with almost 73 million end users around the world.

11. ENGITEC Technologies S.p.A ("ENGITEC")

ENGITEC (Italy) is an engineering and contracting company active in the field of treatment and recovery of non-ferrous metals. ENGITEC is qualified to build small, medium-sized and large industrial plants in-house, from the definition of technology to erection and start-up, and to oversee organization and management of such projects for its customers.

12. ElringKlinger ("ElringKlinger")

ElringKlinger (Germany) is a leading supplier to the automotive industry. ElringKlinger's light weighting concepts help to reduce the overall weight of vehicles. As a result, vehicles powered by diesel or gasoline engines consume less fuel and emit less CO_2, while electric trucks and cars benefit from an extended range. By developing cutting-edge battery and fuel cell technology, as well as electric drive units, ElringKlinger is a specialist in the field of e-mobility.

13. Energo Aqua ("Energo Aqua")

Energo Aqua (Slovakia) has been operating on the Slovak market for water energy. Through collaborations with research organisations in the field of individual mechanical engineering parts of hydroelectric power plants, Energo Aqua aims to design faster and more efficient small water power plants as well as modernize the existing hydroelectric power plants.

14. Ferroglobe ("Ferroglobe")

Ferroglobe (Spain) is one of the largest producers of a wide variety of metal alloys and other metallic products. The company uses state-of-the-art-technology in all its processes to provide quality products, which are critical ingredients in many industrial and consumer products.

15. FIAMM Energy Technology ("FIAMM")

FIAMM's (Italy) core business is the production and distribution of starter batteries for vehicles and industrial batteries. It has two main areas of business: Mobility Power Solutions and Reserve Power Solutions. The Mobility Power Solutions business aims to supply car/truck manufacturers' maintenances workshops with starter batteries that support the most sophisticated start&stop technology. The Reserve Power Solutions business focuses on industrial batteries and ESS.

16. Fiat Chrysler Automobiles ("FCA")

FCA (Italy) is an automaker that designs, engineers, manufactures and sells vehicles in a wide portfolio of brands, including Abarth, Alfa Romeo, Chrysler, Dodge, Fiat, Fiat Professional, Jeep, Lancia, Ram and Maserati. It also sells parts and services under the Mopar name and operates in the components and production systems sectors under the Comau and Teksid brands.

17. Fluorsid Alkeemia SpA ("Fluorsid")

Fluorsid (Italy) belongs to Fluorsid Group Srl, a privately owned group with interests in chemicals, minerals and metals. Fluorsid is part of Fluorsid SpA, which controls all industrial and commercial activities of the group and is one of the largest producers of inorganic fluorine derivatives and the largest consumer of fluorspar worldwide.

18. Fortum Waste Solutions Oy ("Fortum")

Fortum (Finland) is a subsidiary of Fortum Oyj, active in recycling and waste solutions. Fortum Oyj is a leading clean-energy company that provides its customers with electricity, heating and cooling, as well as smart solutions to improve resource efficiency and recycling.

19. FPT Industrial ("FPT")

FPT (Italy) is the powertrain segment of CNH Industrial group, a company active in capital goods that implements design, manufacturing, distribution, commercial and financial activities worldwide. Through its various activities, CNH Industrial group designs, manufactures and sells agricultural and construction equipment, trucks, commercial vehicles, busses and special vehicles, in addition to engine and powertrains, for industrial and marine applications.

20. Green Energy Storage Srl ("GES")

GES (Italy) is an SME that develops RFB for stationary energy storage applications. The company has competencies that span from R&D&I activities on advanced battery electrodes, membranes, electrolytes and testing of battery cells to full battery system manufacturing.

21. Hydrometal ("Hydrometal")

Hydrometal (Belgium) is an SME recycling and recovery centre for a very wide range of materials (over 60,000 t/y), by-products or complex residues containing non-ferrous metals, in particular: Zn, Ni, Cu, Pb, Sn, Co, other minor metals, precious metals and rare earths. Hydrometal's expertise is based on different hydrometallurgical processes, unique in the world, which consume very little energy and generate only small amounts of CO_2 and ultimate waste.

22. InoBat Auto ("InoBat Auto") and InoBat Energy ("InoBat Energy")

Both companies are owned by InoBat j.s.a (Slovakia), a company focusing on the development of battery solutions in the energy and e-mobility sectors. InoBat Auto's primary goal is to become a first-of-its-kind fully integrated battery manufacturing facility for EV, covering a range of activities, spanning from proprietary battery research and development to battery production. InoBat Energy aims at developing and manufacture its own iron flow battery system as an Energy Center for long-duration large-scale energy storage, which is not deployed anywhere in the world and represents the state-of-the-art in ESS.

23. Italmatch Chemicals ("Italmatch")

Italmatch (Italy) is a specialty chemical group for performance additives. Particularly, with 17 manufacturing plants worldwide, it is active in the markets of phosphorus derivatives (both organic and inorganic), flame retardants, plastics additives, lubricants, water & oil, detergents, from synthetic to fully natural products.

24. Keliber Oy ("Keliber")

Keliber (Finland) is an SME aiming at production of battery-grade Li hydroxide for the increasing demand of European Li-ion battery and electric vehicles ("EV") industries. Keliber's own Li ores from several mines will be used as raw material. Keliber will be the world's first company to utilize sustainable and cost-effective soda pressure leaching technology for hydrometallurgical Li extraction and Li hydroxide production.

25. Liofit GmbH ("Liofit")

Liofit (Germany) is a SME active in the fields of production, reparation and disassembly of Li-ion accumulators, with a strong focus on the recycling of bicycle Li-ion accumulators.

26. Little Electric Cars ("Little")

Little (Spain) is a Small manufacturer of EV, battery packs and cells and BMS, and it is also active in recycling for special projects. It offers a range of products with a full service as regards the design, the engineering and the process of assembly and manufacturing of specific battery packs.

27. Manz AG and Manz Italy Srl (together "Manz")

Manz (Germany and Italy) is a high-tech equipment manufacturing company and technology provider in the area of production equipment for Li-ion battery cells, modules and packs but also in the technology development for manufacturing Li metal battery cells. With many years of expertise in automation, laser processing, vision and metrology, wet chemistry, and roll-to-roll processes, the company offers manufacturers and their suppliers, innovative production solutions in the areas of photovoltaics, electronics and Li-ion/Lim metal battery technology.

28. Miba eMobility GmbH ("Miba")

Miba (Austria) is part of Miba AG, which is one of the leading partners to the international automotive industries. Miba's mission is Innovation in Motion – Technologies for a Cleaner Planet. With 26 production sites worldwide, Miba is a technology driven company with a significant research and development capability that resulted in 53 patents in […] many of which in the area of eMobility and batteries. The strategic focus of the company lies in the field of development, production and supply of components for electric and hybrid electric vehicles ("HEV").

29. MIDAC Spa ("MIDAC")

MIDAC (Italy) is a leading company in Europe in the production of motive power battery, with a production capacity of over 70 000 battery packs/year. MIDAC produces lead batteries for motive power, automotive and stand-by use. It is also active in the design, development, and production of Li-ion batteries. MIDAC is a co-owner of the Ecopower Consortium, which deals with the collection and disposal of exhausted batteries of various technologies.

30. Northvolt GmbH and Northvolt AB (together "Northvolt")

Northvolt (Germany and Sweden) was founded in 2016. It is a Li-ion battery cell manufacturer presently building a battery factory with innovative technology that aims at producing the world's greenest battery at competitive price levels.

31. Prayon S.A. ("Prayon")

Prayon (Belgium) is active in the phosphate industry. It produces phosphoric acid and a wide range of phosphate salts for food and technical applications. Besides its activities in phosphate materials manufacturing, Prayon also provides its customers with technology and equipment for the production of phosphoric acid.

32. Rimac Automobili Ltd. ("Rimac")

Rimac (Croatia) is a young, fast progressing company, founded in 2009. The main business is the development and production of the world's highest performance electric sports cars and key components for vehicle electrification, such as battery systems and powertrain systems.

33. Rosendahl Nextrom GmbH ("Rosendahl")

Rosendahl (Austria) is a high innovative world market and technology leader in the lead-acid battery and fibre and cable machinery industry and in developing new production technologies for Li-ion batteries.

34. SGL Carbon GmbH and SGL Graphite Solutions Polska Sp. z o.o. ("SGL")

SGL (Germany and Poland) is an internationally active manufacturer of special graphite and carbon materials, as well as carbon fibre and composite materials. SGL's products are used in a number of different areas, such as the semi-conductor, photovoltaics, and LED industry, the chemical, automotive, and aviation industry, and for energy production and storage. The subject of stationary energy storage, especially Li-ion batteries, represents a central future and growth market for SGL.

35. Skeleton Technologies GmbH ("Skeleton")

Skeleton (Germany) is an SME that produces ultracapacitor cells, modules and systems and offers turn-key solutions to its customers in the automotive and transportation, as well as the grid and renewables sectors. Skeleton offers products with a high power performance and a good energy to power ratio.

36. Solvay SA ("Solvay")

Solvay (Italy) is a large multi-specialties chemical group working in chemicals and materials. Headquartered in Belgium, Solvay operates in 61 countries around the globe. It is active in areas from fuel cells to RFB but focuses in developing innovative materials for rechargeable Li-Ion batteries to support and accelerate the electromobility and the exploitation of energy production from RES. Solvay produces materials that enable battery components (anodes, cathodes, electrolytes, separators) to enhance their performance.

37. SYSTEMS SUNLIGHT SA ("SUNLIGHT")

SUNLIGHT (Greece) is present in the energy sector and it specialises in the development and production of batteries and ESS for industrial and advanced applications.

38. Tesla Brandenburg Manufacturing ("Tesla")

Tesla (Germany) designs, manufactures and markets all-electric battery vehicles together with solutions for renewable energy production and storage. Its mission is to accelerate the world's transition to sustainable energy.

39. Valmet Automotive ("Valmet")

Valmet (Finland) provides service in car manufacturing and engineering, roof and kinematic system supply and battery systems engineering and manufacturing for industrial/consumer and mobility customers. Its battery systems business line includes battery systems engineering and small scale/prototype production for electric powertrain components for mobility and industrial customers.

40. VARTA Micro Innovation GmbH ("VARTA")

VARTA (Austria) is a subsidiary of the Germany-based VARTA AG, the parent company of the VARTA Group, and is active in the business segments of Microbatteries and Power & Energy. In particular, its activities focus on R&D, the validation of new material and process technologies and their qualification in proof of concept prototypes for Li-ion technology and future innovations.

41. Voltlabor GmbH ("Voltlabor")

Voltlabor (Austria) is a high-tech company with focus on battery development and battery module/pack production. The product focus is highest quality for niche-markets with a technological focus on cylindrical cells, laser welding technology and outstanding cooling and safety features.

42. ZTS VaV ("ZTS")

ZTS (Slovakia) is a SME active in research, development, and engineering with a long tradition in energy engineering, especially in water and nuclear power sectors. It is the only company in Slovakia, which deals with the design of small new hydropower plants and with modernisation and overhauls of hydroelectric power plants. ZTS has long-term experience with the construction of water turbines of various types. In the nuclear energy sector, ZTS is mainly involved in back-cycle of nuclear energy and the decommissioning of nuclear power plants.

2.3. Governance of EuBatIn

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

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

Table 1: EuBatIn governance structure

(59) EuBatIn's Supervisory Board ("SB") consists of:

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

(60) The role of the SB will be to supervise, monitor and assure the implementation of EuBatIn at large. This especially concerns the monitoring of the progress of the participating companies, as well as the EuBatIn as a whole. The focus of the implementation is on both, technological advances and the spillover activities to disseminate these advances, which the participating companies have committed to deliver. The SB will be also responsible for the annual reporting towards the Commission on the basis of the information to be provided by the FG.

(61) 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 EuBatIn, in particular regarding the potential entry of a new participating company or the exit of an existing one.

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

(63) As regards the FG, it is composed of the chair, the deputy of EuBatIn, the coordinators of the WS and any additional company representatives or advisors assuming related duties. It will be in charge of the WS coordination, the annual reporting, the communication, the preparation of events, etc.). It will drive the overall progress of the WS on a non-confidential basis to establish a permanent interface between private and public stakeholders with the goal to highlight EuBatIn's role and impact.

(64) The FG will also be responsible for organizing and fostering the collaboration and the communication within EuBatIn and *vis-à-vis* third parties, which can benefit from results of EuBatIn but are not participating companies. For this, the FG will implement two instruments: the annual EuBatIn meeting and the EuBatIn website.

(65) A EuBatIn meeting will take place once a year. The first meeting will take place at the latest one year following the Commission's approval decision. During the first part of this meeting, a restricted session will be dedicated only to the Member States, the Commission and the participating companies. During this first session, each WS coordinator will present the overall activities of its WS. Each participating company will present in more detail the main results of its works, the collaborations achieved and relevant spillover activities.

(66) The second part of the meeting will be a public conference open to any interested party, thus not limited to the participating companies, during which they will present the main results of their works.

(67) The website will host public information about EuBatIn and the participating companies. Moreover, the website will serve as the dissemination and interaction channel of EuBatIn engaging thus entities other than the participating companies. For this, the website will list all spillover activities to which the participating companies have committed themselves (see below section 2.5). This information will be presented in 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 for participation at the activities directly with the participating company who will be in charge of the specific activity. The website will thus also serve as a basis for the annual reporting on the delivery of the committed activities. The FG will collect qualitative and quantitative information for each activity. It may also foresee a restricted area for the participating companies to organise the implementation of EuBatIn.

(68) The members of the FG will change over time to take into consideration the end of participation of the participating companies according to their respective individual portfolios.

(69) Lastly, the GA will be organised once a year, gathering all participating companies and the representatives of the Member States (and the Commission as observer). At its first meeting, within four months after the Commission's approval decision of EuBatIn, the GA will elect the members of the FG, and it will be responsible of adopting respective decisions on any changes of the FG's composition In particular, the GA elects the chair and the deputy of EuBatIn and the coordinators (including their substitutes) of each WS, who will be members of the SB. It will also designate a participating company, 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 EuBatIn either at the next ordinary GA meeting or by written consultation, teleconferencing or videoconferencing. The decisions will be taken by a 2/3 majority. As from its second meeting onwards, the GA shall be organised alongside the annual public EuBatIn conference.

(70) As regards national governance, the individual projects of the participating companies are governed by funding agreements between them and their relevant funding authority within each Member State. Such funding agreements impose requirements and obligations towards the administration of any individual project according to the rules set up by the funding authority. The national funding authorities are in possession of the commitments of all

participating companies. As such, the PAB will be responsible to monitor the completeness of the listings and announcements of the committed spillover activities.

2.4. EuBatIn as an Integrated Project

(71) The Member States submit that EuBatIn is an integrated project within the meaning of point 13 of the IPCEI Communication. The WS are not only complementary but are mutually connected and depend on each other in order to meet the objectives of each WS separately and of EuBatIn as a whole.

(72) The sections below describe how the individual projects are necessary and complementary within each WS and across the different WS in order to achieve the respective goals of EuBatIn.

2.4.1. Description of the necessity and complementarity of the individual projects within each WS for the achievement of the objective of EuBatIn

(73) The different application domains have essential influence on the cell chemistry of the LIB battery cell. The broad application domains are the mobility sector, the industrial/consumer electronics in a wider sense, including e.g. industrial logistics, medical devices, headphones and hearing aids, and the stationary energy storage. Because of these various applications, specific different technical requirements in terms of performance characteristics arise for the battery material itself, which are briefly described below. Developing next generations of batteries, improving performance and sustainability of batteries in those different domains and applications will therefore also trigger different challenges and solutions.

(74) The mobility sector comprises various applications of batteries, specifically LIBs, for EV (excluding HEV) and public transportation, and the end users expect a high driving range of the vehicle combined with a fast charging process and high safety standards. Hence, the battery cell must combine a high energy density, high C-rates for charging or discharging a battery, as well as a cell design that avoids safety risks. Since the battery constitutes with 50-100kWh a significant part of an EV in terms of value, there is a high cost pressure to make EVs affordable. The state-of-the-art chemistry selection in the EV market is based on lithium nickel cobalt manganese oxide ("NMC") for the cathode and ordinary Asian standard graphite for the anode meeting the lower requirements for low-Ni containing cathode types.

(75) In addition, in order to meet the demanding requirements in power and energy density, lifetime and safety in the mobility sector, energy dense cells must be combined with ultracapacitors, yielding resource and cost-efficient so-called HBS. For this approach, low cost LIB cells with high energy densities and low power densities are preferred. Although, automotive is an important field of application due to market size and societal impact, other domains will also benefit, namely grid applications, industrial solutions and heavy transport, such as lifting power-systems for cranes and excavators, kinetic energy recovery systems ("KERS") for public transport and other solutions where peak power exceeds the average by an order of magnitude.

(76) The industrial/consumer sectors (e.g. construction, forestry, mining, cargo handling, agriculture, maritime, etc.) differ from the automotive sector, as the former is more heterogeneous and produces smaller volumes. Thus, understanding the rapidly changing market requirements and the corresponding technology opportunities is necessary and calls for closer collaboration with the end users. Innovative projects that modularize and customize the whole product, and not just the battery as a stand-alone component, become as a result increasingly important.

(77) Depending on the application area, the design parameters and constraints vary considerably. Higher cycle stability is required in an industrial environment. The gravimetric energy density, for example, for forklift trucks, is not the same as for EV, if the trucks were originally operated with lead-acid batteries. With regard to power tools, on the other hand, a very high fast charging capability and a high current are of utmost relevance. In daily use, the batteries are discharged very quickly and should be ready for use again in less than 45 minutes. Reliable operation at lower temperatures in outdoor areas is thus necessary. A further challenging factor is that, normally no active cooling systems can be installed in industrial applications due to their weight. Therefore, the cell type used is mainly of cylindrical nature. The cathode materials used in these segments are lithium nickel cobalt aluminium oxide ("NCA") and NMC. On the anode side, silicon is increasingly used in cylindrical cells. Despite the differences in their requirements (e.g. cycling stability), the consumer and industrial sectors are closely related as regards their capability of fast-charging and minimized cost-pressure.

(78) The requirements in the field of stationary energy storage are significantly different to the mobility sector. Although in most of the stationary systems, as it is the case also in the mobility sector, the energy density plays a minor role since space is often available, the cost of infrastructure and related equipment, which will be impacted by the energy density, is much higher. Important parameters in this regard are the lifetime (cycle and calendar), the reliability and the capital costs. The cells must be optimized with regard to acceptable costs that fulfil the parameters concerned. Therefore, stationary ESS are often designed on the basis of lithium iron phosphates ("LFP") in combination with graphite or lithium titanium oxide ("LTO"). However, relevant applications, such as stationary home storages or grid supporting devices require NMC and graphite based solutions due to space constraints.

(79) The sections below take account of the different application domains and provide a comprehensive overview of the overall work to be carried out in each WS for the achievement of the objectives of EuBatIn.

2.4.1.1. Description related to the necessity and complementarity of the individual projects for the achievement of the goals of WS 1

(80) WS 1 is divided in five tasks and will involve 14 participating companies, namely ACIS, Arkema, Borealis, Tokai Carbon, Ferroglobe, Fluorsid, GES, Hydrometal, Italmatch, Keliber, Prayon, SGL, Solvay and VARTA.

(81) Task one concerns the development of anode materials and its components. Both the R&D&I and the FID phases apply to all three broad application domains. The R&D&I phase contain the following components:

a) Target specification (cost, performance criteria/target specification, sustainability) for advanced anode materials with cell makers;

b) Development of advanced anode materials based on available natural graphite qualities;

c) Establishment of specifications and required property profile for raw materials and recycled anode materials for their use in the development of novel synthetic graphite anode materials;

d) Development of innovative synthetic graphite anode materials;

e) Evaluation and optimization of the compatibility of new graphite anode materials and application systems with Si-based anode materials;

f) Evaluation of pure Si-based anodes with limitation of voltage to obtain high energy density and long cycling due to controlled expansion;

g) Development of new manufacturing processes with increased sustainability and reduced cost in line with given performance targets from cell makers; and

h) Product qualification testing at advanced anode material producers and at cell producers and exchange of results and improvement needs via iterative feedback loops.

(82) The FID phase will generate the intellectual property ("IP") from results transferred from the R&D&I phase for new developed materials and processes (see section 2.5.2). Further pilot and demonstration capacities will be established and product development will be scaled up.

(83) Task two concerns the development of cathode materials and task three concerns the development of electrolyte materials. Also, their components for both the R&D&I and the FID phases apply to all three broad application domains. The R&D&I phase for both tasks contains the following components:

a) Establishment of the technical requirements of and development of new cathode materials (physical and chemical properties, electrochemical performance) and of alternative electrolyte materials (physical and chemical properties, in terms of grade and quality);

b) IP screening, development and consolidation;

c) Development of innovative manufacturing process for new cathode materials and new electrolyte materials (based on cost, performance, environmental impact, raw material supply, and chemical purification process regarding the electrolyte materials);

d) Design and set up of production facilities dedicated to new cathode materials and new electrolyte material production at lab and pilot scales;

e) Production of new cathode materials at lab and pilot scales and electrochemical testing and production of electrolyte materials at lab and pilot scales for LIB, RFB and post-LIB; and,

f) Validation by customers of new cathode materials and electrolyte materials produced at lab and pilot scales.

(84) Thereafter, the FID phase will focus on the production and electrochemical testing and validation by the customers of the new cathode materials and the electrolyte materials at industrial scale.

(85) Task four concerns the development of various battery processes and materials, which differentiate between the mobility and the industrial/consumer sectors on the one hand, and the stationary energy storage on the other.

(86) The R&D&I phase for the mobility and industrial/consumer sectors contains the following components:

a) Development of polymeric binders enabling sustainable cathode manufacturing processes;

b) Development of recyclable polymeric materials and production processes for LIB components (e.g. housings, cell holders or battery separator films) enabling better performance, safety and sustainability of LIB; and,

c) Development of next generation battery materials.

(87) The FID phase for the mobility and industrial/consumer sectors concerns the upscaling of the processes.

(88) The R&D&I phase for stationary energy storage contains the following components:

a) Development of high performing and low-cost membranes for RFB;

b) Production of electrolytes material at lab scale for RFB and post-LIB, compliant with the best available techniques and the most modern EU standards; and,

c) Electrochemical testing of the produced materials at lab and pilot scale.

(89) The FID phase for stationary energy storage contains the industrialized process of RFB membrane synthesis.

(90) Finally, task five concerns the mining, refining and material processing and its components for both the R&D&I and the FID phases apply to all three broad application domains. The R&D&I phase contains the following components:

a) Secure sustainable supply for domestic and imported battery metals (Li, Ni, Mn, Co, C, etc.) and other relevant raw materials (PCl_5);

b) Development of more sustainable refining methods for chemical production;

c) Development of more environmentally sound mining and processing methods;

d) Improvement of recovery and grade of Li in different process stages;

e) Increase of leaching capacity by feed quality improvement; and,

f) Development, construction and building of unique and highly innovative Li hydroxide processing plant for the European market.

(91) In the FID phase, these processing methods will be further optimised and become more energy-efficient.

Description related to the necessity of the individual projects

1. ACIS

(92) ACIS will secure sustainable supply of the imported battery material Li hydroxide at competitive costs. In order to reduce the CO_2 footprint by 30% and become water-neutral, it will develop an innovative raw material production process from brine in mining and an equivalent process in refining for chemicals production.

2. Arkema

(93) Arkema will develop a process for the production of an innovative electrolyte salt that will improve the batteries safety and fit perfectly with high voltage and fast charge batteries. It will also perform significant R&D works at lab and pilot scales to evaluate and validate the best manufacturing process for purified carbon nanotubes ("CNT") pellets and new electrolyte salt. It will set up pilot plant units for both materials and produce a small volume thereof, which will supply to customers for validation. During the FID phase, Arkema will design and build industrial units for the production of purified CNT pellets and new electrolyte salt, and will perform various R&D/iteration works with customers for validation.

3. Borealis

(94) Borealis will develop advanced polyolefin material for LIB components, such as cell trays and battery separator films. It will also perform characterisation, testing, process development and pilot plant runs to achieve better performance, safety and sustainability of LIB in the mobility and the industrial/consumer sectors. Accordingly, it will scale up successful processes.

4. Tokai Carbon

(95) Tokai Carbon will develop new graphite anode material types aligned with the targets and specific requirements of cell producers. Furthermore, it will develop an innovative graphite anode material production process that meets performance criteria/target specification while being significantly more cost-effective and more sustainable than current production processes. During the FID phase, Tokai Carbon will scale up its innovative research to validate the industrial feasibility of its innovation.

5. Ferroglobe

(96) Ferroglobe’s R&D&I efforts include the development of: (i) advanced silicon active materials to increase the energy density of the cells and (ii) tailored silicon, as well as the demonstration of the feasibility of silicon rich anodes. In the FID phase, Ferroglobe will generate new IP related to milling and coating of silicon powders, and will also establish a pilot production of silicon anode material to carry out prototype validation and market demonstration.

6. Fluorsid

(97) Fluorsid will perform research activity at lab and pilot scale to evaluate and validate the manufacturing process for lithium hexafluorophosphate ("$LiPF_6$") electrolyte material. It will also produce small quantities of $LiPF_6$ for customer validation. At the FID stage, Fluorsid will build a $LiPF_6$ production line and perform the necessary fine-tuning with customers to validate the process and the quality of the product.

7. GES

(98) GES plans to develop high performing and low-cost membranes for RFB based on new redox couples, as well as design sustainable large-scale production of membranes. It will develop and optimize anodes and cathodes for RFB based on the best performing electrolytes, and evaluate the optimization of electrolytes synthesis and performance. Finally, it will perform computational screening of promising RFB redox couples and carry out electrochemical tests. As regards its FID activity, GES will scale up anode and cathode materials, electrolytes and membrane manufacturing processes.

8. Hydrometal

(99) Hydrometal's project aim to close the recycling loop by carrying out the last step of recycling and the first step of raw materials' production, enabling it to proceed with new batteries production. It will thus develop an innovative hydrometallurgical recycling route from Li-ion battery black mass in order to supply refineries with Li, Co, Mn and Ni concentrates of a quality for use in new battery production.

9. Italmatch

(100) Italmatch will perform research activity at lab and pilot scale to evaluate and validate the manufacturing process and produce small quantities of $LiPF_6$ for customer validation. During the FID phase, Italmatch will establish a $LiPF_6$ process for the development of ASSB precursors. It will also develop advanced material based disposals to generate a sustainable phosphorous pentachloride ("PCI5") supply chain in Europe to serve the OEM industry.

10. Keliber

(101) Keliber will contribute to R&D&I by taking part in developing traceability systems for Li and processes integration. The utilization of secondary Li raw materials from recycling processes for Li hydroxide production will be also developed and tested.

11. Prayon

(102) Prayon aims to produce a new cathode material $Na_3V_2(PO_4)_2F_3$ ("NVPF") for Na-ion based batteries. It will design, during FID, an industrial facility for the production of its new material based on its pilot development and its partners' feedback during the R&D&I phase and it will provide its customers with industrial scale samples for evaluation and qualification.

12. SGL

(103) SGL plans to develop and scale up new graphite anode material types, aligned with the targets and specific requirements of cell producers, enabling as a result closed loop supply chains that significantly reduce the CO_2 emissions. For the development of these new materials, SGL will follow several technical approaches in order to identify, develop and improve the best manufacturing processes that combine performance with sustainability, as well as cost aspects.

13. Solvay

(104) Solvay's project includes the development, scaling up and industrialisation of (i) polymeric binders enabling sustainable and cost-effective cathode manufacturing processes, and (ii) polymers and membranes for RFB to improve cell performances, increase ionic conductivity, improve chemical resistance, decrease solvent and electrolyte permeation rates, limit capacity fading and reduce costs.

14. VARTA

(105) VARTA will use its cell fabrication knowledge to specify the target parameters for anode and cathode materials, and manufacture prototype cells taking into account the processability and the electrochemical performance. In the field of alternative electrolyte materials, VARTA will qualify the developed electrolyte system in combination with its developed silicon based high-energy cell chemistry regarding cell performance and safety. The FID phase will include the upscaling of the product development.

Description related to the complementarity of the individual projects

(106) The participating Member States have explained that the individual projects of the companies participating in WS 1 are complementary, as they are all designed in a common structure and programme in order to achieve the objectives of the WS.

(107) The participating companies of WS 1 will pursue related technologies and manufacturing process for the development of anode, cathode, electrolyte and various other materials (e.g. for the development of RFB), aiming to meet the sustainability criteria. Further, several individual projects will advance the raw material mining, refining and processing, in order to develop a sustainable fully integrated battery value chain and secure a necessary quantity of raw material for the expected energy transition.

(108) The complementary character of the individual projects is further corroborated by a number of collaborations within the WS, as explained in section 2.4.3.1.

2.4.1.2. Description related to the necessity and complementarity of the individual projects for the achievement of the goals of WS 2

(109) The WS 2 is divided in 11 tasks and will involve 15 participating companies, namely Alumina, BMW, Cellforce, ElringKlinger, FCA, GES, InoBat Auto, Manz, MIDAC, Northvolt, SGL, Skeleton, SUNLIGHT, Tesla and VARTA.

(110) Task one concerns the development and optimisation of innovative cell design that aims to achieve high efficiency, high energy density and fast charging/discharging, high quality cell production, low energy consumption and recycling efficiency. It will predominantly take place during the R&D&I phase and contains the following components, which differentiate amongst the three broad application domains (i.e. mobility, industrial/consumers sectors and stationary energy storage):

a) All broad application domains: Chemical development of LIB cells and final design (including ultracapacitors, also during the FID phase);

b) Mobility and Industrial/consumer sectors: Improvement of LIB cell mechanical design;

c) Mobility: Development of highly specialized automotive battery cells for niche applications; validation of ASSB technologies cell design and process development; and development of advanced LIB for automotive applications;

d) Industrial/consumer sectors: Low-temperature and high-stress industrial applications;

e) Industrial/consumer sectors and stationary energy storage: Development of a high power and high energy cylindrical cell for industrial and stationary applications; and,

f) Stationary energy storage: Development of a high power and high-energy cylindrical cell for LIB and LFP, for RFB and for Na/NiCl2 batteries.

(111) Task two concerns R&D&I and FID works as regards the following components: concept design, planning, development, procurement and commissioning of cell manufacturing development/demonstration/pilot line/facilities for LIB, RFB (only for stationary energy storage), $Na/NiCl_2$ (only for stationary energy storage) and ultracapacitors;

(112) Task three concerns the cell testing and the prototype validation of the new cell design. The following components differentiate amongst the three broad application domains and the production phase (i.e. R&D&I and/or FID):

a) All broad applications: LIB cell development (including ultracapacitors) in prototype line, adaptation of the line and validation (during the FID phase) of semi-automated line for pre-industrial samples;

b) Industrial/consumer sectors: LIB cell prototyping, chemical testing and cell development; and,

c) Stationary energy storage: RFB cell testing and optimization in different operating conditions at lab scale to apply testing procedures for cell quality, safety and lifecycle mapping; development of Na/NiCl2 batteries.

(113) Task four concerns R&D&I works as regards the cell assembly, prototype testing and assessment of further innovations related to the ASSB technology. It focuses on the mobility sector.

(114) Task five concerns R&D&I and FID works related to the design, construction and engineering of related infrastructure.

(115) Task six concerns R&D&I and FID works related to the concept design, planning and development of the cell production line. It aims to achieve among others high efficiency and flexibility and low CO_2 footprint production. It contains the following components:

a) All broad applications: cylindrical, pouch and prismatic LIB cells and ultracapacitors;

b) Mobility: ASSB production line;

c) Industrial/consumer sectors: cell manufacturing process; and,

d) Stationary energy storage: LFP and NMC battery cells automated assembly line, RFB pilot line and Na/NiCl2 battery line.

(116) Task seven concerns the development and assessment of required production equipment for cell production lines, as follows:

a) Development of a low carbon electricity supply model;

b) Development of Industry 4.0 and digitization (machine learning input and algorithms) for automated cell production;

c) Assessment of the requirements of modularity, flexibility and efficiency as well as the deployment plan; and,

d) Development of the equipment supply chain.

(117) Task eight takes place during the FID phase and concerns the specifications required for the production of sensors.

(118) Task nine concerns the further improvement of cell production process, as far as the following components are concerned: cost-effective and energy efficient production methods; high throughput production methods with low cost impact; new process approaches utilizing e.g. laser drying; modular and highly standardized production options; improved recyclability; reduction of toxic input materials; and innovative cooling concepts.

(119) Task ten concerns during the FID phase, the procurement, production installation and upscaling of automated production line, as follows:

a) All broad applications: cylindrical, pouch and prismatic LIB cells and ultracapacitors;

b) Industrial/consumer sectors: cell manufacturing process; and,

c) Stationary energy storage: LFP and RFB automated assembly line and Na/NiCl2 battery line.

(120) Finally, task eleven concerns the validation of the defined performance targets.

Description related to the necessity of the individual projects

1. Alumina

(121) Alumina plans to build large capacity (100 Ah) Na/NiCl2 cells and test their properties aiming for lower production costs and increased efficiency of the production processes. Its R&D&I activities include also the design and testing of concepts and processes to be used for the creation of a small-scale production line. In an effort to increase the output of this (small-scale) production line, Alumina will use additional automatisation techniques in the FID phase.

2. BMW

(122) BMW will define the requirements and develop the chemistry and electrode design for the overall target cell development. To this end, it will adapt its prototype and pilot line to the target cell design, as well as produce and test prototype cells of different TRL. It will develop a target cell for future automotive requirements focusing on decreasing Co content and improving cost efficiency. It will also evaluate different ASSB technologies and define future ASSB concepts that potentially meet the above requirements. Finally, BMW will optimise, in reference specifically to mobility and industrial/consumer sectors, the mechanical cell design as an important part of the overall development of the target cell.

3. Cellforce

(123) Cellforce will develop cells for automotive applications, introducing novel innovative cell design concepts to reduce the internal resistance of the cell. These innovative cells will be tested and certified. During the FID phase, Cellforce aims to enhance production processes for electrodes, cylindrical cells and pouch cells including their respective infrastructure, while also upscaling the production of pouch cells to higher volume scale for automotive applications.

4. ElringKlinger

(124) ElringKlinger will optimise the mechanical integrity of prismatic cells and the design of prismatic cell housings to satisfy the automotive requirements. Current cell housing designs are made of a large number of parts, which are produced and assembled inefficiently. ElringKlinger will reduce the number of parts and change the general approach of assembly that will enable a more reliable second life usage of the cell. During the FID phase, ElringKlinger will focus on a sourcing strategy that aims to achieve a stronger supply chain control leading to a decreased CO_2 footprint. Finally, in assessing the cell production in terms of modularity, flexibility and efficiency, it will evaluate the required changes of the prismatic cell housing to enable new cell generation (e.g. GEN 3, 4 and ASSB).

5. FCA

(125) FCA will render available its dedicated battery cell testing facilities and protocols in order to perform functional, performance and validation tests on prototype cells provided by the project partners according to its automotive cell validation standards.

6. GES

(126) Based on the inputs received from materials development in WS 1, GES plans to develop a new optimised cell design for cost-effective RFB (stationary energy storage) with improved performance. Further, it will develop the concept of an environmentally friendly and automated pilot/production line for the industrialization of the RFB design that it will realise at the FID stage.

7. InoBat Auto

(127) InoBat Auto will use high throughput platform ("HTP") to develop innovative battery solutions for battery cells through the establishment of its own R&D centre. Further, it will carry out the assembling and testing of LIB and ASSB battery cells prototypes on its EV battery cell manufacturing line.

8. Manz

(128) Manz intends to develop an innovative and advanced platform for flexible, modular and fully digitalized production equipment following the approach of Industry 4.0 for the production of GEN 3a and 3b and Li metal ASSB. The project R&D&I activities are addressed to support through innovative FID the building of a new cell assembly technical laboratory and to install battery cell and module assembly systems. The assembly lines will be available for battery cell makers, which require innovative and advanced cell and module assembly process validation.

9. MIDAC

(129) MIDAC plans to design and develop a cell production line for LIB cell in heavy-duty automotive, including trucks, buses, and special cars (sport cars, small niche applications etc.). The R&D&I tasks include the development of Li cells with enhanced performance for industrial fields, the design of prototype cells with high mechanical stress and low temperature application and the increase of the mechanical performances of the cell. During FID, MIDAC will design pre-series batteries to evaluate the performance in different operative conditions, and set up an automated pilot production line for Li-ion cells dedicated to Stand-by applications.

10. Northvolt

(130) Northvolt's project aims at developing the next generation advanced Li-ion and Li-metal batteries by innovations on both the battery material design and the production process. The focus is on cells suitable for automotive applications and the aim is to improving performance of cells, their sustainability (reduction of Co, use of recycled material, etc.) and cost-effectiveness. It will also conduct R&D&I on the development of connected

factory technologies and commissioning processes. Finally, the project also includes the FID of the developed cells and production processes.

11. SGL

(131) SGL will support the cell development by providing relevant anode material input data and samples from the results derived in WS 1 and by evaluating feedback from cell producers. SGL will also perform: (i) scale-up to pre-industrial level, (ii) process and product validation and freeze for advanced anode materials, and (iii) exchange of samples for validation purpose with cell producers. This work will continue during the FID phase, especially via increased supply of advanced anode materials for testing and for the initiation and progress of qualification procedures.

12. Skeleton

(132) Skeleton will identify LIB designs and cell chemistries that are best suitable for HBS technology and it will also set up a scaled fully automated and cost effective production of ultracapacitors. Its R&D&I activities will focus on optimised design for mobility and stationary energy storage, including the design for matching most prominent battery technologies for LIB and ASSB hybrid operation. The results of the above activities will be used to plan and commission a pilot line setup for ultracapacitors to gather data for the FID phase, during which it will conduct pilot runs in contained test environments for production and product optimisation development.

13. SUNLIGHT

(133) SUNLIGHT will develop reliable, long-lasting heavy-duty cells, followed by testing and certification, for special automotive and traction applications, marine applications, as well as for stationary energy storage. Additionally, it will develop a green cell production for large Li-ion cells for heavy-duty applications in pilot scale. Within the FID phase, SUNLIGHT will design a production process for hard case prismatic cells with a robust cell technology, as well as a fully automated production line for prismatic and heavy-duty cells for stationary energy storage and industrial/consumer application.

14. Tesla

(134) Tesla will develop new cathode and anode production processes, and work towards the removal of Co for future EV battery cathodes. For mobility and industrial/consumer applications, Tesla aims to develop innovative welding and winding processes, as well as innovative cell mechanical designs to be integrated with new battery cells. As regards its FID plans, Tesla will design, test and implement development processes for innovative cells, while continuously monitoring and validating performance targets in order to set the path for further innovations. Finally, it will work with partners in order to reduce its environmental footprint by selecting suppliers, materials, and production methods with low carbon footprints.

15. VARTA

(135) VARTA will elaborate the requirements of next generation high-energy materials regarding cell components and design and it will reduce the CO_2 footprint of the manufacturing process and the use of hazardous chemicals. At the same time, it will use the results of these activities for the design planning and commissioning of the demonstration pre-industrial cell manufacturing plant for industry/consumer and stationary energy storage applications. Concerning the LIB cell development, VARTA will perform scale-up to pre-industrial level, process validation, freeze of parameters for the quality management system, and it will exchange the first prototype sample with a selected customer for validation purposes.

Description related to the complementarity of the individual projects

(136) Within WS 2, OEM and suppliers interact in close exchange to coordinate the necessary and sufficient requirements for possible standardisation to ensure reduction of cell costs, while meeting at the same time the functional targets, in terms of safety and performance, of future battery cells.

(137) Particularly in battery cell production, the product development and manufacturing process have to be coordinated at the first stage in order to address the needs of all broad application domains (i.e. mobility, industrial/consumer sectors and stationary energy storage). Different cell design and formats (e.g. cylindrical, pouch and prismatic) and module materials will be processed for new battery generations. The integration thus of the production process partners and coordination of all relevant product and process parameters along the entire production process will enable for the realisation of a cost-optimized innovative battery cell.

(138) The complementary character of the individual projects is corroborated by a number of collaborations within the WS, as explained in section 2.4.3.1.

2.4.1.3. Description related to the necessity and complementarity of the individual projects for the achievement of the goals of WS 3

(139) The WS 3 will involve 22 participating companies, namely ACIS, Alumina, AVL, BMW, Endurance, Enel X, Energo Aqua, FCA, FIAMM, FPT, GES, InoBat Energy, Manz, Miba, MIDAC, Rimac, Rosendahl, Skeleton, SUNLIGHT, Tesla, Valmet and Voltlabor.

(140) The program of the WS (both the R&D&I and the FID works) is divided in five components, which consist of 32 tasks in total that apply predominantly to all broad application domains.

(141) The first component concerns the battery system design and will pursue the following tasks:

1. Development of modular battery pack/system concepts;
2. Development of advanced Thermal Management Systems ("TMS") including heating/cooling plates and auxiliaries;
3. Development of BMS for LIB;

4. Development of data driven concepts to enhance battery systems through predictive maintenance, digital twins or digital passports and development of additional sensors to monitor battery modules/packs/systems;

5. Development of design optimization methods to define the form factor and construction design specifications of the battery module;

6. Development of design optimization methods for ultracapacitors; and,

7. Development of FBS (for stationary energy storage).

(142) The second component concerns the process design and productivity of the battery systems and will pursue the following tasks:

8. Development of designs for highly automated production processes;

9. Co-design of a battery pack assembly line;

10. Application of Industry 4.0 methods and solutions to enable data driven approaches to improve production processes;

11. Construction of development facilities for prototyping and piloting of new products;

12. Usage of innovative production processes related to the construction of production plants and installation of production lines;

13. Development of new soldering and welding processes and machinery for the assembly of battery modules/packs/systems;

14. Technology and financial assessment of products and production lines to improve cost-effectiveness;

15. Development of an advanced module production process including low cost, low CO_2 footprint and full traceability capabilities with optimized total cost of ownership ("TCO").

16. Supplier evaluation to improve the European battery value chain;

17. Use of Industry 4.0 to optimize handling of cells within a short period; and,

18. Definition of processes and feedback mechanisms to upscale production in an efficient manner, using CO_2 dry cleaning processes.

(143) The third component concerns the testing of the battery systems and consists of the following tasks:

19. Development of streamlined prototyping and testing processes to speed up product improvement and perform all required tests to achieve validation according to customer standards;

20. Run battery pack design verification plans ("DVP");

21. Establish strong collaborations with test centres across Europe and create new testing facilities;

22. Run field testing and monitoring programs to feed real life data back into the design and manufacturing process;

23. Experimental analysis of the main parameters affecting battery heat generation and dissipation (internal resistance, entropic heat coefficient, heat capacity, thermal conductivity, etc.) with battery ageing;

24. Establishment of R&D laboratories for EV battery testing;

25. Establishment of Energy centres for utility scale applications, design testing and validation; and,

(144) The fourth component concerns the development of battery systems to specific applications, such as:

26. Development of battery swapping units;

27. Application in energy storage for renewable electricity production;

28. Development of prototypes of traction and HBS;

29. Development of distributed imbalance compensation system ("DICS"); and,

30. Development of hybrid energy source combining ESS and RES for EV charging network.

(145) Lastly, the fifth component of WS 3 involves:

31. State-of-the-art screening for battery pack/system designs and design methods, as well as for manufacturing equipment, manufacturing/assembly line design and process design methods; screening of the IP for battery modules/packs/systems and assembly processes; and investigation of existing assembly lines to further improve the process design; and

32. Institutionalisation of collaborative practices for continuous updating of technology roadmaps and changes in market outlook.

Description related to the necessity of the individual projects

1. ACIS

(146) ACIS aims to develop a CO_2 cleaning module for testing and application, compatible to Industry 4.0 and integral in piloting lines for fully automated battery manufacturing, to increase quality and yield. It will also identify and test key parameters of feedback mechanisms related to CO_2 cleaning systems and their impact on yield increase, lifetime and safety.

2. Alumina

(147) Alumina will develop a new concept of heat insulation with a 15-year vacuum panel system ("VIP"). Different sizes of module systems and voltage levels will be evaluated concerning heat-loss, usability und transport. Alumina will also develop a new BMS for $Na/NiCl_2$ battery modules. Regarding the potential combination of ultracapacitors with $Na/NiCl_2$ batteries, Alumina will check whether the high C-rates/low capacities of ultracapacitors and the low C-rates/high capacities of $Na/NiCl_2$ batteries will increase the scope of application for both systems, maintaining the low costs and high safety of $Na/NiCl_2$ systems.

3. AVL

(148) AVL will scale up the base R&D hub “Battery Innovation Centre” towards series production environment capabilities and overall machine learning processes. It will focus on the invention of innovative and future proven testing

methods for series production for all kind of cell types and electrodes and will develop methodologies to identify and reduce the CO_2 emissions. Through the development of innovative flexible module production processes, AVL aims to expand the flexibility and maximize the throughput of matrix production line for modules and packs within the Battery Innovation Centre.

4. BMW

(149) BMW will focus on the implementation of innovative and flexible manufacturing processes enabling efficient high volume module and system production. Additionally, it will develop an IoT-based prototype production line for modules and battery systems and a pre-series production line for flexible battery systems assembly to be set up during the FID phase.

5. Endurance

(150) Endurance will develop innovative swapping battery modules housings, ready for both transportation and other applications, designed for easy handling, lower environmental impact and better materials management and recycling. The swapping concept will be applied not only for shortening charging time of battery systems in transportation (i.e. e-car, e-scooters, e-motorcycles and e-bikes), but also for energy storage in civil appliances.

6. Enel X

(151) Enel X will implement battery packs/systems that can be partially or fully integrated in high performance computing management systems ("HPC"). It will further develop and fine-tune during the FID phase a BMS to be embedded in the HPC enabling added value services to the grid, while satisfying EV users' needs.

7. Energo Aqua

(152) Energo Aqua's R&D&I activities include the development of 2^{nd}-life battery systems from various types of 2^{nd}-life batteries of different capacities. Further, it plans to develop an energy management system ("EMS") for 2^{nd} -life battery systems employing AI for the collection and management of the different 2^{nd}-life batteries. During FID, Energo Agua will construct the EMS and integrate it with different systems from RES.

8. FCA

(153) The aim of FCA's project is the in-house design, development and production of GEN 3 battery systems for EV. The design of these battery systems, which includes the complete battery electrical and thermal management systems, is characterized by features of modularity, scalability and structural integration in the vehicle. The battery management system is tailored for specific Vehicle-to-Grid and 2^{nd}-life battery applications. The overall Battery system design is protected for upgrade with post-2025 technology cells and ensures efficient battery pack disassembly for materials recovery and recycling.

9. FIAMM

(154) In the sectors of mobility and industrial/consumer applications FIAMM will develop scalable and modular thermal management systems and a family of enhanced battery management systems integrating safety functionalities, modularity, traceability, and rapid disassembly. Furthermore, it plans to develop (i) concepts of highly automated assembly lines for the manufacturing of modules/packs, whose solidity will be verified through pilot production lines and batches, (ii) simplified configuration methods for rapid product configurations, and (iii) Finite element method ("FEM") tools for thermal analyses, vibrations and crash-worthiness simulations.

10. FPT

(155) FPT's priorities at the R&D&I stage include the development of a battery pack design with a modular concept using a top-down approach based on target industrial on- and off-road application, and new specific BMS hardware ("HW") and software ("SW") developed to adapt to the modular battery pack concept. Its activities at the FID stage include the final product testing and validation of battery packs at vehicle level, as well as the installation, upscaling and optimisation of the FID production lines.

11. GES

(156) GES will design and develop highly performing and cost-effective RFB including a flexible BMS and Industry 4.0 for RFB, with in-line control algorithms and machine learning for highest manufacturing efficiency. The Industry 4.0 methods will be implemented during the FID stage in the production plant, with low CO_2 emissions and efficient manufacturing lines.

12. InoBat Energy

(157) InoBat Energy R&D&I and FID work focus on the development of an easily disassemblable and recyclable RFB-flow battery system from product design and engineering, through validation, testing, commissioning and certification of the product. This system will function as an Energy Centre and deliver energy storage solutions for a variety of applications.

13. Manz

(158) Manz will develop modular but integrated assembly line concepts. Its R&D&I efforts include the development of data analytics functions for the establishment of a predictive maintenance strategy and new welding/soldering machine platforms and processes. It further intends to develop and automate by using AI an efficient upscaling support software. In the FID phase, Manz will install multiple module assembly lines, developed in R&D&I, in order to validate a comprehensive line optimization concept.

14. Miba

(159) Miba will develop an innovative heat exchanger, made of flexible materials bringing a new set of properties, which will result in new and possible disruptive design possibilities for heat exchangers. Following the development

of an AI algorithm for product flow optimisation and detection of quality issues via camera systems, Miba will work on a fully integrated process control system to be realized during the FID, consisting of a mechanism covering all stages from material inflow control to final quality control and dispatch.

15. MIDAC

(160) MIDAC will develop a modular battery system with enhanced performance and design for 2nd-life application and an efficient TMS for industrial battery packs. It will also design an enhanced welding process for Li modules, which will be procured at the FID stage, and develop Industry 4.0 methodologies to improve traceability, analytics functions and predictive maintenance strategy. Concerning its further FID activities, MIDAC will procure and optimise highly automated and flexible industrial battery pack production processes, and test facilities for battery pack prototyping.

16. Rimac

(161) Rimac's R&D&I phase includes the development and extensive field testing of (i) AC battery system mitigating the state-of-health ("SoH") of battery cells, (ii) submerged battery cooling system solving thermal limitation and safety issues, and (iii) compact hybrid vehicle battery from prototypes of traction and HBS. Rimac will also develop facilities, infrastructure and innovative (Industry 4.0) processes for the realisation of its R&D projects, as well as supplementary activities in terms of testing and prototyping.

17. Rosendahl

(162) Rosendahl will improve the state-of-the-art production systems design to increase flexibility and scalability from prototype lines to subsequent production lines. Similarly, in applying Industry 4.0 methods, it aims to amplify the operational area of production steering and monitoring method in order to upscale prototype and production processes.

18. Skeleton

(163) Skeleton's R&D&I efforts include the development of standardised integration schemes for ultracapacitor modules into HBS. It will focus on the design of ultracapacitor cells of different sizes and the creation of data collection methods and algorithms based on big data approaches and machine learning for better ultracapacitor quality. As regards the ultracapacitor production, Skeleton will develop novel production methodologies in confined and controlled testing environments and optimised welding processes, both to be later validated at pilot scale.

19. SUNLIGHT

(164) SUNLIGHT will develop scalable battery modules easily adaptable to different cell technologies, including cooling concepts. It will also implement Industry 4.0 methods into the module assembly lines for subsequent production of battery modules and build a testing environment for module testing under extreme conditions. Following their validation in field tests performed at

SUNLIGHT's development laboratory, these modules will be used for heavy-duty, traction and industrial applications.

20. Tesla

(165) Tesla intends to develop a highly innovative battery pack design based on a new cell form factor and pilot manufacturing lines, which will be commissioned and upscaled during FID. Tesla will also design and build small-scale integrated pilot tools in order to implement and test innovative manufacturing technologies together with the innovative pack designs.

21. Valmet

(166) Valmet will create data collection and monitoring systems for production development purposes, as well as modular battery system concepts for different applications with standardised modules. It will also develop highly flexible manufacturing equipment and processes using a modular approach to enhance quick adaptation of new products.

22. Voltlabor

(167) Voltlabor will develop highly automated, cutting-edge battery-pack production, through the integration of laser-welding systems into a pack design for cylindrical cells. In doing this, it will compare and analyse data to improve battery design, cell arrangement and safety features regarding heat generation and dissipation, as well as integrate, during the FID phase, AI methods for product flow optimisation and detection of quality issues.

Description related to the complementarity of the individual projects

(168) In order to develop innovative and cost-effective battery packs and modules that meet the required safety and performance characteristics, joint activity is conducted to integrate also the research results of the previous WS.

(169) As the electrification of equipment becomes important and it may affect the whole design process for a large variety of potential applications, the coordinating efforts of the participating companies need to expand beyond the technological issues relating to battery technology, encompassing ways to integrate the potential of battery technology more broadly into the equipment design and product development process.

(170) The complementary character of the individual projects is corroborated by a number of collaborations within the WS, as explained in section 2.4.3.1.

2.4.1.4. Description related to the necessity and complementarity of the individual projects for the achievement of the goals of WS 4

(171) This WS will involve 16 participating companies, namely Borealis, Enel X, ENGITEC, FCA, FIAMM, Fortum, Hydrometal, Italmatch, Keliber, Liofit, Little, MIDAC, SGL, Tesla, Valmet and ZTS.

(172) The program of the WS (both the R&D&I and the FID works) is divided in six components, which consist of 11 tasks in total that apply predominantly to all broad application domains (see recitals (74) to (78)).

(173) The first component refers to sustainability and life-cycle of batteries and includes the following tasks:

1. Activities such as: life cycle assessment, socio economic impact assessment and a gap analysis of recycling output to production input;
2. Recommendations for design of batteries for better recyclability and re-use and for CO_2 footprint reduction;
3. Identification for customized way to integrate battery data into the battery management to reduce TCO and improve sustainability; traceability benchmarking, standards and system piloting.

(174) The second component concerns the collection and sorting of batteries and includes the following tasks:

4. Definition of recycling process and the necessary individual steps; development of protocols for different types of batteries (including new generation batteries);
5. Development of methods for safe collection, transport and storage of EoL; quality control along the supply chain; and,
6. Testing, sorting and status monitoring of EoL; SoH characterisation; BMS analysis and design modifications for 2nd-life applications.

(175) The third component concerns the dismantling of batteries and includes the following task:

7. Development of methods of effective discharge of batteries with residual energy recovery; dismantling/disassembly of EoL batteries; pre-treatment; and safe and sustainable dismantling and discharge for thermal treatment.

(176) The fourth component concerns the extraction, refining and waste management and includes the following task:

8. Extraction of relevant metals and other materials important for e-mobility (e.g. Ni, Co, Li, graphite); refining and recovery of relevant metals; Internet of Things ("IoT") tool development for on line determination of the required physical chemical conditions to enhance efficacy and sustainability; and, waste management.

(177) The fifth component concerns the re-use and 2nd-life of batteries and includes the following task:

- 2nd-life application; standardisation guidelines for re-use; off-road and stationary applications; development of a techno-economical evaluation with actual business cases, to best value for 1st and 2nd application owners; and, consolidation of EoL battery supply and 2nd-life application demand.

(178) Lastly, the sixth component concerns the setting-up of a pilot and includes the following tasks:

- Design and engineering of pilot plants that implements developed innovative processes;

- Building and testing (e.g. thermal pretreatment facility, processing of black mass for material recovery, unloading, testing and disassembly infrastructure); research and testing of scaled-up solutions; analysis of pilot plant results; and optimization of sub-processes with improved material separation.

Description related to the necessity of the individual projects

1. Borealis

(179) Borealis will identify various contaminants, including additives, reaction and decomposition products of additives, in wastewater streams and develop new wastewater treatment concepts for their removal. It will also evaluate existing recycling processes for polymer ("PO")-based battery components, test the applicability of existing in-house sorting and recycling technologies and develop new process concepts. Its FID activities will include the upgrading of existing recycling and waste management facilities.

2. Enel X

(180) Enel X will conduct research on EoL batteries' collection, storage and operation in terms of safety, work environment, sustainability and transport, as well as on recycling solutions starting with a state-of-art screening towards the implementation of highly environmentally sustainable processes. Moreover, it will develop and increase sorting accuracy, characterisation and testing of EoL batteries, while enhancing degradation-based sorting for battery re-use, re-manufacturing or recycling.

3. ENGITEC

(181) ENGITEC plans to develop new, safe recycling processes for black mass, graphite and other relevant materials by using partners' complementary technologies. Its R&D&I efforts also include waste management studies and the development of a safe, automated disassembly process for batteries. It will further design, build, test and scale up a LIB recycling pilot plant. Following the evaluation of its performance, the company will proceed to the optimisation of the pilot plant's sub-processes and the assessment of alternative solutions.

4. FCA

(182) During its battery management system design process, FCA will adopt the necessary design measures for efficient battery system disassembly and all BMS design features necessary for foreseeable battery 2^{nd}-life applications. Similarly, it will work on ensuring the compatibility of its battery management system features with the necessary requisites concerning life-history monitoring and end-of-life battery characterisation for 2^{nd}-life applications. Lastly, FCA will render available a number of its battery system prototypes, according to the required maturity level, to allow confirmation of their compatibility with the dismantling and recycling processes developed in WS 4.

5. FIAMM

(183) FIAMM will focus on the numerical and experimental evaluation of the impact of 2^{nd}-life cells in the performance of battery modules and packs for industrial applications. Then, it will create a pilot line for the SoH evaluation and sorting of cells, and the dismantling of modules and packs.

6. Fortum

(184) Fortum will develop identification methods and monitoring tools for battery systems of different types and status. It further aims to perform a life-cycle analysis for the comparison of sustainability between using 1^{st} or 2^{nd}-life cells and between recycling or 2^{nd}-life application. Additionally, Fortum will develop digital software to control 2^{nd}-life application, and a logistics management system to handle material flows from 1^{st} or 2^{nd}-life applications, repair and recycling. In the FID phase, Fortum will work on a process to recycle valuable materials from recycled batteries, as well as an automated standard operating procedure for dismantling based on the dismantling procedure database developed during the R&D&I phase. Finally, Fortum plans to set up and further optimise a pilot service model and processing line for EoL batteries.

7. Hydrometal

(185) Hydrometal will develop a new recycling method of black mass to recover and separate Co, Ni and Li metals, while researching into fluorine, Mn and graphite potential recovery from black mass. Further, it will build a pilot line to implement the above innovative process for Co, Ni, and Li recovery.

8. Italmatch

(186) Italmatch will carry out a data cross-evaluation of the impact of secondary raw material usage in terms of energy consumption, reaction yield, gas emissions, waste management and economic cascade effect, in order to adopt a battery design of a less impacting life cycle assessment and socio economic impact assessment regarding the chemical section. Moreover, Italmatch plans to develop IoT integrated chemical refinery technology for real-time determination of the required physical chemical conditions to efficiently refine the selected materials. Following the creation of a sustainable industrial process for the production of elemental phosphorus from waste, the company, during FID, will implement and validate the developed technology at industrial scale aimed at the development of a validated recycling protocol.

9. Keliber

(187) Keliber will develop and test the utilization of secondary Li raw materials from recycling processes for Li hydroxide production. The technologies enabling sustainable Li hydroxide production will be developed in close co-operation with international technology providers, research and technology organizations ("RTOs"), as well as with other participating companies.

10. Liofit

(188) Liofit will define a recycling process and develop a quick industrial-grade test methodology to determine the aging state of the cells within a module, and a quick and safe process to open the storage batteries. Additionally, Liofit will focus on the categorisation of the cell chemistry of more than 80% of the storage batteries without opening them, thus achieving their recycling or re-use in an economical, efficient way. In the FID phase, the company will analyse a centralised EoL battery transportation concept and design and engineer a recycling pilot plant.

11. Little

(189) Little will develop a quick industrial-grade test methodology to determine the aging state of the cells within a module and proceed to the categorisation of the cell chemistry of more than 80% of the storage batteries for better re-use and recycling processes. Its R&D&I activities also include the analysis of battery packs options for improved multi-use batteries, the development of new systems for battery storage, and the optimisation of collecting, sorting and recycling processes. As regards the FID phase, Little plans to create a process of re-use of the complete auto battery pack in ESS without any dismantling or transformation. Lastly, it will design and engineer a recycling pilot plant.

12. MIDAC

(190) MIDAC will develop a recycling process and respective protocols from spent LIBs by evaluating existing processes and cell components. It will design Li cell in an integrated system with recycling process, and a recycling EoL cell process for less energy consumption and environmental impact. Furthermore, the company will develop a recycling pilot plant for spent LIBs, as well as testing and sorting algorithms and processes to classify spent modules to be used in 2^{nd}-life solutions. Its FID efforts include the design and procurement of a 2^{nd}-life solution for stand-by applications and the development of a pre-treatment process towards the dismantling and discharge of EoL batteries.

13. SGL

(191) SGL will analyse the possibility to use recycled anode material as secondary raw material for fresh anode material production, and will coordinate the testing process with cell producers. Additionally, it will accompany the pilot plant implementation of the recycling companies by providing the required specifications for the recyclate, evaluating the recyclate quality of the new plants and providing feedback via feedback loops. Finally, the company will provide pilot plant capacities for upscaling the development of recyclate-based anode materials.

14. Tesla

(192) Tesla will design a novel processing line for module dissection, cell shredder and physical/chemical separation tools including peripherals, analytical equipment and sensors to secure the safety of all processes, in order to recover and refine valuable metals from battery modules and cells efficiently with the highest separation accuracy and minimal rupture losses. It will also develop a

wastewater treatment system and optimise the extraction and exchange process conditions.

15. Valmet

(193) Valmet will conduct research on design for recyclability and develop traceability systems, providing a real-life piloting environment to battery module/systems development and production phases. As regards the testing and sorting of EoL batteries, it will collaborate with partners providing real-life use cases.

16. ZTS

(194) Following the collection and valuation of data for an optimal 2nd-life mode, ZTS will design 2nd-life battery systems for various applications. It will also propose a methodology of battery placement registration enabling to determine and monitor the status and use of batteries within the battery life cycle. Lastly, it will design construction solutions for simple and economical 2nd-life and recycling of batteries, as well as for easy disassembly of battery packs.

Description related to the complementarity of the individual projects

(195) In addressing the recycling and sustainability objective of this WS, the participating companies' individual projects are conducted in different stages of the process, either at the outset (i.e. collection, dismantling and sorting) or throughout and at the end of the process (i.e. extraction, refining and re-use).

(196) By integrating the individual projects within a recycling process, where the used batteries must flow in sequence, the aim of the WS to achieve more independence of the battery cells manufacturers from extraction of critical raw materials is ensured. The different projects aim to bring innovations within each of the recycling process stage, hence contribute to developing environmental friendly solutions and reaching the sustainability objectives.

(197) The complementary character of the individual projects is corroborated by a number of collaborations within the WS, as explained in section 2.4.3.1.

2.4.2. Description related to the necessity and complementarity between the WS for the achievement of the objective of EuBatIn

(198) The Member States involved in EuBatIn submit that each of the four WS is necessary and complementary with each other to meet the objectives of the project.

(199) The figure below shows a schematic representation of the complementarity between the different WS:

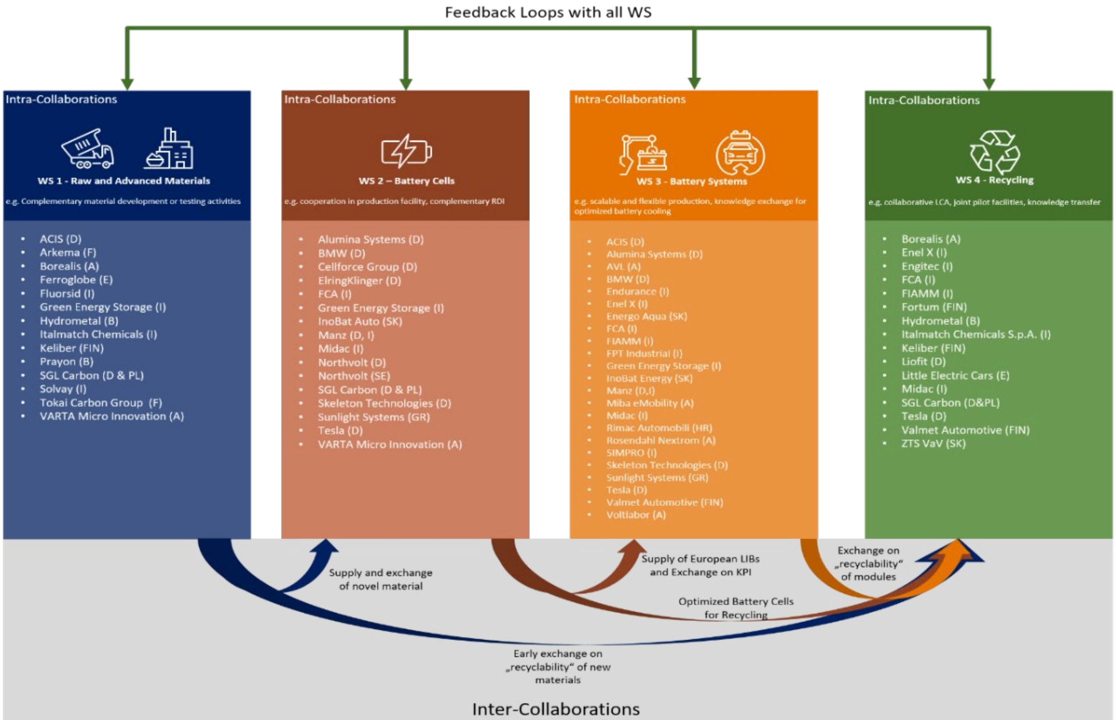

Figure 2: Schematic representation of inter- and intra-collaborations envisaged in EuBatIn

(200) Within EuBatIn and the four WS, six stages of the value chain are specifically addressed: raw and processed materials, as well as the materials part of cell component manufacturing (anode and cathode materials and electrolytes) are covered in WS 1; the mechanical component part of cell component manufacturing (e.g. housings and separators) and cell manufacturing are covered in WS 2; battery pack manufacturing and EV products manufacturing are covered in WS 3 and recycling is covered in WS 4.

(201) These stages constitute distinct as well as complementary steps along the battery production chain and thus both R&D&I and FID related industrial piloting and scaling activities are required in order to meet EuBatIn objectives.

2.4.2.1. Description related to the necessity of WS 1 and complementarity with other WS

(202) WS 1 is necessary for the completion of the other WS:

- Necessity of WS 1 for the completion of WS 2 and WS 3: R&D&I and FID activities over customised materials meeting the specific technical requirements of battery cells by application segments (e.g. EV, ESS, power tools, industrial, wearables and medical devices) are necessary for the production of cost/performance/sustainability-optimised innovative cell/battery systems in WS 2 and WS 3.

- Necessity of WS 1 for the completion of WS 4: The new battery advanced materials that will be developed under WS 1 will allow optimum recovery in recycling processes and use of recycled feedstock under WS 4. In addition to recycling facilities, a domestic refinement and transformation into materials precursors, would facilitate the already highly complex logistics and operations in processing spent batteries. This is necessary to improve the environmental, social and economic profile of the whole battery value chain.

(203) Concerning the complementarity to other WS, WS 1 is complementary to WS 2 for the following reasons:

- The advanced materials on the anode and cathode side of an LIB and RFB are key drivers for the successful implementation of a sustainable battery cell production within the EU. Moreover, advanced electrolyte formulations (including additives, non-toxic or non-caustic, etc.) will enable increased cell performances. Therefore, the output of WS 1 will be used by the participating companies of WS 2; and

- Individual projects conducted under WS 1 depend on iterative feedback loops with cell developers/producers acting within WS 2, both in understanding their needs and targets (on the material level) and in receiving feedback from material tests in the respective cell environment or during cell usage.

(204) WS 1 is also complementary to WS 4 for the following reasons:

- The use of recycled feedstock from cell recycling of battery advanced materials will be used to achieve a circular economy. This is in line with the defined cost/performance/sustainability targets of WS 1;

- Moreover, advanced battery materials that allow optimum recovery in recycling processes and use of recycled feedstock obtained from WS 1, will complement at an early stage the development of WS 4 and optimise the respective processes;

(205) Lastly, in order to ensure a recycling quality that allows for a re-use of the recovered material in the battery value chain, there would be the transition from centralised mining activities to decentralised secondary raw materials re-processing and re-use.

(206) The complementarity is evidenced in particular by the many collaborations between the different WS, as described in section 2.4.3.2.

2.4.2.2. Description related to the necessity of WS 2 and complementarity with other WS

(207) WS 2 is necessary for the completion of the other WS:

- Necessity of WS 2 for the completion of WS 1: A high quality supply of cost-competitive and sustainable advanced materials resulting from innovative R&D&I and FID is necessary to ensure and effectively conduct the FID activities of WS 2. Furthermore, the production equipment will be customised on the basis of characteristics and properties of the advanced materials developed in the frame of WS 1. This will foster technology and processes for the production of highly efficiency battery cells and modules. Therefore, the results in WS 2 are necessary for the assessment of the participating companies in WS 1 and therefore a unique closed-loop material development cycle can be created.

- Necessity of WS 2 for the completion of WS 3: The cells will be designed and processed to meet future performance characteristics of battery modules and battery packs from WS 3, as well as operational, cost-effective targets of manufacturers and customers. Results of completed modules and battery packs will be fed back to WS 2 regarding the required cell characteristics.

- Necessity of WS 2 for the completion of WS 4: The innovative battery cells are necessary to ensure that the battery recycling processes can be adapted to generate a closed loop of battery usage (design for recycling). The energy efficient production process will maintain the sustainability aspects from this WS. Therefore, the materials influence the cell designs, which in turn highly impact module and pack assembly processes, with a further impact on 2^{nd}-life and recycling.

(208) Concerning the complementarity to other WS, WS 2 is complementary to WS 1 for the reasons mentioned in recital (203).

(209) WS 2 is also complementary to WS 3 for the following reasons:

- A battery cell itself is only applicable if used with a suitable battery system. Therefore, the developed innovative battery cells in WS 2 are complementary to the various innovations of WS 3;

- In particular, designing high performing BMS or TMS and the related algorithms is closely linked to the expected hardware performance and behaviour, including but not limited to aging, of new generation cells developed as a result of WS 2 individual projects;

- Selecting and making good use of embedded SoH measurement sensors and gauges requires the same level of consideration for the expected outputs of WS 2 individual projects;

- The cells will be designed and processed to meet future performance characteristics of battery modules and battery packs from WS 3 and meet operational, cost-effective targets of manufactures and customers. Therefore, data of completed modules and battery packs will be fed back to WS 2 regarding the required cell characteristics;

- The implementation for RFB cells in WS 3, including tanks, pumps, BMS, etc., will be carried out simultaneously with WS 2 for better optimisation of battery systems. Also, the ultracapacitor cell design, developed within WS 2, will be impacted by the results of WS 3 for the development of HBS for longer LIB lifetime and better power performance; and

- Innovative cell developers in WS 2 need to understand the markets and services that the battery designers and OEMs target in their individual projects within WS 3.

(210) The complementarity is evidenced in particular by the many collaborations between the different WS, as described in section 2.4.3.2.

2.4.2.3. Description related to the necessity of WS 3 and complementarity with other WS

(211) WS 3 is necessary for the completion of the other WS:

- Necessity of WS 3 for the completion of WS 1: Material characterisation and development in WS 1 will be improved through the design and validation of models and test protocols arising from on-field and real-life data generated in the piloting of modules and packs in WS 3. The impact of aging for example on different battery parameters, which affect directly the heat generated within cells and their ability to dissipate this heat constitute a necessary input for WS 1. The module and pack production system can be optimised in WS 3 using the results of WS 1 and WS 2 (i.e. joining technologies, design for manufacturing, design for cost and design for recycling).

- Necessity of WS 3 for the completion of WS 2: The battery cells in WS 2 are necessary for the implementation of battery packs, modules and systems in WS 3. Using innovative battery management designs, the battery cells can be optimised in WS 2 using the results of WS 3. WS 3 is going to be partially developed simultaneously with WS 2, in order to be able to build and industrialise an optimised battery system. This part includes the definition of a BMS and other battery elements that will be part of the construction of batteries, like tanks, casing, pumps, DC/DC converters, etc. Also, LIB and ultracapacitor cell design impact HBS design in WS 3, thus both designs will be subjected to a feedback loop for optimisation of performance and cost and resource efficiency.

- Necessity of WS 3 for the completion of WS 4: The innovative battery packs, modules and systems in WS 3 will be optimised for recycling in WS 4 and are necessary, in order for the battery recycling process to be undertaken using standardised systems. Moreover, the tasks carried out in WS 3 will be used in the R&D&I and FID activities in WS 4, so that all the applications that are analysed and validated consider in advance the recycling and sustainability parameters. For example, innovative, flexible and gap-filler free battery heat exchangers can be separated easily from the battery cells for repairing, re-use of battery cells in 2nd-life applications and recycling. Furthermore, the development of HBS concepts in WS 3 will open up the possibility to utilise 2^{nd-}life batteries for an extended amount of time in stationary applications WS 4.

(212) Concerning the complementarity to other WS, WS 3 is complementary to WS 1 through indirect synergies stemming from WS 2. A high-quality supply of best-performing, innovative and sustainable advanced materials resulting from highly innovative R&D&I and FID activities within WS 1, will ensure an effective conduct of the FID activities of WS 3.

(213) WS 3 is also complementary to WS 2 for the reasons mentioned in recital (209). Further, the innovative battery systems and modules resulting from WS 3 will be based on innovative cells developed and processed in WS 2 and the

results from the R&D&I phase of WS 3 will be fed back to WS 2 and *vice versa*.

(214) WS 3 is finally complementary to WS 4 for the following reasons:

- Feedback loops within the R&D&I activities of WS 4 and R&D&I and FID activities of WS 3 will enable optimised battery recycling;

- The design of battery systems will allow for an optimised battery assembly, easy disassembly, dismantling and a cost effective recycling process. This will allow WS 4 participating companies to optimise the re-use of battery cells and increase their lifetime with the result of ultimately secure critical raw materials through recycling; and

- The life cycle analysis of battery modules, packs and systems within WS 3, must consider the recycling parameters from the works undertaken in WS 4, in order to better dimension the modules/packs/systems.

(215) The complementarity is evidenced in particular by the many collaborations between the different WS, as described in section 2.4.3.2.

2.4.2.4. Description related to the necessity of WS 4 and complementarity with other WS

(216) WS 4 is necessary for the completion of the other WS:

- Necessity of WS 4 for the completion of WS 1: The utilisation of secondary (Li) raw materials, extracted from recycled materials, is necessary to provide WS 1 participating companies with high quality Li for the production of primary materials. For example, R&D&I activities for graphite recyclate as raw material for advanced anode material production will be investigated in terms of processing the recovered materials from WS 4 to properly prepare new electrochemical active materials in WS 1 for battery production.

- Necessity of WS 4 for the completion of WS 2: A close collaboration of the recycling companies with the battery cells producers is necessary to set the most suitable parameters and conditions for the battery cells, the system design, and for the possibility of producing secondary raw materials.

- Necessity of WS 4 for the completion of WS 3: Battery systems shall be evaluated for their reusability, possible second life application and recycling, in order to create a necessary closed loop approach for the LIB value chain. The monitoring for EoL status determination and design for recycling will be addressed to increase the efficiency of the recycling process for battery system production waste.

(217) Concerning the complementarity to other WS, WS 4 is complementary to WS 1 for the following reasons:

- Secondary raw materials, including but not limited to Li, Ni, Co, Mn, phosphorous, Cu, aluminium, graphite, will be extracted from recycled materials and they will be fused within the within R&D&I and FID activities of WS 1 for the production of primary materials; and

- The integration of secondary raw materials in WS 1 relies on refinement, as some impurities originating from batteries do not exist in natural ores; hence, recyclers and refiners of WS 4 will need to work for mutual adaptation with the material producers of WS 1.

(218) WS 4 is also complementary to WS 2 for the following reasons:

- The battery recycler of WS 4 will set the most suitable parameters and conditions for the battery cell and the system design in terms of recyclability towards the battery cells producers of WS 2. The latter will, from his side, set the basic criteria for WS 4 recyclers to optimise their recycling process;

- The battery cells from WS 2 shall be analysed for the eco-design and suitability for recycling by the WS 4 recyclers to ensure a high recycling quota that is economically viable, leading to efficient recycling processes of battery cell production waste; and

- Identifying the most effective second life processes of LIB and the most effective recycling processes of various batteries types, including but not limited to LIBs, ultracapacitors or RFB, will contribute to high-effective return rates and minimise negative environmental impacts.

(219) Finally, WS 4 is complementary to WS 3 for the following reasons:

- Testing and validating the re-use of the LIB modules/packs in the production of the battery system, thus, optimising the CO_2 footprint of battery pack/module/system production;

- The terms “design to disassembly” and "design to recycle” will be addressed by the R&D&I and FID activities of the participating companies in WS 4 and their results will be fed back to WS 3. This will help evaluate battery packs/modules/systems for their reusability, possible 2^{nd}-life application and recycling quota in order to create a closed loop approach for the LIB value chain;

2.4.3. Collaboration within EuBatIn with respect to the relevant WS

(220) In addition to the necessity and complementarity of the individual projects within each WS, strong collaboration of the participating companies within and across the WS will exist, which, according to the Member States would not occur to this extent without the project.

2.4.3.1. Examples of collaborations intra WS

(221) In WS 1:

- ACIS will supply its raw material samples to Fluorsid for electrolyte production tests and to VARTA for the manufacturing of prototype cells stemming from the […].

- Arkema will collaborate with […] for the development of silicon based products with low emission and waste during evaporation and for improving power performance of anode by developing graphite with higher percentage of silicon.

- GES will develop together with Solvay polymers and membranes for RFB. Solvay will develop high performing and low-cost membranes for RFB that will be embedded within GES's prototypes.

- Fortum and Keliber will collaborate for testing recycled products as raw materials and with SGL for the utilisation of recycled graphite as a raw material.

- Italmatch and Fluorsid will develop the first LiPF6 liquid electrolytes production plant in Europe. Italmatch will provide know how about PCl5 reactivity and process technology and will develop a complete supply chain system to overcome the existing safety, handling and regulatory barriers.

- Prayon will use VARTA's facilities to test NVPF material. VARTA's feedback could benefit Prayon and help in the development of NVPF at pilot and industrial scale.

(222) In WS 2:

- Skeleton and Alumina will evaluate, design and test cells for HBS comprised of ultracapacitors and liquid salt batteries, enabling thus HBS to fit in different application beyond Li-ion technology.

- Cellforce and ElringKlinger will collaborate to analyse the production processes for prismatic LIB cells with focus on energy efficiency and sustainability.

- Northvolt, in collaboration with BMW, will focus on the development and industrialisation readiness of advanced cell design and on optimised concept of manufacturing process of cell volumes with lowest overall CO_2 impact on the market.

- SUNLIGHT will collaborate with Manz for cell production automatisation, flexible production line for different cell sizes and for the implementation of Industry 4.0 for all relevant data and values for traceability, reliability and quality of the products.

- Tesla will work together with Manz on the development of advanced winders used for cathode and anode electrode manufacturing lines. Manz will provide access to its lab/pilot equipment and testing facilities.

- Voltlabor and AVL will collaborate on the development of a highly flexible production facility with special focus on laser-welding technology for cylindrical cells.

(223) In WS 3:

- Enel X's collaboration with FCA will mainly focus on the development of a BMS with effective control algorithms, which will be functional for charging infrastructures and which will enable the interoperability of ESS.

- FIAMM will establish collaboration with Manz on assembly lines that should be Industry 4.0 compliant and which shall help industrial processes to be up to date and capable of performing at expected quality levels.

- InoBat Energy will collaborate with Energo Aqua on the development of an application of InoBat Energy storage system into Energo Aqua unique system of production, storage and distribution of green electricity for hydro power plants and for RES.

- Rimac and Miba will share knowledge and expertise on cooling technologies and will collaborate to evaluate different cooling concepts (e.g. Miba's *FLEXcooler* technology and Rimac's submerged battery).

- Rosendahl and Skeleton will collaborate on the development of assembly requirements and production solutions for ultracapacitor modules and systems for flexible and scalable production lines. This collaboration will aim at an automated production for differently sized ultracapacitor modules and systems for HBS applications.

- Valmet will collaborate with Rosendahl for the development of scalable and flexible production system for mid-size volumes and for the assessment of innovative assembly solutions of Li-ion batteries for advanced applications. It will also share its knowledge to reduce waste generation during production, especially during prototype phase.

(224) In WS 4:

- Enel X will collaborate with ENGITEC on the development of solutions and methods for the dismantling of EoL batteries that would enable the development of effective solutions for battery discharge. They will share knowledge and technology to also deliver an effective methodology for battery pre-treatment solutions.

- FIAMM and FCA will identify methods, rules and processes for EoL management of battery packs for better recyclability and re-use. Their collaboration will also cover the development of guidelines for specific 2^{nd}-life applications in all broad application domains (i.e. mobility, industrial/consumers and stationary energy storage sectors).

- Hydrometal's collaboration with Keliber focuses on the development of a recycling process to produce a proper Li concentrate to fit the specifications of Keliber's process to make pure Li hydroxide. Keliber will carry out the evaluation based on information and samples to check and adapt processes on both sides.

- Italmatch, in collaboration with MIDAC, will offer an innovative chemical IoT integrated technology, as well as general know-how within the recycling process of valuables to support the closure of the loop, as regards batteries recycling.

- Liofit will collaborate with Borealis on polymer recycling and on the provision of materials for testing. In particular, Liofit will receive surplus polymer cases and Borealis will integrate them into polymer classes sorted cases during the recycling process.

- ZTS and Fortum will collaborate in the definition of recommendations for the establishment of procedures needed to design the concept and technology of battery production within the European market. This will help achieve an efficient 2nd-life process and final battery processing with maximum support for the circular economy.

2.4.3.2. Examples of collaborations inter WS

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

- ACIS will collaborate with Cellforce by supply its raw materials to Cellforce for evaluation in the latter's batteries. The complementarity of the projects is also shown by the fact that Cellforce will share the results with ACIS in order to help improve the raw materials' production.

- Arkema will validate new electrolyte salt and purified compacted carbon nanotubes in […]. This collaboration will enable Arkema to perform the various research/iteration works during the FID phase that are necessary to optimise product quality and meet the cost, performance and sustainability targets.

- Ferroglobe and Tesla will collaborate for the development of technologies and processes for the large-scale manufacturing of anode materials and coating technologies and processes.

- Solvay will develop production equipment for battery cells in collaboration with Manz. The projects are complementary as Solvay will provide raw materials to be integrated in Manz's prototype equipment line.

- SGL will supply SUNLIGHT with the synthetic graphite that SUNLIGHT is planning to use as anode material targeting to cell performance improvement.

(226) As regards the collaborations between WS 1 and WS 4:

- Ferroglobe will collaborate with Little for the evaluation of the recovered materials from the anode side of the recycled cells. The recovered material will then be tested for re-use in the Si/C composites production or Si production.

- Italmatch will supply MIDAC, ENGITEC and Northvolt with the developed electrolytes for testing, optimisation and cost evaluation, enabling their sustainability from the recycling process.

- SGL will supply Hydrometal and Fortum with anode material expertise for the specification of the recyclate, while Hydrometal and Fortum will carry out the recycling process for the development of the recyclate as a secondary raw material in the graphite anode material production.

(227) The complementarity between WS 2 and WS 1 is also evidenced by a number of envisaged collaborations:

- BMW, together with SGL and Solvay, will develop advanced solvents and binders to be jointly evaluation in advanced cell design and against automotive requirements.

- ElringKlinger will develop PO-based battery housings in collaboration with Borealis. ElringKlinger will support Borealis to gain an understanding of the performance of development grades that would enable it to tailor-make the polymer design.

- Tesla will collaborate with Ferroglobe for the development of advanced anode material for Li-on batteries; with Solvay, for the development of advanced binder materials; with SGL for the development of advanced cost effective graphite materials; and with Arkema for the development of advanced and cost-effective electrolytes.

(228) Concerning the collaborations between WS 2 and WS 3:

- Cellforce will supply Rimac with A- and B-series cells the within the R&D&I phase and will also collaborate for the joint development of module concepts customised to the Cellforce's cell design, regarding low internal resistance and fast charge capability.

- MIDAC will collaborate with FPT, for the development of battery packs/modules for industrial applications, and with FCA for the development of battery packs/modules for niche markets.

- Northvolt will collaborate with ElringKlinger to develop an advanced, validated and cost competitive prismatic cell design, which is suitable for automotive applications. This includes also the assessment and improvement of the high volume production processes to achieve low resource and energy consumption.

- Skeleton will share knowledge and technology with Alumina in order to evaluate, design and develop a HBS between ultracapacitors and liquid salt batteries.

- SUNLIGHT will develop, with the collaboration of Manz, innovative assembly solutions that support batteries with modular design and different battery housing sizes.

- VARTA will collaborate with AVL, Miba and Voltlabor for the provision of high energy cells needed for AVL's testing and integration into battery packs and for highly automated pack manufacturing plant developed by Voltlabor and […].

(229) Further collaborative projects will take place between WS 3 and WS 2. Indicatively:

- FPT will collaborate with Northvolt in the area of prismatic battery cell design for commercial vehicles applications. The modules and battery packs developed by FPT will require the close collaboration of a cell producer, such as Northvolt, in order explore different cell type and design.

- Manz will collaborate with InoBat Auto for the development of the first fully automated pouch module line in Europe, involving fully automated production processes, welding process for pouch cells and Industry 4.0 features.

- Miba's collaboration BMW aims to evaluate the thermal performance of the developed battery cells and choose cooling strategies accordingly. Miba will contribute with providing its *FLEXcooler* technology.

- Rosendahl and ElringKlinger will work together for the development of production processes for cell housing and module assembly. Rosendahl will provide the production process know-how (e.g. smart manufacturing), while ElringKlinger will contribute with the product know-how for cell housings and battery modules.

(230) A number of collaboration will also take place between the participating companies in WS 3 and those in WS 4:

- Endurance will collaborate with MIDAC to verify the recovery of aluminum from EoL battery cells, in order to obtain secondary alloys, and to test the castability of those alloys for swap unit housing production.

- FPT and FCA will collaborate on battery module and pack design enabled for EoL management (i.e. battery status monitoring, possible use in 2^{nd}-life application, dismantling and recycling).

- MIDAC will collaborate with Enel X on the re-use and recycling of the battery packs/modules. The latter will be designed by MIDAC with the aid to be easily dismantled and re-used in a 2^{nd}-life application.

- Skeleton will develop with the collaboration of Fortum an enhanced recycling process for ultracapacitors. Skeleton will supply ultracapacitor cells and systems at different points in their lifecycles, while Fortum will provide knowledge on recyclability of cells and systems in order to optimise their design towards circular economy.

(231) Concerning the collaborations between WS 4 and WS 1:

- ENGITEC will establish collaborations with Italmatch, SGL and VARTA. ENGITEC will receive data input for anode, cathode and electrolyte materials in order to define the recycling process, carry out the dismantling and disassembly of EoL batteries and provide feedback on the material's recyclability.

- Italmatch will collaborate with Fluorsid as regards the development of tracing methods in recycling. Italmatch will validate the refinery/recovery technology towards wider applications.

(232) As regards the collaborations between WS 4 and WS 2:

- ENGITEC will collaborate with MIDAC, SUNLIGHT and VARTA. ENGITEC will receive data input for battery composition in order to define the recycling process, carry out the dismantling and disassembly of EoL batteries and provide feedback on the battery recyclability.

- Italmatch and Alumina will collaborate for the development of an efficient Ni extraction methodology. Alumina is interested to implement its Na/NiCl2 retrofitting technology within the developed refinery process of Italmatch.

- ZTS will collaborate with InoBat Auto for the development of 2^{nd}-life and recycling processes of LIB for automotive applications.

(233) There will be the following collaboration between WS 4 and WS 3:

- Fortum will develop recycling processes for Valmet's battery systems.

- MIDAC will collaborate with Endurance on the re-use of aluminum for new battery pack. The raw material obtained during the direct recycling phase, in particular aluminum, can be used by Endurance to produce chassis for new battery pack.

- Tesla will collaborate with Solvay on the development of chemicals for the removal of metals. In particular, Solvay will develop chemicals for the effective removal of specified metals during the chemical separation phase.

- ZTS will develop BMS for 2^{nd}-life batteries in collaboration with Energo Aqua. This collaboration will help apply 2^{nd}-life battery systems to high-capacity ESS with BMS programming based on the prediction of using these systems in conjunction with RES.

2.5. Positive spillover effects generated by EuBatIn

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

a. The dissemination and spillover of knowledge that is not protected by IP rights (see recitals (236) to (248));

b. The dissemination and spillover of knowledge that is protected by IP right (see recitals (249) to (265);

c. The dissemination and spillover of knowledge during the FID (see recitals (266) to (284)); and

d. The dissemination and spillover of knowledge to other indirect partners and to other sectors (see recitals (285) to (302)).

(235) Each participating company has committed to and will participate to the dissemination activities up until the end year of its individual project, whereas a member of the FG will be designated as key contact for the implementation of the dissemination and spillover commitments.

2.5.1. Dissemination and spillover of knowledge that is not protected by IP rights

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

(236) The participating companies to EuBatIn will disseminate knowledge that is not protected by IP rights to the scientific community and the industry.

(237) The table below displays the mapping of the main dissemination actions of the non-protected IP rights of EuBatIn within the EU:

Event	Participating companies	Scope
Conferences	All participating companies	• Dissemination of research results • Exchange of views and networking
Conferences organized by participating companies	BMW, Cellforce, ElringKlinger, Endurance, Enel X, Energo Aqua, ENGITEC, Fluorsid, GES, Hydrometal, InoBat Energy, Italmatch Manz, Rimac, Tesla, ZTS	• Dissemination of research results • Exchange of views and networking
Company website in the context of EuBatIn	Alumina, AVL, Cellforce, Endurance, Enel X, Energo Aqua, Ferroglobe, Fluorsid Fortum, GES, InoBat Auto InoBat Energy, Italmatch, Liofit, Manz, Miba, Rimac, Voltlabor, ZTS	• Platform to widespread upcoming activities for the general public (e.g. “Open days”, workshops, summer schools) • Disseminate research results
Newsletters & Press releases	ACIS, Alumina, AVL, BMW, Carbon, ElringKlinger, Endurance, Enel X, Energo Aqua, ENGITEC, Ferroglobe, Fortum, GES, InoBat Auto, InoBat Energy, Italmatch, Liofit, Manz, Miba MIDAC, Prayon, Rimac, Rosendahl, Skeleton, Valmet, VARTA, Voltlabor, ZTS	• Communicating upcoming activities for the general public (e.g. “Open days”, workshops, summer schools) • Sources of communication might be LinkedIn, Twitter, Xing, Company website, etc.

Event	Participating companies	Scope
"Open-Days"	Alumina, AVL, ElringKlinger, Endurance, Energo Aqua, ENGITEC, Fortum, GES, Hydrometal, Manz, Miba, MIDAC, Prayon, Rimac, Rosendahl, Tesla, VARTA, Voltlabor, ZTS	• Invite the general public to visit the facilities in order to strengthen the view of each project • Workshop and guided tour • Demonstration of process and technology • General IPCEI website will present the event
Publications in scientific journals	All participating companies	• Dissemination of research results
Seminars	BMW, ElringKlinger, Endurance, Enel X, Energo Aqua, ENGITEC, Fortum GES, Hydrometal, InoBat Auto InoBat Energy, MIDAC, Rimac, Rosendahl, Tesla, Valmet, ZTS	• Exchanging with other scientists in the battery field • Offer young scientists a platform to present research results
Social Media Streams	ACIS, Cellforce, ElringKlinger, Endurance, Energo Aqua, Enel X, ENGITEC, Ferroglobe, Fortum GES, InoBat Energy, InoBat Auto, Miba, MIDAC, Prayon Rimac, Skeleton, Voltlabor ZTS	• Communicating upcoming activities for the general public (e.g. "Open days", workshops, summer schools) • Objectives of EuBatIn including expected outputs
Summer Schools	ACIS, Ferroglobe, GES, Hydrometal, Rimac, Tesla Voltlabor	• Internships for young scientists (Bachelor, Master or PhD Students) • Network for young scientists
Workshops	ACIS, AVL, BMW, Cellforce, ElringKlinger, Endurance, Enel X, Energo Aqua, Ferroglobe, Fluorsid, Fortum, GES, Hydrometal, Italmatch, MIDAC, Rimac, Rosendahl, Skeleton, Tesla, Valmet, VARTA, Voltlabor, ZTS	• Exchanging with other scientists in the battery field • Offer young scientists a platform to present research results and/or networking possibilities
Work meetings for employees	ElringKlinger, Energo Aqua, InoBat Auto, InoBat Energy, Miba, Rimac, Tesla, VARTA, Voltlabor, ZTS	• Advanced training for employees • Further external activities

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

(238) The table below details in a quantitative manner the main dissemination actions envisaged by the participating companies:

KPIs	Expected dissemination in the course of EuBatIn (estimates per year)	Difference with "business as usual" (estimates per year)
Exhibitor at conferences	152	+92
Financed university chairs	13	+13
Industrial publications	113	+78
Organiser of external events	58	+42
Organiser of internal events	153	+110
Papers and presentations in conferences	148	+111
Sponsorship of PhDs/MScs	201	+164

Table 3: KPIs for dissemination and spillover knowledge

2.5.1.2. Participation to external events

(239) The participating companies will participate in conferences and public presentations in the framework of established international events listed in the table below.

(240) These events cover a number of Member States including but not limited to the participating companies. They relate to a number of different sectors beyond the sector(s) where each participating company operates, such as climate change and global warning, economic geology, photovoltaics and solar thermal technologies, etc. They are open to participants from all EU Member States and ensure wide geographic coverage, beyond the participating companies.

<table>
<tr><th>Conference Title/Location</th><th>Scope</th><th>Participating companies</th></tr>
<tr><td>AABC (USA)</td><td rowspan="2">Annual conference with topics addressing the entire battery value chain:
• Battery technology
• Material
• Recycling</td><td>Arkema, AVL, BMW, Cellforce, ElringKlinger, Manz, Northvolt, Rosendahl, Skeleton, Solvay, VARTA</td></tr>
<tr><td>AABC Asia (China, Korea, Japan)</td><td>Arkema, AVL, Cellforce Manz, Northvolt, Skeleton</td></tr>
</table>

Conference Title/Location	Scope	Participating companies
AABC Europe (Germany)	• Chemistry	ACIS, Arkema, AVL, BMW, Cellforce, FCA, Ferroglobe, Fluorsid, Liofit, Manz, MIDAC, Northvolt, Prayon, Rosendahl, SGL, Skeleton, Solvay, Tesla, VARTA, Voltlabor
Batcircle Seminar (Finland)	Seminar series, addressing topics as: • Circular economy • Recycling technologies • Manufacturing processes of battery chemicals	Fortum, Keliber, Valmet
Batterieforum (Germany)	Annual conference, organized by KLIB, focusing on the entire value chain within Germany • Circular economy • Raw materials • Safety • Recycling • Integration	AVL, Cellforce, ElringKlinger, Liofit, Manz, Rimac
Batteries event (France)	Annual conference including topics (but not limited to): • Circular economy • Raw materials • Safety • Recycling	Arkema, Prayon
Battery Conference "Kraftwerk Batterie"	Annual conference, hosted by two RTOs, focusing on: • Circular economy • Raw materials • Safety • Recycling	ACIS, Arkema, AVL, BMW Cellforce, ElringKlinger Endurance, Ferroglobe Manz, Skeleton, Tesla
Battery experts forum (Germany)	Annual conference focusing mainly on the implementation of: • Battery cells • Battery systems • Recycling	AVL, InoBat Auto, Italmatch, GES, Manz, Miba, Rimac, Rosendahl, Voltlabor
Conference of e-mobility, Battery Recycling and Second lifeworld (Europe)	Topics addressed: • Battery and mobility • Recycling and reuse Circular economy	Ferroglobe, Little
ECOMONDO (Italy)	Annual "Green Technology" expo on circular economy	Arkema, ENGITEC, FIAMM, Fluorsid, Italmatch, MIDAC

Conference Title/Location	Scope	Participating companies
Electrical Energy Storage (Germany)	Annual industry fair focusing on: • Energy storage • Energy transition • Circular economy	ACIS, Cellforce, FCA, GES, InoBat Energy, Manz, Prayon, Rosendahl, Tesla
Elektromobilproduktionstag Aachen (Germany)	Annual conference hosted by PEM Motion, focusing on: • Battery development • E-mobility in broader sense	BMW, Cellforce, Endurance, Manz
Energy Manifest (Slovakia)	Annual conference organized by the Slovak Battery Alliance program, focusing on: • Raw material availability, recent and future development • EU regulations • EV battery Gigafactories	Energo Aqua, InoBat Energy, ZTS
Energy Storage Europe (Germany)	Annual industry fair on energy storage, focusing on: • Scientific issues • Energy storage • Renewable energy storage	Alumina, InoBat Energy, ZTS
Energy Storage International (USA)	Annual energy fair for energy storage and renewable energy integration	FCA, GES, MIDAC, ZTS
Energy Storage Summit (Europe)	Main topics addressed: • Downstream activities • Energy storage	AVL, InoBat Energy
ESWF Energy Storage World Forum (Germany)	Annual conference focusing on energy storage	Enel X, Fortum, GES, MIDAC
FEM (Finland)	Biannual conference: • Raw materials sourcing • Economic geology	Fortum, Keliber
International Meeting on Lithium Batteries (Worldwide)	Biannual international conference focusing on: • Raw materials • Recycling • Next-generation materials	BMW, ENGITEC, Fortum Italmatch, Manz, Northvolt, Rosendahl, Solvay, VARTA
International Battery Production Conference (Germany)	Annual conference, hosted by TU Braunschweig, focusing on: • Battery cell production • Circular economy	ACIS, Manz, Northvolt, Rosendahl

Conference Title/Location	Scope	Participating companies
International Battery Seminar (USA)	Annual seminar and exhibition focusing on: • Battery technology • Materials • Recycling • Chemistry	AVL, BMW, Cellforce, Italmatch, Northvolt, VARTA
International Conference on Advanced Lithium Batteries for Automobile Applications (Worldwide)	Annual conference covering the whole value chain for automotive Li-ion batteries.	Arkema, Manz, MIDAC, VARTA
International Conference on Environment and Renewable Energy (Worldwide)	Topics include: • Climate change • Global warming • New perspectives of renewable energy • Wind/solar technologies • Hydro power • Renewable energy economics	Energo Aqua, ZTS
International Congress for Battery Recycling (Worldwide)	Annual conference, focusing on: • Recycling value chain • Collection • Recycling technologies • Circular economy • Producers and dealers of Ni-Co • Equipment- battery recyclers	AVL, Cellforce, Endurance, Enel X, ENGITEC, Fortum, Hydrometal, Northvolt, Tesla, ZTS
International Flow Battery Forum (Worldwide)	Annual conference focusing on: • Flow battery operations • Applications • Manufacture • Flow battery components development and research • RFBs manufacture and testing • Deployment cases and flow battery system operation	FCA, Fluorsid, GES, Italmatch, Solvay
International Symposium on Polymer Electrolytes (Worldwide)	The topics cover fundamental and applied aspects of polymer electrolytes, both conventional and innovative	ACIS, Manz, Solvay

Conference Title/Location	Scope	Participating companies
Intersolar Europe (Europe)	Intersolar Europe is the world’s leading exhibition for the solar industry with focus on: • Photovoltaics • Solar thermal technologies • Solar plants • Grid infrastructure • Solutions for the integration of renewable energy	InoBat Energy, ZTS
ISE Meeting (International Society of Electrochemistry) (Worldwide)	Annual Meeting, focusing on: • Electrochemistry research and development • Battery and ultracapacitor materials development and testing • Electrochemical engineering issues related to electrochemical cells	FCA, GES, Italmatch, Manz, Northvolt, Skeleton, Solvay, VARTA
Lithium Supply & Market Conference (Worldwide)	Main topics addressed: • Li supply and demand and pricing • Technologies and innovations • EV forecast and battery chemistries	ACIS, Hydrometal, Keliber
Metal Bulletin Nickel Conference (Worldwide)	Market fundamentals, Circular economy and recycling	Fluorsid, Hydrometal Italmatch
Slush (Finland)	Slush is the world's leading start-up and tech event. Slush facilitates meetings between the founders of start-ups and investors such as venture capitalists, accomplished with events such as matchmaking and pitching competitions. Slush aims to build a worldwide start-up community.	Fortum, Valmet

Conference Title/Location	Scope	Participating companies
The Battery Show (Germany)	Annual conference and EXPO, focusing on: • Battery design • Advanced materials • Manufacturing • Stationary power	ACIS, Arkema, AVL, BMW, Carbon, Cellforce, ElringKlinger, FCA, Ferroglobe, Fortum, InoBat Auto, Manz, Miba, Northvolt, RIMAC, Rosendahl, SGL, Skeleton, Tesla, Valmet, Voltlabor
The European Association for Storage of Energy (Europe)	Energy Storage Global Conference, annual: • Technology • Policy • Market	Enel X, FCA, GES, MIDAC
World Alliance for Low Carbon Cities Forum (Sweden)	Biannual Forum with various topics. Main title: "Making transcendent innovation happen"	Enel X, Valmet

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

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

(241) The participating companies commit to disseminate the IP non-protected results acquired in the framework of EuBatIn to the scientific community. In particular, the participating companies will collaborate with the scientific community and with indirect partners (see recitals (285) to (291)).

(242) The participating companies will in particular finance and/or contribute to the creation/development of university/school chairs related to new materials, cells and system designs with a view to train future European scientists, experts, engineers, technicians and operators. The locations of the RTOs go beyond the participating Member States, thus providing genuine spillover effects to e.g. Czechia, Denmark, Estonia, the Netherlands, Sweden, and the United Kingdom. In several cases, even if no university chairs are expected to be financed, the participating companies will collaborate with their respective research partners on different topics, as shown in table 5, hence, the battery research ecosystem will materially benefit from these collaborations.

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

Institution	Cooperating participating companies	Financed university chairs	Scope of the Funding/Collaboration	Country
CEA LITEN	ACIS, Carbon, Northvolt, SGL	---	• Material and quality • Anode material intelligence • material supply	France
Cidetec	SGL	---	Anode material intelligence / material supply	Spain
Competence Center - Virtual Vehicle	AVL, Rosendahl, VARTA	--- ---	Establishment of SW-Platform to interconnect real and virtual domains	Austria
Consiglio Nazionale delle Ricerche	Fluorsid, Italmatch	---	Detailed scope under consideration	Italy
Constantine the Philosopher University in Nitra	Energo Aqua, ZTS	2	• Monitoring of the impact of HES on the environment. • Environmental impact assessment for the construction of 2nd-life battery production workplace	Slovakia
Czech Technical University in Prague	Energo Aqua, ZTS	2	• Research and development of power semiconductors elements. • Development of BMS for 2nd-life batteries	Czech Republic
Dutch Institute for Fundamental Energy Research	GES	---	Detailed scope under consideration	The Netherlands
ENEA	ACIS, , ENGITEC, FCA, Fluorsid, Italmatch, Manz, MIDAC	---	• Development of innovative manufacturing process for the advanced GEN 4 ASSB.	Italy
Fondazione Bruno Kessler (FBK)	Energo Agua, GES, Skeleton	---	• Development of RFB solutions (cells, stacks, BMS, etc.) • Development of hybrid ultracapacitor-based ESS • Development of advanced solutions for energy communities	Italy

Institution	Cooperating participating companies	Financed university chairs	Scope of the Funding/Collaboration	Country
Graz University of Technology (TU Graz)	AVL, VARTA	2 (part-time)	Production process development, IoT and 5G implementation within production environments	Austria
Fraunhofer Institutes	ACIS, Alumina, Arkema, BMW, Tokai Carbon, Liofit, Manz, MIDAC, Northvolt, SGL, Skeleton, Valmet,	---	• Cell testing • Cell development • Process development • Anode material intelligence / material supply • Material research, advanced characterization • Basic electrochemistry in laboratory cells	Germany
Helmholtz Institute Ulm (HIU)	BMW, Italmatch, Manz, MIDAC, Skeleton, SGL	---	• Anode material intelligence / material supply • Material research, advanced characterization; basic electrochemistry in laboratory cells • Advanced development of ASSB based on P2S5 precursor	Germany
Karlsruhe Institute of Technology (KIT)	Arkema, BMW Cellforce, Manz, MIDAC, Skeleton	---	• Process development • Material research, advanced characterization • AI/big data / Industry 4.0	Germany
KTH Royal Institute of Technology	Borealis, Northvolt	---	Technology development partner for compounding and testing of mechanical properties of flame retardant PO-solution	Sweden
MEET Battery Research Center	BMW, Cellforce Ferroglobe, Northvolt SGL, Skeleton	---	• Cell development • Process development • Anode material intelligence / material supply • Material research, advanced characterization; basic electrochemistry in laboratory cells	Germany
PEM RWTH Aachen	BMW, Cellforce, Northvolt, Skeleton	---	• Cell development • Process development	Germany

Institution	Cooperating participating companies	Financed university chairs	Scope of the Funding/Collaboration	Country
Pavol Jozef Šafárik University in Košice (UPJŠ)	InoBat Auto, InoBat Energy, ZTS	3	• Material design, preparation, testing and processing, development of small-scale prototypes of Li-ion batteries. • Material design, preparation, testing and processing. • Physical and chemical analysis of electrolytes • Research in recovering processes for the second life of batteries	Slovakia
Politecnico di Milano	Italmatch, ENGITEC	---	• Hiring of MSc specialists- CO2 footprint & eco-sustainability of the innovation	Italy
Polytechnic of Turin	FCA, Manz	---	Detailed scope under consideration	Italy
Slovak Academy of Science	InoBat Auto	---	• R&D of materials for Si anodes • R&D of materials for solid electrolytes and ASSB related R&D processes	Slovakia
SINTEF	Borealis	---	Method development and material characterisation of PO Materials for battery components, characterisation of electrical properties of PO-Compounds (Electrical Lab)	Norway
Tallinn University of Technology	Skeleton	---	Detailed scope under consideration	Estonia
Technical University of Braunschweig	BMW, SGL	---	• Anode material intelligence • Material supply	Germany
Technical University of Denmark	Northvolt	---	Process development	Denmark
Technical University of Košice	InoBat Auto InoBat Energy	1	• Degradation processes inside battery system • Modular battery for minibus (testing, measurements, calculations, design of prototype etc.)	Slovakia

Institution	Cooperating participating companies	Financed university chairs	Scope of the Funding/Collaboration	Country
Technical University Munich	BMW, Northvolt, SGL	---	• Cell development • Process development • Anode material intelligence / material supply • Material research, advanced characterization; basic electrochemistry in laboratory cells, post-mortem analysis	Germany
TU Bergakademie Freiberg	Liofit	1 (co-financed)	Subcontracting and direct research involvement	Germany
University of Bologna	FCA, Manz, MIDAC, Skeleton	---	• Cell and module testing • Cell and module development • Process development • Material research, advanced characterization • Basic electrochemistry in laboratory cells • Artificial Intelligence /big data / Industry 4.0	Italy
Université de Liège	Hydrometal, Prayon	---	• Hiring / Training of MSc students/ R&D development	Belgium
University of Oulu	Keliber, Northvolt	---	Recycling	Finland
University of Ulm	BMW, Northvolt	---	• Cell development • Process development	Germany
University of Žilina	Energo Aqua, ZTS	2	• Testing and monitoring of operational status • Development of partial electrical equipment for efficient cooperation of RES (water turbine, photovoltaic panels, wind turbine, etc.). • Second life of cells and batteries testing and methodology development • Development of BMS for 2nd-life batteries • Material engineering • Research in recovering processes for the second-life of batteries	Slovakia

Institution	Cooperating participating companies	Financed university chairs	Scope of the Funding/Collaboration	Country
VTT	Fortum, Valmet	---	Detailed scope under consideration	Finland
Zentrum für Sonnenenergie- und Wasserstoff-Forschung (ZSW)	BMW, Manz, Northvolt, MIDAC, SGL	---	• Cell development • Process development • Anode material intelligence / material supply • Material research, advanced characterization; basic electrochemistry in laboratory cells, post-mortem analysis	Germany

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

2.5.1.4. Dissemination and spillovers through the participation of participating companies to clusters

(244) The results of EuBatIn will be disseminated through the clusters to which they are members. These include notably:

- The Batteries Europe Platform is a European open coordination platform for research, innovation and battery applications. Its main objectives are to promote open cooperation and exchange of information, including financing and funding from European, public and private sectors; to develop R&D roadmaps and prepare strategic research and innovation agendas through respective working groups; to promote R&D&I across the battery value chain; and, to keep up to date its members of newest developments, including reaching out towards new market segments, market players and ensuring full EU geographical coverage;

- The European Battery Alliance bringing together over 100 stakeholders sharing similar interest in the furthering the development of a battery industry within the EU. Several groups have been set up with the task to enhancing coordination amongst industry, academia, public and private research centres and recommend policies to the EU bodies, as well as to national governments; and

- The EIT (European Institute of Innovation and Technology) Raw Materials is the largest consortium in the raw materials sector worldwide. Its mission is to enable sustainable competitiveness of the European minerals, metals and materials sector along the value chain by sharing matchmaking activities, developing innovative technologies and supporting business creation. The cluster brings together unites more than 120 core and associate partners and 180+ project partners from leading industry, universities and research institutions from more than 20 EU countries.

(245) Table 6 illustrates the clusters represented in EuBatIn and the participating companies involved. All the clusters are described by each participating company in its respective individual project portfolio.

Battery Cluster	Participating companies
A3PS - Austrian Association for Advanced Propulsion Systems	AVL, Miba
BatteRies Europe Platform	ACIS, Arkema, AVL, ElringKlinger Enel X, ENGITEC, FCA, Ferroglobe Fortum, FPT, GES, Italmatch Manz, Northvolt, Rimac
Battery 2030+	Arkema, ElringKlinger, GES, Manz, MIDAC, Northvolt, Rosendahl
CharIn E.V.	Tesla
Comité stratégique de filière (CSF) industrie des nouveaux systèmes énergétiques	Arkema, Carbon
EERA-JPES (European Energy Research Alliance-Joint Programme Energy Storage)	Manz
EG*VIA*	AVL, BMW, FPT
EIT InnoEnergy	Fortum, MIDAC, Northvolt, Skeleton
EIT Raw Materials	Arkema, Ferroglobe, Fluorsid, Fortum Italmatch, Keliber, Northvolt, Skeleton
EMIRI	ACIS, Carbon, Italmatch
ERTRAC	AVL, BMW
ETIP (European Technologies and Innovation Platforms)	Manz
EUCAR	BMW, FPT
European Battery Alliance	Arkema, BMW, Carbon, ElringKlinger, Enel X, ENGITEC, FCA, Ferroglobe Fluorsid, Fortum, FPT, GES, InoBat Auto InoBat Energy, Keliber, Manz, MIDAC, Northvolt, Rimac, Rosendahl, SGL, Skeleton, Tesla
European Flame Retardants Association	Arkema, Italmatch
Harjavalta Suurteollisuuspuisto industrial park	Fortum
Kompetenznetzwerk Lithium Ionen Batterie	BMW, Cellforce, ElringKlinger, Manz, SGL
Nordic Urban Mobility Ecosystem	Valmet
RS2E Research network on electrochemical energy storage	Arkema, Prayon
Smart Chemistry Park (SCP) in Raisio	Fluorsid, Fortum

Table 6: Representation of clusters in EuBatIn

2.5.1.5. Dissemination and spillovers through publications in scientific journals

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

Journal	Scope
Advances in electrical and electronic engineering	*The Advances in Electrical and Electronic Engineering* is a peer-reviewed periodical scientific journal focusing on electrical and electronic engineering, computer science and information technology, applied mathematics, physics and optics.
Batteries	*Batteries* is an international, open access journal of battery technology and materials, covering all aspects of primary and secondary batteries, including chemical batteries and thermal batteries, etc.
Batteries and Supercaps	*Batteries & Supercaps* is aimed to become a top-ranking journal on all aspects of battery research, from fundamentals to applications, including engineering aspects. It is published on behalf of Chemistry Europe, an association of 16 European chemical societies.
Carbon	The journal *Carbon* is an international multidisciplinary forum for communicating scientific advances in the field of carbon materials, including low-dimensional carbon-based nanostructures.
Chemistry - European Journal	*Chemistry—A European Journal* publishes top quality contributions of original fundamental research and topical reviews in all areas of chemistry. It is published on behalf of Chemistry Europe, an association of 16 European chemical societies.
Electrochemica Acta	*Electrochimica Acta* is an international journal focusing on works in the field of electrochemistry.
Energies	*Energies* is an open access journal of related scientific research, focusing on energy fundamentals, primary and secondary energy sources, energy exploration and use, energy conversion systems etc.

Journal	Scope
International Review of Electrical Engineering	*The International Review of Electrical Engineering (IREE)* is a peer-reviewed journal that publishes original theoretical and applied papers on all aspects of electrical engineering.
Journal of Applied Electrochemistry	*The Journal of Applied Electrochemistry* is the leading journal on technologically orientated aspects of electrochemistry.
Journal of electrical engineering and technology	*Journal of Electrical Engineering & Technology (JEET)* is the official publication of the Korean Institute of Electrical Engineers (KIEE).
Journal of Energy Storage	*The Journal of Energy Storage* focusses on all aspects of energy storage, in particular systems integration, electric grid integration, modelling and analysis, novel energy storage technologies, sizing and management strategies, business models for operation of storage systems and energy storage developments worldwide.
Journal of Power Sources	*Journal of Power Sources* focuses on all aspects of science, technology and applications of sources of electrochemical power, such as primary and secondary batteries, fuel cells, supercapacitors and photo-electrochemical cells.
Journal of the Electrochemical Society	*JES* is the flagship journal of The Electrochemical Society. Published continuously from 1902 to the present, JES remains one of the most highly-cited journals in electrochemistry and solid-state science and technology.
Nature Chemistry	*Nature Chemistry* is a monthly journal dedicated to publishing high-quality papers that describe the most significant and cutting-edge research in all areas of chemistry.
Photonics View	*PhotonicsViews*, the successor of Laser Technik Journal and Optik & Photonik, is a business-to-business magazine that highlights innovations and developments in the fields of optics, photonics, and industrial laser technology.
Solid-state Ionics	This interdisciplinary journal is devoted to the physics, chemistry and materials science of diffusion, mass transport, and reactivity of solids.

Table 7: Representation of scientific journals in EuBatIn

2.5.1.6. Dissemination and spillovers through training events.

(247) The participating companies have committed to organize educational, academic and social dissemination through dedicated training of professional and researchers. The training courses will be offered by EIT Raw Materials, co-funded by EuBatIn stakeholders and developed with the support of partner universities and RTOs. The objective will be to provide hands-on experience to the targeted audience, including training courses on state-of-the-art pilot lines, summer schools, and on-site industry courses. If needed, certification schemes could also be developed with an accredited body.

2.5.1.7. Other dissemination activities

(248) EuBatIn will ensure a close collaboration with the EU funded Coordination and Support Action, Li-ion Cell Pilot Lines Network ("LiPLANET"). The objective of LiPLANET is to create a European innovation and production ecosystem by bringing together the most relevant European Li-ion cell pilot lines and the main stakeholders of the battery sector. The creation of such network will allow exploitation of synergies between pilot line operators all over Europe, improvement of the overall manufacturing quality and product qualification through standardisation, training and a common framework, collaboration with industry and academia, and facilitate the access to market.

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

(249) The participating companies have committed to the dissemination of the IP-protected results. This dissemination will be carried out in different ways. As a matter of principle however, all participating companies will apply fair, reasonable, and non-discriminatory terms ("FRAND").

(250) Indicatively, some examples are presented below.

(251) For ACIS, Endurance, Miba and Rosendahl, the usage of IP-protected and license fees will be fixed in cooperation contracts. The licenses related to the technology developed under EuBatIn will be under FRAND terms to make the results accessible to the whole European battery industry. Furthermore, all RTOs participating in EuBatIn as indirect partners (see recital (286)) can receive the IP-protected results at FRAND terms

(252) As part of the development of Alumina, a large number of IP will emerge, which will, through licensing at FRAND conditions, be spread beyond the battery industry. For example, the corrosion-resistant connection techniques that are necessary for the development of battery systems, are also important for the ceramic industry, for wide applications in the chemical industry and in mechanical engineering.

(253) Through the collaboration with Borealis in different R&D activities that produce IP-protected results, companies can enter into licensing agreements at FRAND conditions and gain from new knowledge and insights developing thus their technologies and processes further. Also, innovative IP-protected material solutions from Borealis as a raw material supplier, will allow its customers to enhance productivity, to use them for process and product innovations and to bring better products to the market themselves.

(254) Cellforce will make the IP-protected results available to the public inside and outside EuBatIn at FRAND conditions. They may also be shared RTOs and universities to further support the development of sustainable technologies and circular economy.

(255) The research results of Energo Aqua will be protected through utility models and patents. It is expected that these results will be more widely used by third parties, such as start-ups, spin-offs, long-term businesses.

(256) ElringKlinger will enable other partners inside and outside EuBatIn to use the generated IP-protected results at FRAND conditions. This could involve e.g. new materials, cell designs or safety features.

(257) InoBat Energy will provide third parties access to knowledge that is protected by IP rights under FRAND conditions. It is expected that this knowledge will lead to the development of patents in certain areas of research. It will further engage research universities to ensure greater knowledge transfer between the public and private sector. By engaging such academic institutions during the process of commercialising the IP-protected results, valuable knowledge and skills will be passed on to students, fostering further innovation in the region. Additionally, InoBat Energy plans to develop a virtual sandbox environment so that researchers, SMEs and other stakeholders can work with available data to improve the state-of-the-art in energy management, after concluding a confidentiality agreement.

(258) Manz will allow other interested companies to access the Manz Open Fab, where they can run experiments using the developed IP-protected software and hardware platform. They can thus adapt Manz solutions to increase the overall effectiveness efficiency ("OEE") and reduce the carbon footprint and energy consumption by implementing Industry 4.0 solutions in their production processes.

(259) Prayon will publish its results through the appropriate channels (patents or i-Depot) and grant licences at FRAND terms with potential European partners.

(260) Rimac's primary goal is to obtain patent rights on the technologies created. It will disseminate the protected knowledge mainly by the conclusion of licensing agreements under FRAND conditions. In the R&D&I phase, Rimac will collaborate with end-users for testing the results of three R&D&I battery systems sub-projects. For each battery system Rimac will collaborate with at least one OEM for testing purposes, which will directly affect the knowledge created through the IP-protected results. Rimac will also consider using or developing/testing an open application programming interface ("API") in relation to the BMS and to participate in the testing of different, as well as of different business models.

(261) Skeleton is committed to license the IP-protected results at FRAND terms to interested parties in Europe. This, among others things will allow companies exploring the latest standards in automation, flexible and scalable production lines and will enable energy storage production in Europe to become less costly.

(262) Solvay will provide interested EU-based companies licenses to specific IP developed during its project and owned exclusively by Solvay. In addition, Solvay will organise visits of the installed equipment and provide RTOs and SMEs with access to the testing lines, enabling them to develop new product applications and designs and to acquire specific skills and knowhow.

(263) SUNLIGHT will contact the European Patent Office in order to apply for suitable patents, which will then be licensed to all interested parties at FRAND terms.

(264) Tesla irrevocably pledges that it will not initiate a lawsuit against any party for infringing its patents through any activity relating to EVs or related equipment for as long as such party is acting in good faith. The covenant not to sue stated within the patent pledge provides a license to parties who are acting in good faith, in compliance with the terms and conditions of the pledge. […]

(265) ZTS's project results will be protected through utility models and patents. These results will be more widely used by third parties, such as start-ups, spin-offs, long-term businesses by way of licenses, under market conditions.

2.5.3. Dissemination and spillover effects in FID

(266) The participating companies will use several ways for disseminating results during the FID. The Member States have provided information showing that the FID activities will lead to spillover effects in downstream markets among the participating companies but also beyond them, involving indirect partners and the society in general.

(267) Some examples are provided below.

(268) The sourcing of Li raw materials by ACIS will be held transparently towards every interested European company. Therefore, ACIS will invite all European companies interested in purchasing Li raw materials through a public announcement with the aim of concluding offtake or similar agreements.

(269) Alumina will work during the FID phase with different suppliers of machines and testing equipment to develop an efficient, highly automated ceramic production technology. Results from this can be used to improve ceramic production lines not included in the battery production as well as other ceramic production processes.

(270) Arkema's CNT production pilot plan will be involved in private and public collaborative projects in order to stay technologically up-to-date and enlarge the partnerships. In particular, Arkema agrees to open its infrastructures (namely the purified CNT and the new electrolyte salt pilot plants), to third parties (i.e., SMEs, RTO and start-ups). A life cycle assessment will be performed on both pilots, whose results will be published and/or given freely

to any RTO that is interested in promoting further collaboration and knowledge on the process of battery manufacturing.

(271) The FID activities of BMW will lead to significant spill-over effects in downstream markets within and outside EuBatIn. EuBatIn will enable downstream markets to develop new product applications and designs and to acquire specific skills and know-how. The BMW's FID results will also spill-over to BMW's worldwide partner network expanding to many EU high-tech industries, businesses and RTOs and will penetrate into other industry sectors, such as stationary energy storage.

(272) Cellforce will cooperate with various suppliers of materials, components, as well as systems and end users during the FID phase. As part of this cooperation, not only high-performance cells but also sustainable production processes and usage concepts will be developed. For this purpose, it will be possible to install novel process steps directly on site and integrate them into the Cellforce's production processes. This means that the FID results can be transferred directly to cell production, whilst the cells from the FID phase will be provided to these partners, which would be interested in improving their own applications, for testing.

(273) In cell housings, a material transition is needed from aluminium to Cu. ElringKlinger will collaborate with suppliers with highly developed process know-how, relating for example to tools and production lines or raw materials, with whom it will share know-how and carry out testing, data gathering and sampling.

(274) FCA will develop its individual project within EuBatIn using significant external support provided by engineering partners, suppliers, as well as RTOs. The partnership scheme includes large, SMEs and academic institutions, which will benefit directly from the collective knowledge developed in the course of the project.

(275) GES will hold open days dedicated to the demonstration of the different processes and the innovative technologies used, offering workshops and guided tours. That way, GES will try not only to attract industry representatives or companies but also reach out to the academia by establishing collaborations with technical high schools and universities.

(276) InoBat Energy will open a data sandbox, where other partners can experiment with new smart electrical muscle simulation technology solutions using real world data systems and API. This can facilitate quicker innovation with industry and the academia.

(277) Manz will create an "Open Fab" that will contribute to creating a strong EU cross-cutting ecosystem, where synergies between RTOs, universities and industries will accelerate the development of next generation batteries.

(278) Northvolt will make advanced Li-ion battery technology available to start-ups and young companies that need access to high-end battery cells for their various products and applications. In practice, this can be done through the supply of smaller numbers of Li-ion cells to companies that need quick access to cells in order to validate or demonstrate own technologies.

(279) Prayon undertakes to share its pilot lines for R&D&I purposes with European RTOs and SMEs beyond its usual partners and beyond EuBatIn. It commits also to give them access to the whole FID toolset and scientific knowledge acquired by the company during the duration of its project. Prayon commits to give them access at FRAND terms to its pilot lines disruptive prototypes upon request and in compliance with the confidentiality rules and environmental specifications. The supply of prototype scale samples of battery materials will benefit other European companies involved in battery manufacturing and battery materials processes designing.

(280) Rimac plans to establish a start-up incubator within the new R&D and FID facilities as open infrastructure for knowledge based, new and promising ventures in the technological area related to battery systems and its application in EV and other related application within the value chain. Start-ups, as well as other interested SMEs getting access to this incubator will benefit from the new technological knowledge created during both R&D and FID phases. Rimac will also create spill-over effect on the downstream market, in the process of procurement of materials and components needed for the project realisation.

(281) SGL will offer promising anode materials developed and prepared in course of its project to RTOs and universities across Europe via material transfer agreements for their research activities.

(282) Skeleton expects FID spillover effects in cooperation with suppliers that will develop relevant know-how in automation and machine-learning know-how in the manufacturing machine supply chain respectively. Over the course of the FID project, the suppliers will gain automation and machine learning know-how specific to ultracapacitors and HBS module production. This know-how will in time extend to other ultracapacitor and module manufacturers.

(283) SUNLIGHT plans to cooperate with many SMEs that will supply products (materials and components) during the FID phase and will contribute to production improvements for battery cells, BMS and Battery Remote Management applications.

(284) Tesla has made commitments to generate spillover effects through the FID stage, providing opportunities for suppliers in the EU to work in close collaboration with the company in particular as regards raw materials and equipment sourcing. Tesla will also initiate partnerships with public labs and invite start-ups to work on innovative products.

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

(285) EuBatIn envisages producing dissemination and spillover effects to other undertakings, organisation and sectors outside EuBatIn, through the involvement of its participating companies in numerous collaborations with over 150 indirect partners, as shown in table 5 under recital (243) and further supplemented below in recitals (288) to (291).

(286) The indirect partners are undertakings and organisations that have not submitted an individual project within EuBatIn. Nevertheless they hold collaboration agreements with one or more participating companies of EuBatIn and they are therefore benefitting from the various dissemination activities.[9]

(287) In addition to the RTOs already listed above in table 5, the participating companies commit to collaborate with several undertakings from the same or different Member State inside or outside EuBatIn.

(288) In WS 1, 11 participating companies will collaborate with 39 indirect partners. The following collaborations are indicative: Arkema (France) will collaborate with […] for the validation of the new electrolyte salt in combination with other salts in […] cells and batteries; Prayon (Belgium) will collaborate with ENEA (Italy) in order to evaluate and optimise the compatibility of new cathode material and develop new manufacturing processes with increased sustainability and reduced costs; and VARTA (Austria) will collaborate with Arlanxeo B.V. (the Netherlands) for the development of next generation binder systems.

(289) In WS 2, 14 participating companies will collaborate with 45 indirect partners. For example: InoBat Auto (Slovakia) will collaborate with A.En (Slovakia) for the use of battery cells in A.En's project; SUNLIGHT (Greece) will collaborate with Saubermacher (Austria) for assessing possibilities to implement recycling capacities at SUNLIGHT's plant; and, Tesla (Germany) will collaborate with Trumpf GmbH (Germany) to develop advanced production equipment for new cells.

(290) In WS 3, 20 participating companies will collaborate with 56 indirect partners. For example: FCA (Italy) will collaborate with Engie SA (France) to develop a BMS compatible with specific 2nd-life applications; SUNLIGHT (Greece) will collaborate with CRES (United Kingdom) for the testing of cells and electronic components to be used for the development of battery unit prototypes; and Manz (Germany and Italy) will collaborate with Ducati Motor Holding S.p.A.

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[9] This category includes also companies or research organisations that participated in setting up EuBatIn and contributed to the drafting of the Chapeau document, namely A.En. Slovensko s.r.o. ("A.En", Slovakia), Ampere Power Energy S.L. ("Ampere", Spain), ENEA Italian National Agency for New Technologies, Energy and Sustainable Economic Development ("ENEA", Italy), Endesa Generacion ("Endesa", Spain), European Lithium Limited ("European Lithium", Austria), Fondazione Bruno Kessler ("FBK", Italy), Suomen Malmijalostus Oy (Finnish Minerals Group "FMG", Finland), Marposs Italia S.p.A.("Marposs", Italy), Saubermacher Dienstleistungs AG ("Saubermacher", Austria) and Simpro S.p.A ("Simpro", Italy). These companies and research organisations remain within the ecosystem created by the Project.

(Italy) for the development of battery modules properly designed to fulfil the end users' requirements.

(291) Finally, in WS 4, 13 participating companies will collaborate with 33 indirect partners. For example, Borealis (Austria) will collaborate with MTM GmbH (Austria) concerning the mechanical recycling of PO-based battery housing; Little (Spain) will collaborate with Endesa (Spain) for the development of methods of effective discharge of EoL batteries aiming for their re-use and 2nd-life applications; and SGL (Germany and Poland) will collaborate with FMG (Finland) for achieving efficient sourcing of natural graphite in order to optimise refining processes and recipes.

(292) Furthermore, EuBatIn will have spillover effects to other industrial sectors. For example, in the sector of smart energy, Manz (Italy), in cooperation with the University of Bologna (Italy) and the Karlsruhe Institute of Technology (Germany) will run a specific activity project to collect all the data relevant to the application of the smart energy strategy on their equipment. Also, InoBat Energy will develop a smart EMS system for its iron-flow battery technology that utilises real-time data streams and predictive AI algorithms to increase efficiency of the system itself and for the end user. This system will further implement smart solutions for autonomous energy policy management.

(293) EuBatIn activities include, in addition to the mobility sector, the lightweight industry (e.g. battery casing of ElringKlinger and innovative materials from Arkema, SGL and others) and e-drives in a wider sense. The latter comprises: i) magnet materials, ii) motor designs, and iii) innovative and integrated designs of efficient drive trains, which are mainly developed by suppliers not directly participating in EuBatIn. The expected increase of the participation of participating companies in the network of EIT Raw Materials (see recital (244)) (Arkema, Ferroglobe, Fluorsid, Fortum, Italmatch, Keliber, Northvolt and Skeleton are already active in the network) due to battery value chain knowledge, will potentially achieve the best overall and best performing solution for future automotive applications.

(294) Further, the stationary energy sector constitutes a key sector within EuBatIn. This sector develops material synergies in terms of "greening" other industries (e.g. energy sector, production sector etc.), particularly those causing the most stress on the grid. Therefore, the large-scale long duration of some of the battery technologies developed in EuBatIn (e.g., InoBat Energy's iron flow battery system, GES's RFB or the CO_2-optimized battery cells from Tesla, Cellforce or Northvolt) will be optimized to achieve the ambitious sustainability targets (see recitals (343) to (345)).

(295) Further, the participating companies in EuBatIn commit to invest on the support and construction of charging infrastructure. This is a major issue in terms of market success of electric mobility, due to its limited driving ranges and it will help accelerate the infrastructure deployment for a European charging network. The development and improvement of ESS though EuBatIn will also provide for sufficient energy necessary for the fulfillment of the fast charging, hence it will improve indirectly the applicability of this infrastructure.

(296) The recycling processes developed over the course of EuBatIn aim at the recovery of suitable metals from LIBs. However, several other metals are included in batteries in minor quantities which can be used elsewhere. Hydrometal for example, expects that the developed recycling processes will have spillover effects on other sectors (e.g. construction sector or chemical production sector) in metal separation/recovery for Co, Mn and Li from other materials than black mass.

(297) Borealis is willing to facilitate use of the developed technologies in other sectors than e-mobility. It will carry out feasibility studies and implement strategies to employ these technologies to various other industries requiring innovative energy storage solutions. This applies to all the different applications in the field of e-mobility, such as cars, busses, e-bikes, drones or forklifts. For example, through e-forklifts, manufacturing companies can rearrange in-house transport towards higher sustainability. Also, drones powered by Li-ion batteries are predicted to be used increasingly for various industrial and logistic purposes. Moreover, innovative solutions from Borealis could be used in different applications such as uninterruptible power supply ("UPS"), telecom, medical, power tools etc.

(298) Northvolt commits to support the development of innovative battery applications in non-automotive sectors, such as marine, ESS, mining, agriculture, etc. This support takes the form of cell supply and battery system development, as well as custom cell technology development for specific purposes and applications.

(299) Italmatch commits to cross-fertilize other industrial sectors, such as pharmaceuticals and advanced agro-chemistry, by offering the developed innovative charging/discharging supply technology.

(300) Tesla will contribute to accelerating the sustainable transition beyond the mobility sector, including the sustainable energy and construction industry and the transport safety community.

(301) The participation of Rimac in EuBatIn is expected to have an impact on increasing the country productivity level via the indirect involvement of other Croatian companies in relevant technologies and innovation value chains.

(302) Lastly, EuBatIn foresees an increased collaboration with end users (both during the R&D&I and FID phases) with the aim to enhance exponentially the spillover effects of EuBatIn, also to sectors outside the targeted ones. The dissemination activities to other sectors/end users include showcases in brochures, presentations, promotion videos and fairs. An example of such showcasing and dissemination activities is the Borealis own innovation show rooms, which is open to scientific community and the academia, as well as to the general public at special events. This room consists of many exhibition pieces, such as bumpers, dashboards, high voltage cables from energy business, white goods (e.g. dishwasher), medical equipment etc. Other examples of such collaborations include Northvolt, which will establish collaborations with customers, in industrial, ESS, marine, mining and other sectors; and Alumina which will collaborate with potential end users in sectors such as power electronics, home storage and wind parks.

2.6. Description of the aid measures

2.6.1. Selection of the participating companies in EuBatIn

(303) The notifying Member States have submitted information about the following national procedures that have taken place for the selection of EuBatIn participants:

- In Austria, the IPCEI application process has been based on an open and transparent call for interested parties organised by the Austrian National Battery Initiative. The latter was set up also through an open process. Nine applications were submitted, three were eventually withdrawn and six remained as participating companies to EuBatIn.

- In February 2019, Belgium published an open and transparent call for all the Battery IPCEI projects. This resulted in the selection of one RTO and eight companies. Three applications were submitted, one was eventually withdrawn and two remained as participating companies to EuBatIn.

- In Croatia, the IPCEI selection process has been based on two continuous open and non-discriminatory phases. The first consisted of an interactive bottom-up non-discriminatory process of all the potential participants, whilst the second included the selection of one company.

- In Finland, there is a continuous open call principle complemented by specific programs and campaigns on emerging topics, such as a national state-of–the-art battery ecosystem organised by the Finnish governmental organization "Business Finland" under an open non-discriminatory campaign in 2018, "Batteries from Finland". Both the first IPCEI on Batteries and EuBatIn were communicated to interested participants in an open and non-discriminatory manner in the context of various meetings and workshops organised by Business Finland (on 28 March 2019, 15 May 2019 and 25 May 2019). Based on this process, four companies were pre-selected for assessment, on was withdrawn and at the end, three companies were selected as participating companies to EuBatIn.

- France has launched an open and transparent call for expression of interest on 9 January 2019, followed by the selection of two participants for EuBatIn.

- In February 2019, Germany launched an open and transparent call for IPCEI projects in the batteries field. After a detailed and independent assessment of 41 project proposals, 11 companies were selected to join EuBatIn.

- In July 2019, Greece launched an open and transparent call for expression of interest resulting in the selection of one company to participate in EuBatIn.

- In Italy, the IPCEI application process is based on a continuous open call principle complemented by specific information campaigns, which started in January 2019 with a publication of a request for expression of interest. In addition, an information event and a workshop were held over the period July to September 2019 with the aim of informing all interested parties of the IPCEI process. The pre-selection phase involved 24 companies and two RTOs. Finally, 12 companies were selected as participating companies to EuBatIn.

- Poland has launched an open and transparent call for projects on 16 April 2019. By the deadline of 10 May 2019, 17 applications had been submitted. In the end four projects proposals were selected as participating companies under the IPCEI mechanism, one of which is participating in EuBatIn.

- In May 2019, Slovakia established a working group to support the development of industrial battery production. This group consisted of representatives of the Slovakian government, the automotive sector, the business and scientific community, and the European Investment Bank. Following an invitation for expression of interest to the members of the working group, five companies expressed an interest to participate in EuBatIn. After the withdrawal of one company, four companies remained as participating companies to EuBatIn.

- In June and July 2019 Spain launched two open and transparent calls of interest to participate in EuBatIn. Ten companies applied to the call. Following the withdrawal of eight companies, two companies remained as participating companies to EuBatIn.

- In Sweden, the IPCEI process in the batteries field was communicated to interested participants in an open and non-discriminatory manner in the context of two conferences held in November 2018 and March 2019. This resulted in the selection of one company to participate in EuBatIn.

2.6.2. Total eligible costs in EuBatIn

(304) The notifying Member States authorities indicate that the activities performed during EuBatIn qualify as R&D&I and FID in the meaning of points 21 and 22 of the IPCEI Communication.

(305) They also submit that the total EuBatIn eligible costs[10] are approximatively EUR 5.4 billion, out of which EUR 3.9 billion for FID and EUR 1.5 billion for R&D&I:

WS	R&D&I												Sum
	Austria	Belgium	Croatia	Finland	France	Germany	Greece	Italy	Poland	Slovakia	Spain	Sweden	
WS 1	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]
WS 2	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]
WS 3	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]
WS 4	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]
SUM	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	1.563.459
WS	FID												Sum
	Austria	Belgium	Croatia	Finland	France	Germany	Greece	Italy	Poland	Slovakia	Spain	Sweden	
WS 1	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]
WS 2	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]
WS 3	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]
WS 4	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]
Sum	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	3.863.277
Sum total	[150.000 - 200.000]	[100.000-150.000]	[100.000-150.000]	[10.000 - 20.000]	[100.000 - 150.000]	[3.500.000 - 4.000.000]	[100.000 - 150.000]	[750.000 800.000]	20.000 – 30.000]	[150.000 – 200.000]	[10.000 -20.000]	[80.000 90.000]	5.426.737

Table 8: Total eligible costs per WS, per type of activity, per Member State, in 1 000 EUR

2.6.3. Aid amounts per participating company and chronology of funding per Member State

(306) The Member States have submitted the amounts of State aid under the measures that will be provided to the participating companies[11], together with the individual eligible costs and funding gaps:

Company	**Eligible costs**			**Funding Gap**	**State aid nominal amount**
	R&D&I	**FID**	**Total**		
AVL	*[…]*	*[…]*	[15.000 - 25.000]	[-5.000 – -10.000]	[5.000 – 10.000]
Borealis	*[…]*	*[…]*	[15.000 – 25.000]	[-5.000 – -10.000]	[5.000 – 10.000]

[10] Eligible costs are only those costs of the individual projects, which comply with the requirements of the Annex to the IPCEI Communication. They, however, do not represent all costs required to conduct the R&D&I and FID activities concerned. The remaining portion of the costs required to conduct those activities, which are not considered eligible for public financing, will be absorbed by the Participating companies.

[11] The aid is capped in nominal terms by the eligible costs. Member States will also ensure that the discounted value of the aid for each participating company (using the relevant weighted average cost of capital ("WACC") as the discount factor) will not exceed the notified funding gaps. The amounts shown under the funding gap column are expressed in net present value terms ("NPV") while the amounts in all other columns are expressed in nominal terms.

Miba	*[…]*	*[…]*	[10.000 – 20.000]	[-5.000 – -10.000]	[5000 – 10.000]
Rosendahl	*[…]*	*[…]*	[40.000 – 50.000]	[-10.000 – -20.000]	[10.000 – 20.000]
Varta	*[…]*	*[…]*	[20.000 – 30.000]	[-10.000 – -20.000]	[10.000 – 20.000]
Voltlabor	*[…]*	*[…]*	[20.000 – 30.000]	[-5.000 – -10.000]	[5.000 – 10.000]
Sum	*[…]*	*[…]*	153.054	[-50.000 – -60.000]	[50.000 – 60.000]

Table 9: Austria – State aid in 1 000 EUR

Company	**Eligible costs**			**Funding Gap**	**State aid nominal amount**
	R&D&I	**FID**	**Total**		
Hydrometal	*[…]*	*[…]*	[20.000 - 30.000]	[-5.000 – -10.000]	[5.000 – 10.000]
Prayon	*[…]*	*[…]*	[100.000 – 150.000]	[-50.000 – -60.000]	[30.000 – 40.000]
Sum	*[…]*	*[…]*	143.856	[-50.000 – -60.000]	[40.000 – 50.000]

Table 10: Belgium – State aid in 1 000 EUR

Company	**Eligible costs**			**Funding Gap**	**State aid nominal amount**
	R&D&I	**FID**	**Total**		
Rimac	*[…]*	*[…]*	[100.000 - 150.000]	[-100.000 – -150.000]	[100.000 – 150.000]
Sum	*[…]*	*[…]*	[100.000 - 150.000]	[-100.000 – -150.000]	[100.000 – 150.000]

Table 11: Croatia – State aid in 1 000 EUR

Company	Eligible costs			Funding Gap	State aid nominal amount
	R&D&I	FID	Total		
Fortum	*[…]*	*[…]*	[1.000 – 5.000]	[-5.000 – -10.000]	[1.000 – 5.000]
Keliber	*[…]*	*[…]*	[1.000 – 5.000]	[-1.000 – -5.000]	[1.000 – 5.000]
Valmet	*[…]*	*[…]*	[10.000 – 20.000]	[-10.000 – -20.000]	[10.000 – 20.000]
Sum	*[…]*	*[…]*	19.892	[-15.000 – -25.000]	[10.000 – 20.000]

Table 12: Finland – State aid in 1 000 EUR

Company	Eligible costs			Funding Gap	State aid nominal amount
	R&D&I	FID	Total		
Arkema	*[…]*	*[…]*	[80.000 - 100.000]	[-60.000 – - 80.000]	[80.000 – 100.000]
Carbon	*[…]*	*[…]*	[20.000 – 40.000]	[-10.000 – -30.000]	[20.000 – 40.000]
Sum	*[…]*	*[…]*	106.239	[-70.000 – -90.000]	[100.000 – 150.000]

Table 13: France – State aid in 1 000 EUR

Company	Eligible costs			Funding Gap	State aid nominal amount
	R&D&I	FID	Total		
ACIS	*[…]*	*[…]*	[10.000 - 20.000]	[-10.000 – -20.000]	[10.000 – 20.000]
Alumina	*[…]*	*[…]*	[30.000 – 40.000]	[-5.000 – -10.000]	[5.000 – 10.000]
BMW	*[…]*	*[…]*	[100.000 – 150.000]	[-70.000 – -80.000]	[60.000 – 70.000]

Cellforce	*[…]*	*[…]*	[100.000 – 150.000]	[-100.000 – -150.000]	[60.000 – 70.000]
ErlingKlinger	*[…]*	*[…]*	[60.000 – 70.000]	[-50.000 – -60.000]	30.000 – 40.000]
Liofit	*[…]*	*[…]*	[5.000 – 10.000]	[-1.000 – -5.000]	[1.000 – 5.000]
Manz	*[…]*	*[…]*	[90.000 – 100.000]	[-50.000 – -60.000]	[70.000 – 80.000]
Northvolt	*[…]*	*[…]*	[650.000 – 700.000]	[-100.000 – -150.000]	[150.000 – 200.000]
SGL	*[…]*	*[…]*	[40.000 – 50.000]	[-30.000 – -40.000]	[40.000 – 50.000]
Skeleton	*[…]*	*[…]*	[100.000 – 150.000]	[-40.000 – -50.000]	[50.000 – 60.000]
Tesla	*[…]*	*[…]*	[2.000.0000 – 2.500.000]	[-900.000 – -950.000]	[1.000.000 – 1.500.000]
Sum	*[…]*	*[…]*	3.693.546	[-1.000.000 – -1.500.000]	[1.500.000 – 2.000.000]

Table 14: Germany – State aid in 1 000 EUR

Company	**Eligible costs**			**Funding Gap**	**State aid nominal amount**
	R&D&I	**FID**	**Total**		
SUNLIGHT	*[…]*	*[…]*	[100.000 - 150.000]	[-50.000 – -60.000]	[40.000 – 50.000]
Sum	*[…]*	*[…]*	[100.000 - 150.000]	[-50.000 – -60.000]	[40.000 – 50.000]

Table 15: Greece – State aid in 1 000 EUR

Company	**Eligible costs**			**Funding Gap**	**State aid nominal amount**
	R&D&I	**FID**	**Total**		
Endurance	*[…]*	*[…]*	[5.000 - 10.000]	[-5000 – -10.000]	[5.000 - 10.000]
Enel X	*[…]*	*[…]*	[10.000 –	[-5.000 –	[5.000 –

			20.000]	-10.000]	10.000]
ENGITECH	*[…]*	*[…]*	[10.000 – 20.000]	[-5.000 – -10.000]	[5.000 – 10.000]
FCA	*[…]*	*[…]*	[300.000 – 350.000]	[-200.000 – -250.000]	[250.000 – 300.000]
FIAMM	*[…]*	*[…]*	[50.000 – 60.000]	[-10.000 – -20.000]	[10.000 – 20.000]
Fluorsid	*[…]*	*[…]*	[20.000 – 30.000]	[-30.000 – -40.000]	[20.000 – 30.000]
FPT	*[…]*	*[…]*	[20.000 – 30.000]	[-10.000 – -20.000]	[10.000 – 20.000]
GES	*[…]*	*[…]*	[60.000 – 70.000]	[-40.000 – -50.000]	[60.000 – 70.000]
Italmatch	*[…]*	*[…]*	[10.000 – 20.000]	[-10.000 – -20.000]	[10.000 – 20.000]
Manz	*[…]*	*[…]*	[70.000 – 80.000]	[-50.000 – -60.000]	[50.000 – 60.000]
MIDAC	*[…]*	*[…]*	[60.000 – 70.000]	[-40.000 – -50.000]	[50.000 – 60.000]
Solvay	*[…]*	*[…]*	[60.000 – 70.000]	[-20.000 – -30.000]	[40.000 – 50.000]
Sum	*[…]*	*[…]*	771.554	[-500.000 – -550.000]	[600.000 – 650.000]

Table 16: Italy – State aid in 1 000 EUR

Company	**Eligible costs**			**Funding Gap**	**State aid nominal amount**
	R&D&I	**FID**	**Total**		
SGL	*[…]*	*[…]*	[20.000 - 30.000]	[-20.000 – -30.000]	[20.000 – 30.000]
Sum	*[…]*	*[…]*	[20.000 - 30.000]	[-20.000 – -30.000]	[20.000 – 30.000]

Table 17: Poland – State aid in 1 000 EUR

Company	Eligible costs			Funding Gap	State aid nominal amount
	R&D&I	FID	Total		
Energo Aqua	[…]	[…]	[40.000 - 50.000]	[-30.000 – -40.000]	[30.000 – 40.000]
InoBat Auto	[…]	[…]	[40.000 - 50.000]	[-30.000 – -40.000]	[30.000 – 40.000]
InoBat Energy	[…]	[…]	[30.000 – 40.000]	[-20.000 – -30.000]	[20.000 – 30.000]
ZTS VaV	[…]	[…]	[30.000 – 40.000]	[-20.000 – -30.000]	[20.000 – 30.000]
Sum	[…]	[…]	158.303	[-100.000 – -150.000]	[100.000 – 150.000]

Table 18: Slovakia – State aid in 1 000 EUR

Company	Eligible costs			Funding Gap	State aid nominal amount
	R&D&I	FID	Total		
Ferroglobe	[…]	[…]	[5.000 - 10.000]	[-10.000 – -20.000]	[1.000 – 5.000]
Little	[…]	[…]	[1.000 – 5.000]	[-1.000 – -5.000]	[1.000 – 5.000]
Sum	[…]	[…]	[10.000 – 20.000]	[-10.000 – -20.000]	[1.000 – 5.000]

Table 19: Spain– State aid in 1 000 EUR

Company	Eligible costs			Funding Gap	State aid nominal amount
	R&D&I	FID	Total		
Northvolt	[…]	[…]	[80.000 - 90.000]	[-40.000 – -50.000]	[50.000 – 60.000]
Sum	[…]	[…]	[80.000 -	[-40.000 –	[50.000 –

			90.000]	-50.000]	60.000]

Table 20: Sweden – State aid in 1 000 EUR

(307) The Member States submit that the durations of the individual projects of the participating companies differ. The funding period (i.e. the period during which the costs, which the companies can claim to be eligible, should be incurred) is the following, per WS:

WS	Starting date[12]	End date
WS 1	This WS starts at the earliest in 2019.	The last eligible year during the FID phase is at the latest 2028.
WS 2	This WS starts at the earliest in 2020.	The last eligible year during the FID phase is at the latest 2028.
WS 3	This WS starts at the earliest in 2019.	The last eligible year during the FID phase is at the latest 2028.
WS 4	This WS starts at the earliest in 2020.	The last eligible year during the FID phase is at the latest 2028.

Table 21: EuBatIn funding period

2.6.4. The aid instruments

(308) The aid to be granted by all the participating Member States will predominantly take the form of direct grants. In the case of Hydrometal and Prayon, Belgium has decided to provide direct grants for the R&D&I activities of the companies and mainly repayable advances for the FID activities.

2.7. Granting of the aid under the notified measures

(309) All the participating Member States have subjected the effective implementation of State aid to the prior approval of the Commission.

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

(311) They have further confirmed that the participating companies are not undertakings in difficulty.

(312) Finally, the participating Member States have indicated that cumulation with other aid, de minimis aid, or EU funding will be allowed to cover the same

[12] EuBatIn funding period begins with the start of the works. Some participating companies have already started, at their own risk, their works in 2019, whereas others in 2020.

eligible costs, as long as the total funding will not exceed the aid amount which is declared compatible with the internal market under this decision.

2.8. Transparency

(313) The Member States have in their notification committed to respect the transparency and publication requirements of points 45 and 46 of the IPCEI Communication.

2.9. Claw-back mechanism

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

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

(316) The claw-back mechanism will apply at minimum to participating companies having a notified aid amount, per Member State, above EUR 50 million[13].

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

3. ASSESSMENT OF THE MEASURES

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

(318) According to Article 107(1) TFEU, "any aid granted by a Member State or through State resources in any form whatsoever which distorts or threatens to distort competition by favouring certain undertakings or the production of certain goods shall, in so far as it affects trade between Member States, be incompatible with the internal market".

(319) In order to qualify as State aid under Article 107(1) TFEU, the following cumulative conditions must be met: (i) the measure must be imputable to the State and financed through State resources; (ii) it must confer an advantage on its recipient; (iii) that advantage must be selective; and (iv) the measure must

[13] This threshold ensures that all the larger and more complex projects will be subjected to the mechanism and avoids imposing burdensome administrative requirements on the relatively smaller and less complex projects. Member States are free to introduce stricter conditions. In this regard, ACIS in Germany and Northvolt in Sweden will be subject to a claw-back mechanism, although the respective notified aid amounts are less that EUR 50 million.

distort or threaten to distort competition and affect trade between Member States.

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

(321) The aid measures in the form of direct grants (and repayable advances in the case of Hydrometal and Prayon) granted to the participating companies will relieve them from costs that they would have had to bear themselves. By contributing to the financing of their R&D&I and FID activities with funds that would not have been available under normal market conditions, the aid measures confer to the aid beneficiaries an economic advantage over their competitors. These measures are granted only to the aid beneficiaries listed in section 2.2.7 and the funding is not available to all undertakings in a comparable situation. The aid measures are therefore selective.

(322) The aid beneficiaries involved in the relevant WS described above in section 2.2, operate in different sectors along the battery value chain, for example automotive and automotive components, battery design and battery engineering, battery systems, BMS, carbon and graphite materials, cell manufacturing, ceramic, chemical, e-mobility, electric sports automotive, electronics, energy, energy and infrastructure, energy storage, metals, minerals, phosphate, photovoltaics, refining, recycling, water energy and waste solutions. These are economic sectors open to intra-EU trade (both in terms of supply and demand). Therefore, the measures may affect trade between Member States.

(323) By reinforcing the aid beneficiaries' position in their respective sectors, the measures are therefore liable to distort competition by conferring beneficiaries a selective advantage as compared to their competitors.

(324) In the light of the foregoing, the Commission considers that the public resources granted to the aid beneficiaries in the form of direct grants (and repayable advances in the case of Hydrometal and Prayon) for the R&D&I and FID activities as described within the framework of EuBatIn qualify as State aid within the meaning of Article 107(1) TFEU.

3.2. Legality of the aid measures

(325) By notifying the measures before putting them into effect, the Member States have fulfilled their obligations under Article 108(3) TFEU.

3.3. Assessment of the aid measures

3.3.1. Applicable legal basis for assessment

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

(327) According to Article 107(3)(b) TFEU, aid to promote the execution of an important project of common European interest may be considered to be compatible with the internal market.

(328) In the IPCEI Communication, the Commission has provided guidance on the analysis of the compatibility with the internal market of State aid to promote the execution of important projects of common European interest. The criteria set out in the IPCEI Communication are applicable to this case.

(329) As Article 107(3)(b) TFEU allows the Commission to consider as compatible with the internal market aid to promote the execution of an important project of common European interest, it is appropriate to consider first whether the notified measures relate to such a project. These general eligibility criteria are assessed in section 3.3.2. 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 3.3.3.

3.3.2. Eligibility criteria

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

3.3.2.1. Definition of a project

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

(332) The participating Member States, as explained above in section 2.4, consider the notified EuBatIn to constitute an integrated project. The Commission shares this analysis for the reasons explained below.

(333) The Commission finds that EuBatIn is designed in such a way as to contribute to a common objective, formulated by the participating Member States and companies, as described in section 2.1. As mentioned therein, the main aim of EuBatIn is to develop an innovative and sustainable battery value chain in the EU that goes substantially beyond the state-of-the-art and which brings together companies operating at different levels of the battery value chain. This aim is planned to be achieved by subjecting all 46 individual projects in a common programme aiming at the same objective.

(334) The R&D&I and FID activities of the individual projects are combined in coherent systemic approach in four WS, which constitute the individual but interlinked components of EuBatIn. Within these four WS, EuBatIn distinguishes six stages of the value chain (see recital (200)).

(335) The organisation and work plan of the four WS is divided in different tasks, each of which consisting of different components during both the R&D&I and the FID phases (see sections 2.4.1.1 to 2.4.1.4).

(336) As described in section 2.4 above, each individual project is necessary and complementary to the other projects for the achievement of the overall EuBatIn's objectives. In particular, the Commission notes that:

- The different individual projects in WS 1 constitute the building blocks of the battery value chain supplying new generation of cathode and anode active materials (including ASSB, SIB, as well as innovative materials for RFB), binders, electrolytes, separators and battery housings. In addition, WS 1 covers the material part of cell component manufacturing, which is to be fully developed under WS 2. They are thus necessary for WS 2, as well as for the development of battery systems under WS 3. In addition, WS 1 encompasses both advanced materials and novel precursors and raw materials, so that one part of the projects within WS 1 constitutes input for the other part;

- The different individual projects in WS 2 will deliver next generations of LIBs satisfying the performance and sustainability characteristics for mobility and industrial/consumer applications, as well as RFB and ultracapacitors for mobility and stationary energy storage applications. They are complementary with each other in providing cells in different formats and specifications. They set the level of ambition for WS 1, supplementing it also with the mechanical part of cell component manufacturing. They further constitute an input to both WS 3 and WS 4, given that the improved recyclability and improved life cycle of the batteries require interaction and collaboration between the WS;

- In WS 3 the participating companies will develop innovative battery systems that are based on the innovative cells produced in WS 2. The latter will also benefit from the results of WS 3 and the development of innovative battery designs in order to optimise the battery cells. The interactions between WS 3 and WS 2 will in addition impact the research to be carried out and the results to be achieved in WS 1, leading to an improvement of material characterisation and development.

- WS 4 is key to deliver on the sustainability objective of EuBatIn. Introducing a circular economy logic into the battery value chain is only possible if there is close interaction between WS 1 and WS 4. This cooperation is needed in order to track, collect and dismantle LIBs, post-LIBs, HBS and ultracapacitors, until recovering of relevant metals, monitor their EoL status, refine them to battery grade and re-use them for other 2nd-life applications. Cooperation and interaction between WS 2, WS 3 and WS 4 is further needed to develop cells and modules that can more easily be recycled with a higher efficiency and re-examined in terms of any modifications in their chemistry and structure that would also lead to changes of existing recycling processes and waste management systems. Within WS 4, the different participants are also complementary to each other as together they cover the full recovery chain (i.e. safe transport, collection, dismantling, sorting, pre-treatment, recycling and refining).

(337) In addition, and as described in detail in section 2.4 above, the Commission observes that the individual projects of the participating companies and the four WS are inserted in a common structure and programme having the same

objective and based on a coherent systemic approach. This approach aims at an innovative and sustainable battery value chain in the EU that goes substantially beyond the state-of-the-art and brings together companies operating at different levels of the battery value chain to push innovation and sustainability across the entire value chain and for a large range of applications. In addition, the various WS have common objectives, as well as tasks and deliverables for the R&D&I and the FID phases. The actions required in all the tasks included within the organisation and work plan of the four WS are considered necessary to achieve the overall objectives of EuBatIn. As already highlighted in recital (336), the four WS and the actions needed to perform the respective tasks, constitute distinct and consecutive stages of value creation along the battery value chain. They each require very specific R&D&I and FID activities along the value chain, which also constitute inputs to the next level of the chain and introduce circularity.

(338) Further, in order to ensure the coherent implementation of EuBatIn, the participating Member States will establish a common governance structure, as described in section 2.3, under a SB, which will have the task to review the progress and the results of EuBatIn and propose changes if necessary, giving specific attention to the benefit for the European society. The Commission will be represented in the SB as an observer.

(339) Therefore, in view of the above, the Commission concludes that the notified EuBatIn qualifies as an integrated project in the meaning of the IPCEI Communication, as its individual projects and WS are inserted in a common structure and program, and aim at the same objective, being necessary and complementary for the achievement of the important common European objective.

3.3.2.2. Common European Interest

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

a) General cumulative criteria

<u>Important contribution to the Union's objectives</u>

(341) According to point 14 of the IPCEI Communication, the project must contribute in a concrete, clear and identifiable manner to one or more Union objectives and must have a significant impact on the competitiveness of the Union, sustainable growth, addressing societal challenges or value creation across the Union.

(342) According to point 15 of the IPCEI Communication, the project must represent an important contribution to the Union's objectives, for instance by being of major importance for one of the strategies or policies listed, which explicitly include, the Union's flagship initiatives such as the Innovation Union European strategy, the 2030 framework for climate and energy policies, the Energy

Strategy for Europe and the Integrated Industrial Policy for the Globalisation Era.

(343) The Commission notes the important role that the battery industry has to play in reaching the decarbonisation targets of the EU. The Commission's 2030 Climate target plan 2030[14] presents an EU-wide, economy-wide greenhouse gas emissions reduction target by 2030 compared to 1990 of at least 55%, a target endorsed by the European Council in December 2020.[15] Further, the Commission has proposed a communication presenting its long-term vision for a climate-neutral economy by 2050.[16] Electrification of the economy, associated with the deployment of renewable sources of electricity and including the deployment of e-mobility, is set to be one of the main technological pathways to reach carbon neutrality.

(344) The above supplements the Commission's Communication that sets out a *European Green Deal* for the EU and its citizens.[17] The aim is to transform the EU into a climate-neutral society, where there will be no net emissions of greenhouse gases by 2050 and where economic growth is decoupled from resource use.[18]

(345) In the same context, in its Communication on *Europe on the Move*, the Commission states: "Batteries production and development is a strategic imperative for Europe in the context of the clean energy transition".[19] The report on the implementation of the Strategic Action Plan on Batteries ("*the 2019 SAPB Report*") was adopted following consultation of and close cooperation with the "European Battery Alliance"[20] launched in October 2017

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[14] 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.

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

[16] 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.

[17] 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.

[18] 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.

[19] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - *Europe on the move – Sustainable mobility for Europe: safe, connected and clean*, COM(2018) 293 final, 17.5.2018. See also Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *Sustainable and Smart Mobility Strategy – putting European transport on track for the future*, COM(2020) 789 final, 9.12.2020.

[20] https://ec.europa.eu/growth/industry/policy/european-battery-alliance_en

with key industrial stakeholders, interested EU Member States and the European Investment Bank. The *2019 SAPB Report* states that "Europe is forecast to develop a capacity of 207 GWh by 2023, while European demand for electric vehicle batteries alone would be around 400 GWh by 2028"[21].

(346) In the *2019 SAPB Report*, the Commission moreover observes that batteries will be one of the key enablers for a transition to a low carbon economy given the important role they play in stabilizing the power grid and in the roll-out of clean mobility. The Commission also stresses that Europe shall move fast in reaping the benefits of its technological and industrial excellence and seize the opportunities arising along the entire batteries value chain. The Commission therefore, shall work together with the Member States and key European companies "[…] to build a competitive, sustainable and innovative battery ecosystem in Europe, covering the entire value chain".[22]

(347) The Commission considers that EuBatIn will contribute to fulfilling the objectives laid down in the *European Green Deal* Communication, the *Europe on the move* Communication and the *Clean Planet for All* Communication and noted by the *2019 SAPB Report,* by:

- Bringing together in an integrated project 42 participating companies from 12 EU Member States, with more than 150 indirect partners;

- Covering the entire value chain with sustainable battery cells, modules and systems at its core;

- Focusing on sustainability, both through the implementation of sustainable materials sourcing approaches, as well as by significantly improve the CO_2 footprint of battery cell production, as well as ensure consequent battery recycling. The circular material flow will also be optimised through the integration of new and more efficient Industry 4.0 strategies, allowing for cost efficient 2nd-life applications, while maintaining high environmental and social standards;

- Increasing the development and strengthening of the battery value chain within Europe through the exploitation of battery-related mining sources in the EU and/or through securing sources under the highest ethical and social standards, ensuring at the same time cost effective and efficient repurposing and recycling targets;

- Helping to develop next-generation battery cells, modules and systems within the EU, aiming to serve the needs of the mobility,

[21] Report from the Commission to the to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank, *on the Implementation of the Strategic Action Plan on Batteries: Building a Strategic Battery Value Chain in Europe*, COM(2019) 176 final, 9.4.2019.

[22] Report from the Commission to the to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank, *on the Implementation of the Strategic Action Plan on Batteries: Building a Strategic Battery Value Chain in Europe*, COM(2019) 176 final, 9.4.2019.

industrial/consumer and stationary energy storage sectors, contributing thus to a successful decarbonisation of the economy; and

- Contributing decisively to the proliferation of battery-based grid-connected energy storage, accommodating higher shares of renewable energy in the electricity grids, by directly addressing challenges of batteries for stationary energy storage applications.

(348) It is expected that though EuBatIn the carbon footprint of the cells produced will be significantly reduced as compared to the current global state-of-the-art of 60–150kg CO_2/kWh. Recycling processes will be piloted which will make it possible to close the material loop and re-use the critical raw materials within the EU. The lifetime of battery systems is expected to improve by 30% to 100% for high power profiles through the implementation of hybrid concepts. Also, more efficient and safe recycling processes will be developed that can recover up to 90 % off all raw materials on the material level and up to 75% on battery module level, compared to the state-of-the-art of approximately 50–60% recycling quota. EoL batteries will further be efficiently diagnosed for their viability and re-use in applications where the battery performance is suitable. Lastly, the consumption of process water for the production of Li raw materials (e.g. Li hydroxide monohydrate) from brines will be avoided, so that precious water resources could be spared.

(349) EuBatIn 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.[23] The SET Plan was revised in 2015 to help realise the research and innovation priorities of the Energy Union, particularly in relation to the development of low-carbon technologies. EuBatIn, through the setting up of an entire value chain for cells, modules and battery systems, will contribute to the development of all broad application domains and will allow EU advance on the agreed priorities. In particular, it is expected that EuBatIn due to the specific research activities will materially contribute in the field of stationary energy storage with the development of innovative cell technologies focusing on RFB or LFP/LTO batteries.

(350) Overall, in addition to the expected results mentioned in recital (348), EuBatIn aims to achieve the following:

- The use of critical resources such as Co, natural graphite, Li and Ni will be reduced by making more effective use of each battery cell during and after its lifetime, specifically through hybridisation with other energy storage technologies, such as ultracapacitors. Moreover, the development of alternative cathode materials (including Na-ion), which use less than 10% Co will ultimately lead to the usage of cathode materials with no critical resources, such as Co;

- Furthermore, EoL batteries will be collected and transported safely and efficiently; they will be re-used in 2nd-life applications without

[23] 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.

unnecessary transportations; and they will be recycled in an automated process line providing low CO_2 footprint material for further refining process; and

- As far as the cell housings is concerned, it is expected that EuBatIn will reduce the greenhouse gas emissions by around 40%.

(351) The Commission further notes that EuBatIn will also contribute to the *Innovation Union European Strategy,* the *EU Renewed Agenda for Research and Innovation*[24]and the *new ERA for Research and Innovation*[25]. In this context, EuBatIn will:

- Host R&D activities for innovative and sustainable battery materials, cells and systems for automotive and other key applications to unlock the full technological potential of the battery value chain in Europe;

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

- Support the training of highly skilled staff; and

- Help coordinate battery-related activities across Europe in order to create an integrated EU battery ecosystem, thus redeeming the goals of the European Battery Alliance and delivering on the ambition of EuBatIn.

(352) It is further expected that EuBatIn will trigger R&D&I investments by the participating companies of up to around 5.1 billion euros, according to estimates provided by the Member States. It will carry out 67 FID activities, and the participating companies will directly target piloting their R&D&I results in 37 newly set-up pilot lines. Also, over 200 new collaborations between the participating companies and indirect partners and a total number of over 500 collaborations will be created, which would not have been realised without EuBatIn (see table 23 in recital (379)). The dissemination of results will be realised by more than projected 500 publications, and over 177 young scientific talents will be aided, as well as additional educational training for technical workers will be offered.

(353) The Commission considers, in view of the above, that EuBatIn will deliver on its overall objectives (see recital (9)). In addition, it will contribute significantly at fostering R&D&I, especially through the substantial investments undertaken by the participating companies. The numerous collaboration will further contribute at ensuring R&D&I cooperation across the EU, as well as facilitate the cooperation between the industry and the RTOs.

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[24] 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.

[25] 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.

(354) As regards the contribution of EuBatIn to the *New Industrial Strategy for Europe*[26], the Commission acknowledges the importance of EuBatIn for supporting significant investments in the EU's battery value chain and that EuBatIn will contribute, according to estimates provided by the Member States, to job creation by creating over 18 000 direct jobs in total over its implementation.

(355) The Member States have provided estimates on the number of new direct jobs to be created annually as a result of EuBatIn:

Member State	Jobs in WS 1	Jobs in WS 2	Jobs in WS 3	Jobs in WS 4	Total jobs
Austria	31	25	178	9	243
Belgium	20			13	33
Croatia			85		85
Finland			50	30	80
France	71				71
Germany	47	1017	912	27	2003
Greece		20	20		40
Italy	19	98	119	17	253
Poland					tbd
Slovakia		65	169	52	286
Spain				10	10
Sweden		45			45
Total	**188**	**1250**	**1533**	**178**	**3149**

Table 22: EuBatIn breakdown of created jobs per Member State per year.

[26] 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.

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

Member States involved

(357) The IPCEI Communication, point 16, further requires that more than one Member State is involved. The notified EuBatIn involves 12 Member States: Austria, Belgium, Croatia, Finland, France, Germany, Greece, Italy, Poland Slovakia, Spain, and Sweden.

Positive spillover effects generated by EuBatIn

(358) As required by points 16 and 17 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 European economy or society through positive spillover effects (such as having systemic effects on multiple levels of the value chain, or up- or downstream markets, or having alternative uses in other sectors or modal shift) which are clearly defined in a concrete and identifiable manner."

(359) The IPCEI Communication requires for spillover effects to be identified at all the following levels: beyond the participating Member States ("European economy or society"); 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").

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

(361) As regards spillover effects for non-IP protected results of R&D&I and FID activities, the Member States have provided an extensive list of activities (described in section 2.5.1) illustrating that the effects of EuBatIn are not limited to the participating companies but will be disseminated to the whole scientific community and be of wider relevance and application to different economic sectors. For example, the Commission recognises that involvement in conferences and events as speaker, contributor, or participant will contribute to the dissemination of the knowledge and skills in the sense that attendance to these events is typical of all key actors (undertakings, RTOs, universities, etc.) of the battery value chain, as they provide an excellent opportunity to exchange on the latest updates in the battery industry (see section 2.5.1.2). Moreover, the establishment of collaborations with numerous and various indirect partners (see recitals (285) to (291)), as well as the close communication and connection to clusters, professional trade associations and

other intermediary bodies will enhance the dissemination effort (see section 2.5.1.4).

(362) The Commission also notes the significant effort undertaken by the participating companies in spreading and sharing knowledge by publications in peer-reviewed journals (see section 2.5.1.5) and in increasing links with the academic world, including through direct collaborations for the implementation of EuBatIn but also through a significant sponsorship of PhD and MSc degrees and university chairs (see recital (238) and (242)-(243)). This is particularly important to ensure that the knowledge is also transmitted to the next generations and that the future workforce can acquire the skills and knowledge that will be needed in the future. This is furthermore, corroborated by the commitments undertaken by all participating companies to provide training activities in collaboration with RTOs and universities, targeting professional and researchers (see recital (247)).

(363) As regards spillover effects for IP-protected results of R&D&I (see section 2.5.2), the Commission considers that the Member States have shown adequately the dissemination activities and the commitments undertaken by the participating companies to spread those results as widely as possibly to the scientific community and across economic sectors that stretch beyond the broad application domains of mobility, industrial/consumer and stationary energy storage, without jeopardising the objectives of EuBatIn. The IP-protected results will not only benefit the participating companies but will belong to the party or parties generating those results during EuBatIn.

(364) In addition, interested parties, e.g. SMEs or RTOs, will be granted access to those results from the participating companies at FRAND conditions. The setting of the licence fees will be fixed in the respective cooperation contracts between the participating companies and the interested parties. This dissemination will provide interested parties the possibility to reap the benefits of the R&D&I and FID activities undertaken by EuBatIn across the WS. Interested parties will 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, contributing, as a result to the overall objectives of EuBatIn.

(365) As far as particular spillover effects of FID activities are concerned, the Commission considers that, on the basis of the information provided by the Member States (described in section 2.5.3), the FID activities across the four WS will lead to significant spillover effects in downstream markets amongst the participating companies, but also beyond those markets by either strengthening already initiated businesses or by creating new businesses. EuBatIn will enable the participating companies to develop new product applications and designs and acquire specific skills and know-how, which can be used in cooperation with third parties within or outside EuBatIn. EuBatIn will also provide access to next generation batteries, as well as to new technologies issued from the FID phase to the participating companies, other interested large companies, OEMs, as well as to SMEs and RTOs that want to develop new knowledge and applications considering the entire lifecycle of these high-performance batteries. These parties should benefit of an early

access to the latest technologies available and may thus be able to reduce their development time.

(366) In this regard, the Commission notes that some of the participating companies have committed to allow access to R&D&I lab production lines for SMEs (including start-ups) and RTOs that do not have the capability to build up their own lab system (see section 2.5.3), in order to carry out further material, cell, process or equipment research and testing. These facilities are in principle planned to function as start-up incubators for knowledge-based ventures in the technological area related to battery systems, for applications in EV and other related applications within the battery value chain, creating as a result spillover effects in the downstream markets.

(367) It stems from the above that the benefits of EuBatIn are not limited to the participating companies but extend to the EU economy and society at large. EuBatIn will benefit various other sectors in up- and downstream markets that are not directly targeted by the activities covered by EuBatIn (see recital (292)). By analysing the individual company project portfolios the Commission notes that EuBatIn will benefit indicatively the following sectors: charging infrastructures, chemical industry, food industry, energy storage devices, equipment manufacturers, forestry and agriculture, high-tech industries, IoT (also combined to recycling), medical applications, mining, pharmaceutical industry, power tools, raw material suppliers, smart energy, system integration companies, telecom industry, shipping and aviation, UPS etc. All these additional economic sectors will benefit from their own feedback to the R&D&I and FID activities concerned, in order to improve their own equipment, materials and processes, develop new product applications and designs and acquire specific skills and know-how.

(368) Finally, the Commission underlines the efforts undertaken by the participating companies to establish collaborations with end users, such as with service and product designers, in order to enhance the social innovation perspective of EuBatIn across the four WS. This collaboration not only represents a new approach to the product development by including the consumers in the value chain, but allows further to meet several additional goals of the *European Green Deal* by supporting the shift to a smarter and fairer society that provides them with more affordable, accessible, healthier and cleaner alternatives.

(369) The Commission considers that the benefits of EuBatIn are clearly defined in a concrete and identifiable manner and the Member States have adequately shown how EuBatIn benefits interested parties beyond those directly involved in EuBatIn and beyond the sectors concerned. In addition, the Commission notes that at both integrated and national governance levels EuBatIn will monitor the correct implementation of the committed dissemination activities and spillovers of the participating companies (see recitals (69) and (70)) in compliance with the provisions of the IPCEI Communication and the national funding agreements.[27]

[27] For some projects (Tesla in Germany, MIDAC in Italy and InoBat Auto in Slovakia), the respective Member States will put in place dedicated monitoring systems to focus either on the progress of the planned R&D&I and FID activities or on meeting the targets related to spillover effects.

(370) Therefore, in view of the above the Commission considers that this eligibility condition is satisfied, in accordance with point 17 of the IPCEI Communication.

Co-financing by the aid beneficiaries

(371) As required by point 18 of the IPCEI Communication, co-financing of the beneficiaries is present, as evidenced by the fact that aid to individual beneficiaries does not cover 100% of the individual projects' costs. The Commission estimates that the cash flow needs for the implementation of the beneficiaries' projects are approximatively EUR 12 billion in total, which is significantly higher than the total aid to be granted by the Member States.

Environmental harmful subsidies and environmental impact

(372) The public financing of EuBatIn does not relate to environmentally harmful subsidies. Therefore it is not in conflict with the principle of phasing out such subsidies recalled by the Resource Efficiency Roadmap, as well as several Council conclusions, as required by point 19 of the IPCEI Communication. On the contrary, sustainability is one of the core objectives of EuBatIn and is one of the drivers of the innovations concerned; each participating company is committed to reduce its own footprint on the environment and reduce the environmental footprint of the developed products once they are in use notably through:

- Designing cells, modules and batteries having an extended lifetime allowing for 2^{nd}-life applications and being easier to dismantle and recycle;
- Designing cells and modules having a higher efficiency, reducing the energy needed to charge them;
- Designing storage products with a view to minimise their CO_2-eq footprint throughout the whole life cycle of the product, from cradle to grave;
- Developing environmentally friendly processes causing less water pollution and less health and safety hazards to workers;
- Developing innovative battery recycling and refining processes that allow for a higher degree of battery recyclability;
- Developing novel active materials with improved environmental benefits (e.g. waste, CO_2, energy consumption), reducing as a result the CO_2 footprint of battery cells and modules;
- Establishing cost effective and efficient recyclability targets for critical raw materials;
- Following the EU environmental protection principles for carrying out sourcing activities;
- Generating own electricity based on renewable energy or supply electricity from renewable energy;
- Increasing the energy efficiency through the use of Industry 4.0, compact plants, energy efficient equipment, cogeneration and energy efficient production processes;

- Introducing energy storage solutions (e.g. electrochemical energy storage) for cleaner energy generation;
- Improving air quality and avoiding water contamination by introducing solvent free processes;
- Proactive actions to minimize the impact of mining towards protected species;
- Producing tailings that can be reused for other industries instead of being discarded;
- Reducing the amount of Co in cells, allowing for a further reduction on the supply pressure of this metal;
- Reducing the use of fossil fuels by implementing an energy-efficient and sustainable battery production;
- Reducing waste; and
- Where possible, using secondary materials instead of raw materials.

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

b) General positive indicators

Open procedure for Member States

(374) All Member States were made aware in the first months of 2019 of the creation of EuBatIn.

(375) In addition, this open procedure is illustrated by the fact that different types of individual projects with a different amount of public financing have been selected by the Member States, whereas the entry of new participating companies is possible and can be decided under specific conditions that will be fixed on the first SB meeting.

Involvement of the Commission in the design of EuBatIn

(376) The Commission facilitated the emergence of EuBatIn and contributed to having enhanced the coordination of Member States in such a project by having organised technical meetings with open invitation for all Member States and companies interested to participate.

Governance

(377) As described in detail above under section 2.3, the governance structure of EuBatIn involves the Commission through participation into the SB.

Collaboration within EuBatIn

(378) The Member States have provided detailed information (see section 2.4.3) describing how each individual project creates important collaborative interactions in terms of number of partners, involvement of companies

participating in the same and different WS and the involvement of companies of different sizes.

(379) The Commission takes note of the number of collaborations within each and across the different WS, as the table below illustrates:

WS	Collaborations intra WS	Collaborations inter WS	Collaborations inter WS		Number of direct collaborations	Number of indirect collaborations
			WS			
WS 1	23	24	**WS 2**	16	47	54
			WS 3			
			WS 4	8		
WS 2	60	34	**WS 1**	10	94	65
			WS 3	24		
			WS 4			
WS 3	79	17	**WS 1**	10	96	57
			WS 2			
			WS 4	7		
WS 4	37	16	**WS 1**	7	53	38
			WS 2	6		
			WS 3	3		
Total	199	91		91	290	214

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

Co-financing by a Union fund

(380) The Commission takes note of the fact that some Member States (Croatia, Greece, Poland and Slovakia) will be using co-financing from the European Regional Development Fund.

(381) In view of all the foregoing, the Commission considers that on grounds of section 3.2.2 of the IPCEI Communication, five general positive indicators, in accordance with point 20 of the IPCEI Communication are met.

c) Specific criteria and parameters of assessment of the innovative nature

(382) Point 21 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. According to point 22 of the IPCEI Communication, projects comprising of industrial deployment must allow for the development of a new product or service with high research and innovation content and/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 IPCEI.

(383) In general, the Commission has verified at the level of individual aid beneficiaries and per project that each aid beneficiary has a well-defined and documented research programme regarding the innovations brought forward. It has verified that those innovations are either fundamental innovations or a collection of novel approaches and improvements, due to the many challenges that they aim at solving. In this regard, the Commission has verified that the research activities proposed go beyond a purely evolutionary and incremental

improvement of existing products or processes (see section 3.3.3.1). Also, if the research programme of a specific aid beneficiary included several products or applications, the Commission has verified that each of those products or applications contains fundamental product or process innovations not only compared to the state-of-the-art on the market but also compared to each other.

(384) Particularly, the innovative nature of each individual project portfolio during the R&D&I and the FID phases has been analysed taking into account the following specific principles and parameters.

(385) For the R&D&I phase:

- State-of-the-art: the Commission has compared all product and process innovations of each participating company against the state-of-the-art on the market at global scale;
- Innovation: as regards the technical assessment of the innovative nature of the different projects, the Commission has examined whether each project portfolio has 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; which are the innovations brought forward; and what are the benefits and expected results stemming from these innovations;
- Technical process/approach: the participating companies were asked to provide a clear description of the technical process/approach needed to reach the innovation targets. The Commission has assessed in this context the type of technology used, the challenges encountered by each participating company (see sections 2.2.3 to 2.2.6) and the means chosen to overcome those challenges;
- KPI's/targets: the Commission has assessed the level of improvement and measured the success of each individual project with the use of KPIs/targets. For example, as regards innovative products the Commission looked at performance (e.g. energy and power densities), durability (e.g. cycle lifetime), cost, safety and sustainability (e.g. carbon footprint, % of recycled materials in the product, use of green energies, reduction of water consumption, reduction of emissions into the air/water, circular economy, impact on biodiversity etc.). For innovative processes, the focus was on production speed and volume, overall equipment effectiveness, yield and sustainability; and,
- Collaborations: the Commission has assessed the various collaborations envisaged within and across the four WS. By examining the share of responsibilities within those collaborations, the Commission was enabled to quantify the distribution of tasks and budget across the different activities.

(386) For the FID phase:

- The Member States have described the testing, sampling and upscaling processes implemented by each participating company during the FID phase and explained how they are differed from mass production and normal commercial activities. The Commission examined whether the FID phase contains important R&D&I activities, going beyond the above processes (i.e. testing, sampling and upscaling) but instead including an optimisation of innovation developed in the R&D&I phase; and,

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

(387) Based on the information provided by the notifying Member States the Commission's assessment confirms that the R&D&I and FID activities carried out in each WS clearly aim to result in outcomes that will bring the technology substantially beyond the state-of-the-art. The innovations identified by the Commission are described below.

Major innovative nature and expected results

(388) The Commission considers that the Member States have demonstrated the innovativeness of EuBatIn including both R&D&I and FID activities, in all areas of the battery value chain and for the three broad application domains (see recitals (73) to (78)) that are specifically targeted by EuBatIn.

(389) In WS 1 (raw and advanced materials), the focus will be on alternative materials for anode and cathode materials, separators and electrolytes. Additionally, WS 1 will also focus on sustainable and ecological mining of battery materials either from EU or third country sources (see section 2.2.3).

(390) Regarding the anode materials, the innovation consists in particular in:

- Developing novel graphite anode material recipes beyond state-of-the-art, meeting the future performance requirements for innovative cells and particularly compatibility requirements with new cathode materials (e.g. high-Ni types);

- Addressing targeted cell profiles (consisting of cell capacity, energy/power densities, cycle life, efficiency, charge/discharge capabilities, costs etc.) by innovation in graphite and Si-based technologies, in parallel as well as in combination;

- Reaching a first cycle coulombic efficiency of Si-containing anodes of more than 90% compared to the state-of-the-art of 70% for existing Si technology. In terms of Si/C composite materials the goal is to increase the specific capacity of more than 800 mAh/g^{-1} whereas for Si-rich anode materials the goal is to achieve capacities of more than 1800 $mAh\ g^{-1}$;

- Developing novel electrolyte formulations to achieve higher energy densities and faster charge currents and to compensate for the massive electrolyte consumption used for the Si volume expansion; and

- Developing additives to improve the lifetime of the materials. Especially for the application in Si-containing cells, novel additives are necessary to further improve the lifetime of such materials on the cell level to more than 800 cycles.

(391) Regarding the cathode materials, the innovation consists in particular in:

- Developing coating using higher Ni contents (as compared to NMC 811) resulting in elevated safety standards with regard to the cell level;
- Developing novel electrolyte formulations (and additives) for high-voltage applications (more than 4.2V on cell level), considering also the safety of the cells regarding high Ni contents; and
- Developing cathode materials using NVPF for the implementation of SIBs, which although they are not as reliable on critical raw materials (such as Co and/or Ni) as the LIBs, they exhibit a limited energy density due to the nature of Na-ion (with respect to lower redox potential and limited charge/discharge capacity);

(392) Regarding material processes, the innovation consists in particular in:

- Developing and implementing new processes for the graphite anode materials, including new equipment types, in order to enhance the efficiency, while reducing production costs, as well as the carbon footprint;
- Introducing innovative processes for the mining of raw materials from EU-based sources or overseas taking social and ecologic standards into account. For example, these novel processes will address the mining of Li from brines, as these resources are often in dry and remote areas; thus, the water consumption must be limited to minimise influences by material sourcing.

(393) Regarding in particular the stationary energy storage application field, the innovation consists in the development of the RFB as an additional non-Li related energy storage solution. The innovative activities will focus on increasing the energy density and lifetime of the battery, as well as on addressing the toxicity/causticity of the compounds.

(394) The key expected results of the WS 1's R&D&I and FID activities and the corresponding contribution of the participating companies are:

Expected results	Participating companies
Mining, Refining and Material Processing	
• Safeguard sustainable raw material supply (required volumes in suitable quality at competitive conditions) for battery advanced materials including anode, cathode and electrolyte	ACIS, Arkema, Borealis, Tokai Carbon, Fluorsid, Fortum, Keliber and SGL
• Exploit EU based sustainable mining, refining and processing facilities for critical raw materials (e.g. Li, Ni, Co, Cu etc.) in terms of ecological effects	Fluorsid, Hydrometal, Fortum and Keliber
• Develop EU based sustainable processing facilities for polyolefin solutions for LIB components; identification of producers of intermediates (e.g. films) for LIB components	Borealis
• Meet cost/performance requirements with less supply critical and more sustainable alternatives of raw materials and/or advanced material concepts	Borealis, Hydrometal, Fluorsid, Fortum Italmatch, Tokai Carbon and SGL
• Integrate pre-treated batteries in global material processing	Hydrometal
Sustainable advanced material production	
• Meet the specifications for advanced battery materials (active and inactive) according to requirements by cell manufacturers	Arkema, Tokai Carbon, Ferroglobe, Italmatch, Prayon and SGL
• Optimised CO_2 footprint with reduced energy consumption and reduced waste generation	ACIS, Arkema, Borealis, Tokai Carbon, Ferroglobe, Hydrometal, Keliber, Prayon and SGL
• Cost and performance optimised processes & materials within sustainable production	ACIS, Arkema, Borealis, Tokai Carbon, Ferroglobe, Hydrometal, Italmatch, Prayon, SGL and VARTA
• Use of alternative or non-critical raw materials and/or recycled feedstock	Arkema, Borealis, Tokai Carbon, Ferroglobe, Fluorsid, Hydrometal, Italmatch, Keliber, Prayon and SGL
• Sustainable low-cost and high performance redox couples, catalysts and membranes for RFB	GES and Solvay
• Industrialization of the production of advanced and innovative cathode, anode and non-active materials, electrolytes precursors of ASSB for all targeted electrochemical stationary energy storage applications under the FID phase	Arkema, Borealis, Tokai Carbon, Ferroglobe, Italmatch, Prayon, SGL and Solvay

Table 24: Expected results from innovation - WS 1

(395) In WS 2 (battery cells), the focus will be on battery components, battery cell designs and innovative cell formation methods (see section 2.2.4).

(396) The abovementioned innovations in WS 1 for raw and advanced materials and processes and the accompanied increased energy densities on the cell level apply also in this WS leading to technologically upscale battery cells.

(397) The innovations of WS 2 cover all the processes of the battery cell production, namely: i) electrode production, ii) cell stacking and winding and iii) finishing and formation.

(398) Regarding the electrode production, which comprises the mixing, coating, drying and the calendaring steps, the main innovation activities consists in the following:

- The state-of-the-art mixing process is performed with N-methyl pyrrolidone ("NMP"), which is a hazardous and toxic solvent, and polyvinyl difluoridine ("PVdF"), a fluorine containing binder. The innovation pursued consists in reducing the NMP content;

- As regards the coating process, the innovation consists in developing novel production equipment capable of outperforming the state-of-the-art in terms of several parameters used, namely viscosity of the slurry (i.e. mixture of active material, binder, additive and solvent), coating speed, coating gap and coating technique (intermediated *vs.* continuous).

- The next step in the electrode production process, the drying, is currently performed in ovens with high energy consumption, with slurries containing NMP as solvent, which is often released in the environment. The innovation pursued consists in developing NMP-free slurries reducing as a result the energy consumption required. Another innovation in this regard will be the development of beyond the state-of-the-art drying ovens (e.g. laser drying of coated electrodes), which aims to reduce the energy consumption by 40%, and the use of micro dry environments (i.e. small sections with controlled temperature and/or humidity) utilizing much less energy consumption in comparison to the larger drying rooms.

- The final step of the electrode production process is the calendaring, where the dried electrode films are pressed to a certain extent that is necessary for the porosity of the electrodes. The state-of-the-art values are in the range of 30%, resulting in optimised wetting behaviour as well as Li-ion transport and conductivity. The innovation consists in the production of improved machineries capable of increasing the production output via innovative process designs (e.g. roll-to-roll calendaring).

(399) Regarding the cell stacking and winding, three innovative cell designs will be developed by EuBatIn, namely: i) cylindrical, ii) prismatic and iii) pouch. These cell designs will apply to all broad application domains, i.e. mobility, industrial/consumer and stationary energy storage.

(400) Particularly as regards the pouch cell assembly process, the state-of-the-art uses the Z-folding technique, which is capable, depending on the capacity of

the cell, to stack up to 2 cells per minute. During the cell stacking one layer of (double)-sided anodes and cathodes are stacked in an alternating order and separated by a thin polymeric film (separator). The innovation of EuBatIn in this regard consists in accelerating this process up to 4 cells per minute.

(401) Regarding the final step of the battery cell production, the finishing or formation, innovative formation strategies will be developed, which will accelerate the formation process, increase the safety and lifetime of battery cells and optimise the energy consumption during this process. The state-of-the-art process to finish the produced cells is to slowly charge and discharge the cell in the range from 10 up to 20 hours per charge/discharge step. This ensures a homogenous formation of the protective and essential layers on the electrodes. The innovation of EuBatIn consists in developing and adapting innovative formation routines, which will use distinct working potentials, accelerated charge rates and electrochemical regimes. Through this innovation, the time for a sufficient formation can be reduced from several days to 24 hours.

(402) Regarding in particular the stationary energy storage application field, the innovation consists in the development of RFB and Na/NiCl2 batteries, which aim to increase the cell capacity.

(403) A final holistic innovative element of WS 2 is the digitization of the battery factory with the use of Industry 4.0 and AI. The current battery cell production lines are normally set-up with equipment from many different machine OEMs due to the diverse cell production process. This leads to cell manufacturers having to integrate and connect machines from different OEMs with different mechanical and software interfaces to reach an appropriate level of automation. As a result, this process leads to high upscaling costs and scrap-rates during operation and to quality issues that cannot be fully traced back. WS 1, aims at developing an Industry 4.0 and AI strategy for the whole battery cell production facility, using advanced data analytics with the aim to reduce scrap-rates and upscaling costs and to increase quality and traceability.

(404) The key expected results of the WS 2's R&D&I and FID activities and the corresponding contribution of the participating companies are:

Expected results	Participating companies
• Cost-optimised and sustainable LIB cell chemistry concepts and common database of the cell materials	BMW, Cellforce, ElringKlinger, FCA Italmatch, Northvolt, SGL, SUNLIGHT and Tesla
• Cost-optimised LIB, ultracapacitor and RFB cell design concept and platform design with improved mechanical and electrical parameters (e.g. thermal management systems, mechanical stress resistant, shielding, low-temperature designs) and standardisation approaches	Alumina, BMW, Cellforce, ElringKlinger, FCA, InoBat Auto, Manz, MIDAC, Northvolt and Skeleton
• Post-LIB cell concepts (designs, development and prototyping)	BMW, ElringKlinger and InoBat Auto
• Cost-optimised RFB stack design	GES
• Design of LIB pilot production lines for design and process validation purposes	BMW, Cellforce, ElringKlinger, InoBat Auto, Manz, MIDAC, Northvolt, Skeleton, SUNLIGHT and VARTA
• Design and preparation of full-scale production model adaptable to varying contextual parameters.	Cellforce, Manz, MIDAC, Northvolt, Skeleton and Tesla
• New manufacturing and process technologies scalable for large-scale LI B production, including innovative sensors, (evolving) next generation material elaboration technologies and process innovation	BMW, Cellforce, ElringKlinger, Manz, MIDAC, Northvolt, Skeleton, SUNLIGHT, Tesla and VARTA
• Modular automation for cell factory	Cellforce, ElringKlinger, GES, Manz, Northvolt, MIDAC, Skeleton, SUNLIGHT Tesla and VARTA
• Development of Industry 4.0 strategies, including digitization with full traceability, advanced analytic tools and predictive AI	BMW, Cellforce, ElringKlinger, GES, Manz, MIDAC, Northvolt, Skeleton, SUNLIGHT, Tesla and VARTA
• Concepts for environment optimised production process (lowest CO_2 footprint)	BMW, Cellforce, ElringKlinger, GES, Manz, MIDAC, Northvolt, Skeleton, SUNLIGHT, Tesla and VARTA
• Production technology for Post-LIB cells	ElringKlinger, InoBat Auto, Italmatch, Manz and Northvolt
• Defined automated testing procedures for cell quality, safety and lifecycle mapping	MIDAC and Skeleton
• FID assembly lines for each cell format (cylindrical, prismatic and pouch)	Alumina, Cellforce, ElringKlinger, GES, InoBat Auto, Manz, MIDAC, Northvolt, SUNLIGHT and Tesla

Table 25: Expected results from innovation - WS 2

(405) The WS 3 (battery systems) will focus on the design and process of battery systems, including BMS, on battery management software and algorithms, as well as on innovative testing methods (see section 2.2.5).

(406) The main innovation activities in WS 3 consist in:

- Developing innovative processes for the assembly of battery modules using Industry 4.0, which allows full traceability of batteries together with highest quality standards, leading also to reduced scrap rates;
- Implementing neural networks, in the context of Industry 4.0, to determine the battery status with the highest accuracy. This network will select the production data and the appropriate measurement methods (such as impedance spectroscopy, cycle tests, etc.) as a function of cell chemistry, cell age and history of the cells;
- Converting unconventional ideas, such as submerged cooling, from concept to industrialisation. This activity will result in safer, more reliable, high-performance batteries with high gravimetric and volumetric power density, enabling thus faster charge cycles and longer cycle life due to better temperature control;
- Developing, in the context of BMS activities, novel software settings, advanced battery management algorithms, optimised battery sensors, temperature controls for extreme applications (both hot and cold conditions) etc.; and
- Developing scalable and reusable products taking into account the time-to-market and the product life cycle elements to ensure sustainability and 2nd-life applications.

(407) The key expected results of the WS 3's R&D&I and FID activities and the corresponding contribution of the participating companies are:

Expected results	Participating companies
System Design	
• Efficient wiring, advanced power electronics or advanced wireless connection	Enel X, FCA, Manz, MIDAC, Rimac, SUNLIGHT, Tesla and Valmet
• Battery integration systems, modular distributed BMS architecture, smart BMS, self-learning BMS, open platform BMS	FCA, FIAMM, FPT, GES, MIDAC, Rimac, SUNLIGHT, Tesla, Valmet and Voltlabor
• Real-time control systems using smart data analytics, as well as sustainable charging strategies and innovative sensors	Enel X, FCA, FPT, MIDAC, Rimac, SUNLIGHT and Valmet
• Advanced thermal management system, simulation tool for simulations representing battery lifetime (10 years), submerged battery	FCA, FPT, MIDAC, Miba, Rimac, SUNLIGHT and Valmet
• Defined parameters and design of a standardized storage module	Enel X, MIDAC and Rimac

Expected results	Participating companies
System Design	
• Smart design for easy disassembly, possibly damaged cell replacement, electrolytes replacement in RFBs and recycling	FCA, FIAMM, FPT, Enel X, GES, Miba MIDAC and SUNLIGHT
• Intrinsically safe, sustainable, and compact flow battery design with smart BMS	Enel X, GES, InoBat Energy and Rimac
• Low cost ultracapacitor-LIB HBS design with optimal power-to-energy ratio	Skeleton
• Compact hybrid vehicle battery	Rimac
• Modular high voltage packs for HE/E buses and trucks or heavy duty railways/tramways applications with focus on cost reduction and life-time improvement	FIAMM, MIDAC and SUNLIGHT
• Integrated collaboration processes for joint product development with customers	Valmet
• New, highly insulated modules for Na/NiCl2 battery systems reducing thermal heat loss	Alumina
Process Design & Productivity	
• Fully automated/digitalized module assembly line with a high level of modularization and efficiency, including intelligent material management and Industry 4.0 aspects.	AVL, BMW, Enel X, FCA, FIAMM, FPT, Manz, MIDAC, Rimac, Rosendahl, SUNLIGHT, Tesla, Valmet and Voltlabor
• Fully automated production system for ultracapacitors and ultracapacitor-battery hybrid modules, as well as compact hybrid vehicle battery via Industry 4.0 aspects	Manz, Rimac and Skeleton
• Pilot plant for the production of battery modules and systems towards zero net CO_2 production environment, as well as using innovative production processes (e.g. CO_2 dry cleaning), pilot plant for testing new production methodologies and equipment	ACIS, AVL, BMW, FCA, FIAMM, FPT, Manz, MIDAC, Rimac and SUNLIGHT
• Defined protocols for the optimization of techniques and software and control system for large scale ESS by Industry 4.0 aspects	Enel X and InoBat Energy
• Definition of technical specification regarding the building and assembly of battery systems intended to back EV charging stations/allowing the use of 2nd-life batteries	Enel X
• Reduced non-recyclable waste from battery pack components.	FIAMM, MIDAC and SUNLIGHT
Testing	
• Advanced test methods, including prototypes, life time tests and definition of reference battery cycles	AVL, Enel X, FCA, FPT and Manz
• Testing methods for energy storage systems considering on-field and real-life data, creation of a testing and application centre	Enel X, FCA, FIAMM, GES, InoBat Energy, Manz and Rimac

Expected results	Participating companies
Testing	
• Testing and simulation methods for industrial applications	FIAMM, Manz, SUNLIGHT and Valmet
• EoL battery pack test with reduced cycle time	Rimac
• Homologation/certification and external testing for verification of battery safety, performance, durability and longevity	Rimac
Applications	
• Fleet management	FCA, FPT and MIDAC
• Affordable and reliable battery swapping unit	Endurance
• KERS energy storage prototypes (2 applications)	Skeleton and SUNLIGHT
• Grid system prototypes (2 applications)	Enel X, GES, MIDAC and Skeleton
• Potential market applications for tailored/high-level innovative stationary energy storage system	Enel X, GES and InoBat Energy
• Prototypes of traction and hybrid systems	SUNLIGHT
• Modular battery platform for industrial/consumer applications	GES and Valmet
• 48 V architecture dedicated to industrial/consumer applications and "mild hybrids" • Modular architecture for easier disassembly and recycling	FIAMM, MIDAC and SUNLIGHT
• 12 V system for mobility applications - Cold cranking (-25 °C/-30 °C) - Improved safety and efficiency	FIAMM
• Containerised 2nd-life battery stationary energy storage system of different capacity categories from different 2nd-life battery modules	Energo-Aqua
• Prototype of hybrid stationary energy storage system based on combining 2nd-life ESS and RES	Energo-Aqua
• Prototypes and FID of Submerged Battery Module & Pack	Rimac
• Implementation of battery systems in various hybrid and EV applications of large and small car manufacturers	Rimac
• Home-Storage Systems and stationary energy storage systems for industrial/consumer applications using Na/NiCl2 technology	Alumina

Table 26: Expected results from innovation - WS 3

(408) In WS 4 (recycling and sustainability), the focus will be to carry out a life cycle assessment and ensure a continuous material flow of all relevant materials for the re-use of batteries or for other 2^{nd}-life applications. It also aims to adopt novel recycling technology steps and develop pilot plants and recycling facilities (see section 2.2.6).

(409) The main innovation activities of WS 4 consist in:

- Developing an efficient recycling process that balances between the variety of Li-ion battery sizes and chemistries and the increase in recycling yields;

- Developing a life cycle assessment based on the current technologies used for mobility, industrial/consumer and stationary energy storage application domains;

- Creating a valid database with current LIBs based on their materials, the SoH, the state-of-charge ("SoC") and the lifetime and safety elements. The life cycle assessment will then be used for the re-use of batteries or for other 2^{nd}-life applications or to re-integrate the raw material via recycling;

- Introducing novel electrical testing of the cells, using the Industry 4.0 strategies of WS 2 and WS 3, to ensure that high quality cells used in the mobility field for example, and whose remaining capacity exceeds 80% of the initial value, can be re-used for other applications. This process can provide the information about the current state of the battery cell and/or system, as well as predicting the further battery aging. The exact determination of the battery condition will also enable its certification after the EoL, without further costs;

- Developing novel recycling technology strategies to ensure sufficient recycling rates. The state-of-the-art recycling steps of LIBs are limited to a recycling rate of 50-60% using the pyrometallurgical technology. EuBatIn will increase this value to higher than 70% on the module level, using optimised pyrometallurgical routes and/or the combination of pyrometallurgical routes with hydrometallurgical steps. That way, EuBatIn aims to recover all relevant materials from current LIBs, including Li and the electrolyte, via the precipitation of the respective metal salts.

(410) The key expected results of the WS 4's R&D&I and FID activities and the corresponding contribution of the participating companies are:

Expected results	Participating companies
Sustainability and Life cycle approach/assessment • Holistic life cycle approach for Li-ion batteries • Life cycle assessment and socio economic impact assessment • Progress in utilization of recycled Li and other materials • Traceability concept (material, life cycle management etc.) • Digitization for information collection to support material flow • Monitoring tool for EoL batteries • Material and CO_2 efficient processing technologies	Borealis, Enel X, ENGITEC, FCA, Fortum, GES, Hydrometal, Italmatch, Keliber, MIDAC, Valmet and VARTA
Re-use/2nd-life • Sorting, testing & remanufacturing of batteries for re-use • Reconditioning of used batteries • Assemble automotive batteries for 2nd-life applications • Guidelines for 2nd-life batteries re-use • Pilot plant to produce portable packs for EV batteries for 2nd-life stationary energy storage applications • Monitoring the status of battery cells, modules and systems and service concept based on reliable information about the battery or some parts of the battery	FCA, FIAMM, Fortum, Little, MIDAC, Valmet and ZTS
Recycling technology steps • Development of innovative, (automated) and safe methods of collection, transportation, storage and dismantling of LIBs, including vision technologies and digitalization • Safe and innovative methods for recovery and refining of metals and other relevant materials (e.g. Ni, Co, graphite, Li, electrolyte etc.) to provide high-quality materials for re-use • Development of a pilot logistic solution for handling LIBs and other waste containing metals • Adaption of the established waste management system to the new challenges posed by new developments of the battery market and invention of new recycling technologies	Borealis, Enel X, ENGITEC, Fortum, Hydrometal, Italmatch, Keliber, Liofit, MIDAC, SGL and Tesla
Development of pilot plants/recycling facilities • Development of a complete Li batteries recycling pilot plant • Modularisation of recycling process to custom fit various battery technologies • Build pilot/industrial units for recovery of valuable materials	Borealis, ENGITEC, Fortum, Hydrometal, Italmatch, MIDAC, SGL and Tesla

Table 27: Expected results from innovation - WS 4

(411) Based on the above, the Commission considers that the specific criteria established by the IPCEI Communication in points 21 and 22, as regards the R&D&I content of the R&D&I and FID projects that will be performed within EuBatIn are fulfilled.

3.3.2.3. Importance of EuBatIn

(412) According to section 3.3 of the IPCEI Communication, in order to qualify as an IPCEI, a project must be important quantitatively or qualitatively. It should either be particularly large in size or scope and/or imply a very considerable level of technological or financial risk.

(413) As evidenced by the number of participating companies (42 participating companies and over 150 indirect partners both companies and RTOs) covering the entire battery value chain, the amount of total eligible costs (approximatively EUR 5.4 billion), the amounts of State aid envisaged for EuBatIn (see section 2.6.3), and the innovative character of the WS involved (as described in recitals (388) to (410)), the Commission considers EuBatIn an important project meeting the quantitative requirements of the IPCEI Communication.

(414) In addition, the Commission takes note of the considerable level of technological and financial risks for both R&D&I and FID activities entailed in EuBatIn.

(415) Regarding the technological risks, EuBatIn will be confronted to a number of technological hazards that could lead to an unacceptable failure in performance, cost and sustainability. Dealing with those risks would require unforeseen additional work (studies, modifications, tests, etc.), hence leading to significant delays and additional costs. This could be in particular the case for cells, modules and systems manufacturers, which, for instance, could not meet the power requirements nor the necessary safety level by the intended user.

(416) As far as the raw materials producers are concerned, the technological risks are related to the introduction of new technologies, such as the novel mining of critical raw materials (e.g. Li, Ni, etc.), the upscaling time, the high product quality requirements and the prolonged qualification time, required by the clients. Concerning the key ingredients for next generation and novel electrolytes (e.g. ASSB), the risks stem from the fact that the technologies associated with EuBatIn are disruptive, with a low TRL and have never scaled-up to an industrial level. For the advanced materials producers, the challenge to design materials with the required purity to fulfil the requirements of commercial batteries and match an acceptable cost is still to be demonstrated, and will require an outstanding effort of R&D&I and process development, with a significant risk of delay and additional costs. Regarding recycling and refining, the technological risks reside in not developing a cost-competitive, versatile and scalable process able to generate battery materials with best recovery in the most appropriate forms for further use in the battery value chain.

(417) EuBatIn will moreover be confronted to strategic and organisational risks. The sales of cells, modules and systems, as well as of the active materials needed for these cells, modules and systems will depend on customers' (and other downstream market players') requirements in terms of timing (e.g. as regards the capacity to deliver on time the next generations of cells), costs and performance of the cells, modules and systems. In addition, the different contributors to EuBatIn will have to align their development schedules to reach the same level of maturity at the same time, in order to fit with the customers' demand requirements. Any delay therefore would jeopardize the effective implementation of EuBatIn.

3.3.2.4. Conclusion on the eligibility of EuBatIn

(418) In view of the above, the Commission concludes that the general eligibility criteria of the IPCEI Communication are met by EuBatIn.

3.3.3. Compatibility criteria

(419) When assessing the compatibility with the internal market of aid to promote the execution of an IPCEI on the basis of Article 107(3)(b) TFEU, the IPCEI Communication (point 25) requires the Commission to take into account a number of criteria, as elaborated below. Moreover, it requires also that the Commission carry out a balancing test to assess whether the expected positive effects outweigh the possible negative effects (point 26).

(420) Having regard to the conclusion that the general eligibility criteria are fulfilled by EuBatIn, as stated in section 3.3.2 above, and the nature of EuBatIn, the Commission considers that the presence of a market failure or important systemic failure can be presumed in line with point 27 of the IPCEI Communication.

(421) The analysis of the compatibility criteria has been performed by the Commission at the level of individual aid beneficiaries and per project.[28]

3.3.3.1. Necessity and proportionality of aid

Necessity of aid

(422) According to point 28 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, EuBatIn's realisation should be impossible, or it should be realised in a smaller size or scope or in a different manner that would significantly restrict its expected benefits. Footnote 24 thereto requires that the aid application must precede the starts 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. According to point 29 of the IPCEI Communication, the Member State should provide the Commission with adequate information concerning the aided project, as well as a comprehensive description of the counterfactual

[28] Such individual projects can be composed of an R&D&I part and a FID part.

scenario, which corresponds to the situation where no aid is awarded by any Member State.

(423) The Commission has verified that all companies have submitted their aid applications to the Member States before the start of their work on their individual projects included in EuBatIn, therefore the formal incentive criterion, as required by the IPCEI Communication (footnote 24) is met.

(424) The Member States have submitted information demonstrating that the aid has an incentive effect for all aid beneficiaries, i.e. that the aid will induce a change of the behaviour of the beneficiaries by means of allowing them to engage in their individual projects in their full ambitious scope and in the time span as notified. More specifically, this information is revealed in the counterfactual scenarios for the aid beneficiaries.

(425) The Member States affirm that, absent EuBatIn public financing, the aid beneficiaries would not undertake their individual projects and for example continuing buying inputs from external suppliers rather than developing innovative ones themselves, or, if they would, they would not undertake them rapidly enough, or they would carry out activities with a significantly lower level of ambition. The aid beneficiaries would instead either not develop the new products under EuBatIn or they would not conduct the R&D&I to introduce the different fundamental innovations under EuBatIn. .

(426) The Member States have underlined that absent the aid, the development of a competitive, innovative and sustainable ecosystem would not take place. The innovations both in terms of performance and sustainability, would not be made available to European consumers, as each participant would have focussed on its own program.

(427) In view of the above, the Commission notes that the information provided by the Member States shows that in all instances where the counterfactual scenario consisted in the absence of a project in the same segment or in mere incremental improvements or in project delays , jeopardising thus the materialisation of EuBatIn, there is no appropriate evidence showing that the participating companies had clearly considered these alternatives in their internal decision-making at the time of taking the decision to apply for the public support. Moreover, such alternatives were not further substantiated by any financial calculations of the costs, revenues and profitability to be compared with the scenarios of the aided project.

(428) From the foregoing, the Commission concludes that there are no counterfactual scenarios within the meaning of point 29 of the IPCEI Communication, which defines the counterfactual scenario as "a clearly defined and sufficiently predictable alternative project considered by the beneficiary in its internal decision making".

(429) The Commission further verified that the aid was necessary to induce a change of behaviour by the aid beneficiaries. For the companies with no counterfactual scenario within the meaning of the IPCEI Communication, this change of behaviour is assumed to occur when the individual projects achieve a sufficient degree of profitability. The sufficient degree of profitability corresponds to the company WACC, as commonly applied by them as minimum internal

benchmark for selection of projects. As represented by the funding gap analyses, submitted by the Member States for all aid beneficiaries, the aid is needed in order to cover the funding gap of the individual projects (the net present value of all these projects, calculated by using the respective WACC as a discounting factor, is negative).

(430) For the companies with a clearly defined and sufficiently predictable counterfactual scenario, the Commission compared the net present values of the aided and alternative projects, in line with point 32 of the IPCEI Communication. Furthermore, the Commission verified that the aid is kept to the minimum necessary to ensure the implementation of EuBatIn.

(431) The Member States also submit (also where the aid would not cover the full funding gap (see recital (306)) that the aid helps to induce the change of the behaviour of the aided companies due to further strategic long-term considerations (such as to offer innovative and differentiating products, to preserve the EU-based technological, research and technical capabilities, strategic KETs importance, strategic security considerations, etc.). Also, in its assessment of the eligibility of the costs, the Commission verified that the list of submitted costs would not include costs that an undertaking would anyhow incur such as costs linked to already existing laboratories in which research would have been conducted anyhow and the company would have had to support those facility and personnel costs even without EuBatIn.

(432) In view of the above, the Commission considers that the Member States have sufficiently demonstrated that the aid measures do not subsidize the costs of the projects that the participating companies would anyhow incur and do not compensate for their normal business risks.

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

Proportionality of the aid

(434) According to point 30 of the IPCEI Communication, in the absence of an alternative project, the Commission will verify that the aid amount does not exceed the minimum necessary for the aided project to be sufficiently profitable, e.g. by making it possible to achieve an internal rate of return ("IRR") corresponding to the sector or firm specific benchmark or hurdle rate. According to point 31 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.

(435) The Member States have submitted, for all participating companies, detailed calculations of the eligible costs for their IPCEI specific R&D&I and FID projects and funding gap calculations. In the individual project descriptions, the contents of the companies' individual R&D&I and FID projects falling into the scope of EuBatIn are detailed. In particular, the R&D&I activities to be performed, technology risks and challenges, the state-of-the art in the sector

concerned are detailed and it is explained how their R&D&I activities bring about important added value in going substantially beyond the state of the art, are of major innovative nature, how the FID allows for the development of new products with high R&D&I content and/or fundamentally innovative production processes and contains a very important R&D&I component. They also detail the eligible costs for the R&D&I and FID projects.

(436) In its assessment of the eligibility of the costs, for the individual R&D&I projects, the Commission verified individually for all aid beneficiaries that their projects contain R&D&I activities of major innovative nature, going substantially beyond the state-of-the art in the sector concerned. This verification was based on the nature of the activities to be performed, the technology challenges and risks to be overcome within each WS and the duration of each activity, as demonstrated by each company (see section 3.3.2 above).

(437) The Commission consistently verified for all WS and individual projects that a high innovation level is to be reached, and that the activities do not merely allow for an incremental evolution of the technologies existing and embedded in battery products already existing on the market (see recitals (388) to (411)). Moreover, the Member States have verified that the related R&D&I costs of each aid beneficiary comply with the Annex on eligible costs to the IPCEI Communication. The Commission confirms that these costs fulfil the conditions set out in the Annex to the IPCEI Communication. In addition, if instruments and equipment are not to be used during the full life for EuBatIn, the Commission has verified that only the depreciation costs corresponding to the life of EuBatIn are considered for the calculation of the eligible costs. The Commission has also required the aid beneficiaries to demonstrate that the depreciation periods used corresponded to good accounting practice.

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

a. Concern "the development of a new product or service with high research and innovation content and/or the deployment of a fundamentally innovative production process"[29];

b. Do not relate to "regular upgrades without an innovative dimension of existing facilities and the development of newer versions of existing products"[30];

c. Consist in "the upscaling of pilot facilities, or [to] the first-in-kind equipment and facilities which cover the steps subsequent to the pilot line including the testing phase;

d. Do not correspond to neither mass production nor commercial activities"[31];

[29] Point 22 of the IPCEI Communication, first sentence.

[30] Point 22 of the IPCEI Communication, second sentence.

e. Relates 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 a very important R&D&I component, which constitutes an integral and necessary element for the successful implementation of the project"[32].

(439) Having regard to the specificities of the battery value chain concerned and the participating companies' individual FID projects contained in EuBatIn, the Commission has assessed the eligibility of FID costs for each aid beneficiary according to the above criteria, in the following manner.

(440) This assessment took into account, for each FID project specifically, the integration of processes in the industrial environment, the necessity of process, equipment and/or component redesign in relation with the complexity of the line, the technological complexity and progress going substantially beyond the state-of-the-art of the targeted components and systems, the applications addressed and their specific constraints in particular in terms of safety and security in relation to the components it embarks. When assessing the setting up of processes, activities are only considered eligible where they relate to the introduction of processes that transfer the R&D&I performed before FID and are critical for the functionality of the resulting product. These activities were assessed against the most up-to-date publicly available information related to the different EuBatIn components (including scientific and technical literature journals, corporate technical scientific publications, corporate and news, patents).

(441) The Commission finds for all aid beneficiaries, for each FID project, that it concerns either a new product with high R&D&I content or a fundamentally innovative production process or even both (see recitals (388) to (411)).

(442) The Commission further finds for all aid beneficiaries, for each FID project, that the FID concerns technologies with high R&D&I content or fundamentally innovative nature, and these highly innovative technologies are a result from a preceding R&D&I activity but yet they still require very important R&D&I to be carried out even after the R&D&I phase, i.e. to put these technologies into FID requires very important R&D&I; as such, the FID of these specific technologies contains a very important R&D&I component on its own (quantitatively or qualitatively), and this R&D&I in the FID phase is indispensable for the successful FID of the technologies.

(443) In relation to the very important R&D&I component, the Commission finds that for all beneficiaries an adequate demonstration of the very important (in quantitative and/or qualitative terms) R&D&I activities in their FID, which constitutes an integral and necessary element for the successful implementation of their individual projects, is provided. In particular, the

31 Footnote (1) in the Annex to the IPCEI Communication.

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

Commission verified for each FID project that the planned important R&D&I during the FID, necessary to solve outstanding technological roadblocks, among others in terms of process integration, design stability, testing, packaging of components and/or security and safety of components, in the context of the complex technologies and large number of processes involved, is demonstrated. Mere engineering work accompanying normal activities of FID does not constitute the required R&D&I in FID. In particular, the assessment of the very important R&D&I component in the FID of each aid beneficiary took into account the following issues.

(444) In its assessment, the Commission verified, on the basis of the parameters established in recitals (438) and (440), that the FID is not a mere regular upgrade, without an innovative dimension, of existing facilities, or a development of newer versions of existing products or technologies.

(445) In its assessment, the Commission further considered that where FID costs and the embedded R&D&I do not relate to the highly/fundamentally innovative technologies the beneficiary is developing, these are not eligible. Where the R&D&I in FID does not take place before the end of FID (end date in line with the IPCEI Communication), the FID costs are not eligible. The Commission has verified that such R&D&I costs are excluded from the eligible costs represented in tables 9 to 20 above.

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

(447) In this connection, the Commission first examined whether the different beneficiaries established KPIs (e.g. quality of product, throughput, level of scrap, energy consumption, safety, environmental impact, etc.) for identifying the moment in time that they reach a stabilised production process and mass production. Any costs relating to production occurring after the KPIs have met cannot be included in eligible FID costs. The Commission verified that they were not included in the eligible costs represented in tables 9 to 20 above.

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

(449) A FID phase corresponds to a phase in which the undertaking starts to test the production of its new product or the new production method outside the lab and the pilot line. Undertakings provide samples to potential customers to verify the quality of the product and how it can be integrated in the potential customers' activities. Typically, at that moment, new issues will appear and the product might need to be changed or the production process might need to be modified. During the FID, numerous trial runs and a critical number of testing scenarios will be performed at different days and shifts to validate the production process with many idle moments in between.

(450) Concerning the samples, during FID, some companies develop the so-called "C-sample", which could result from either the pilot line or already the production line it is planned to be made in. This sample is extensively tested by downstream partners and potential customers, which provide feedback on the performance parameters and is adjusted accordingly if not found satisfactory. With an approved C-sample, the product is then transferred to the production line it is planned to be made in, and a production line sample is provided. In this sample, referred to as "D-sample", all settings must be defined and frozen, with regard to process parameters and raw materials. The production line then needs to qualify as well. Moreover, after feedback by the customers, further development adjustments may still be necessary. D-samples are produced in large volumes, i.e. in volumes that are sufficient to allow for the detection of systemic flaws. Once the testing of samples is done, the production can be progressively upscaled. The FID phase is characterised by a low output rate, high scrap rates and high inefficiencies.

(451) In addition, as the activities supported under EuBatIn involve substantial innovations, the FID activities (including testing, sampling and upscaling) continue to involve an important R&D&I effort until the end of FID, which the Commission has verified, as indicated under recital (443). During ramp-up, given that the production processes are implemented for the first time complications are expected and adjustments will in any event be needed to remedy the situation, potentially requiring that part of the production process is redesigned.

(452) Even during the upscaling, customers expect the delivery of products of a high quality level despite the high inefficiencies and reject rates that undertakings face during FID. In the FID phase, this can only be achieved with the supply of products under abnormal commercial conditions: extraordinary quality assurance and extended return policies. Customers will be particularly keen to require extensive liabilities from new entrants. Those quality assurances imply for the companies additional quality control, screening and sorting processes, which are not needed anymore when the production process is stabilised and would also not be sustainable under normal commercial conditions (because they are too costly). During the FID phase, customers reserve the right to reject or return shipments not only in the event of a quality issue but also in cases that customer applications show technical problems or the market introduction is postponed, in particular from new entrants.

(453) The Commission verified that the planned FID activities included by Member States in the eligible costs calculations presented in tables 9 to 20 above: a) correspond only to the testing, sampling and upscaling activities described in recitals (449) to (452), b) include only activities that still require significant R&D&I effort, c) correspond only to a limited output volume, and d) when a small volume of sales is planned, those sales occur under extended liability conditions. Conversely, the Commission verified that sales occurring after product qualification and years for which high volumes of sales were already planned were not included in the FID anymore and excluded from eligible cost calculations summarised in tables 9 to 20 above, given that such sales would point to mass production and commercial activities.

(454) The Commission's assessment confirms that the notified FID phases of all aid beneficiaries comply with the requirement of the IPCEI Communication not to cover neither mass production nor commercial activities and that the costs summarised in tables 9 to 20 for the FID phase of each beneficiary relate to FID within the meaning of the IPCEI Communication.

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

(456) With regard to the operating costs, which should be limited both in scope and in time to the R&D&I that the FID entails according to the Annex to the IPCEI Communication, the Commission examined thoroughly the costs information provided by the Member States and considers the requirement fulfilled.

(457) The Commission moreover reviewed the FID cost information provided by the Member States and summarised in tables 9 to 20 above and considers that they fulfil the conditions set out in the Annex to the IPCEI Communication.

(458) Based on the above, the Commission finds that the costs notified by the Member States in relation to all aid beneficiaries constitute eligible costs for EuBatIn and fulfil the requirements of the Annex to the IPCEI Communication.

(459) The Commission reviewed in detail the funding gap calculations provided by the aid beneficiaries and verified the main assumptions in those calculations against publicly available data.

(460) The funding gap refers to the net present value of the difference between the future cash in- and out-flows projected over the lifetime of the investment, i.e. including the financial streams related to the mass production following from EuBatIn. In line with the IPCEI Communication, the Commission assessed the funding gap of each project at the level of each beneficiary.

(461) The Commission verified two main assumptions underpinning the calculation of the funding gap. First, the Commission checked that the participating company's internal WACC, which is the rate used to discount the cash flows determining the funding gap, corresponds to the company's internal WACC and is calculated in line with the best practices in finance. The Commission also constructed a company-specific benchmark WACC based on publicly available data, with the aim of assessing the plausibility of the company internal WACC.

(462) Second, the Commission made sure that the participating companies consider all the revenues that can be reasonably expected from the investments and costs included in their business plan. To this end, the Commission verified that the length of the revenue streams is in line with the expected life cycle of the product. The Commission also assessed whether those revenue streams, taking into account the individual projects' costs and investments, lead to a reasonable profit (i.e. EBIT) margin over the course of the business plan period, especially during the mass production phase. In addition, the

Commission checked that the participating companies include a terminal value among their revenues. This value refers either to the residual value of capital investments (equipment and buildings) at the end of the planning period or to the terminal value of their projects resulting from the additional profits each participating company might expect to earn at a future horizon beyond the planning period.[33]

(463) Finally, the claw-back mechanism described above in section 2.9 provides further reassurance on compliance with the proportionality requirement.

(464) Taking into account the foregoing, the Commission considers that the aid to all participating companies does not exceed the individually identified funding gap of each beneficiary neither does it exceed the eligible costs displayed in the tables presented in section 2.6.3.

(465) In addition, Member States have put in place mechanisms to make sure that irrespective of the source of the funding (local, regional federal, EU), the total support will not exceed the notified and approved aid amount under this decision.

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

3.3.3.2. Prevention of undue distortions of competition and balancing test

Appropriateness

(467) According to point 40 of the IPCEI Communication, the Member State should provide evidence that the proposed aid measure constitutes the appropriate policy instrument to address the objective of the project.

(468) The Member States submit that State aid is the appropriate policy instrument to support EuBatIn. In their view, due to the exceptional size of EuBatIn and the synergies it requires from the various partners, it could not be achieved and such technological breakthroughs could not be created without the support of the Member States involved in the financing of EuBatIn. Alternatively, the participating companies would have focused on their own programmes to the detriment of innovations whose spillover effects largely benefit the EU ecosystem.

(469) Further, the Austrian and the French authorities submit additional considerations as to why other policy instruments would be inappropriate alternatives to State aid. They consider that the use of regulation and mandatory pollutions standards or the use of pricing mechanisms and environmental taxes to implement the objectives of EuBatIn and reduce the environmental impact would not be realistic and would not lead to the same outcome as the proposed measures.

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[33] The terminal value of the project is calculated assuming cash flows in the last year of the business plan will grow at a constant rate in the future.

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

(471) Some Member States have also provided further additional considerations. Croatia submits that the use of direct grants will encourage the development of patenting activities. Germany, Italy and Poland argue that State aid in the form of grants will facilitate the implementation of the spillover activities. Germany and Sweden consider that this form of financial support will provide a certain degree of public influence over the planned projects. Finally, Italy, Slovakia and Sweden add that direct grants will trigger further investments and contribute thus to economic growth and job creation.

(472) The Belgian authorities submit that for the projects of its participating companies (see recital (308)), the FID phase will be supported also through a repayable advance instrument.

(473) The Commission shares the views of the Member States that given the level of ambitions pursued by EuBatIn, its size and numerous collaborative interactions that it will induce, the public support through the notified State aid measures constitutes the appropriate policy instrument to address the objectives of EuBatIn. Given the level of risk and uncertainty, the Commission considers appropriate the use of direct grants for the R&D&I phase. The Commission also considers that the FID phase will equally entail a relatively high level of risk and uncertainty and therefore finds appropriate the use of direct grants or repayable advances (for two specific individual projects). The Commission further notes that all larger aided individual projects (and two smaller ones (see footnote 13)) will be subject to a claw-back mechanism that will further ensure the appropriateness of the aid measure.

Identification of the potential risks of distortions of competition

(474) According to point 41 of the IPCEI Communication, aid can be declared compatible if the negative effects of the aid in terms of distortions of competition and impact on trade between Member States are limited and outweighed by the positive effects in terms of contribution to the objective of the common European interest. The assessment of the potential negative effects of the aid under the IPCEI Communication needs to consider, in particular, the effects on competition between undertakings in the product markets concerned, as well as risks of market foreclosure and dominance (points 42 and 43 of the IPCEI Communication).

(475) The Member States provided detailed information and reasoning on the absence of undue distortions to competition in relation to each specific measure object of EuBatIn. In particular, the Member States argue that the European markets impacted by this IPCEI are either non-existent (as yet to be developed) or in their infancy. This is reflected by the fact that most of the

participating companies of EuBatIn are not currently active in the markets in which they intend to develop their production as a results of the discussed measures. In the few cases of participating companies already active in these markets, they do not raise concerns of undue distortions of competition in the products or services that constitute the object of EuBatIn. The Member States also argue that the current and expected market shares of the participating companies already active in markets impacted by EuBatIn are not material. Finally, the Member States argue that the participating companies will face intense competition notably from the many established competitors located outside the EEA that are currently already selling or providing services in the EEA. The Member States in their submissions also indicate that there will be no risk of foreclosure and overcapacity as a consequence of EuBatIn.

(476) The Commission's analysis of undue distortions to competition is always specific to the particular case. The assessment of the potential negative effects of the aid under the IPCEI Communication needs to consider, in particular, the effects on competition between undertakings in the concerned product markets, as well as risks of market foreclosure and dominance.

(477) EuBatIn involves an unusually large number of companies, each with a current or future presence in a wide range of product and service markets concerned along the battery value chain. For this reason, in this particular case, the Commission adopted a two-step approach, as described below, in order to identify potential significant competition distortions that might result from the aid measures.

(478) First, the Commission screened participating companies based on a uniformly available metric on European production (the "PRODCOM" statistics on the production of manufactured goods collected by the EU Member States). Second, the Commission reviewed the more detailed information provided for each participating company by the relative Member State and carried an overall assessment of competition distortions based on that information.

(479) As for the first step, the Commission requested and received data on the aid recipients' past production values by 8-digit PRODCOM classification for the products categories related to the aided project. In this first screening the Commission considers, on a conservative basis, prima facie potentially problematic those cases in which aid beneficiaries have a share of European production higher than 10%. This screening is conservative because the chosen threshold of 10% is a relative low threshold and because the share is computed on European production, when production also has a global dimension and sales in Europe are both affected by European and non-European production for the products and services concerned by EuBatIn.

(480) The indicators used by the Commission to filter companies as raising potential competition concerns can be considered as proxy to horizontal market shares. For example, a larger share in EU production value might be correlated with a larger market share in related relevant markets. These indicators therefore approximate the likelihood that the aid strengthens a horizontal bottleneck position of the beneficiary in a market. The presence of such horizontal bottlenecks also makes upstream and/or downstream foreclosure more likely.

(481) This first screening identified six potentially problematic cases in terms of possible distortion of competition. This means that for all the other cases the participating companies have a share of European production below 10% and often it is the case that these companies are new entrants in the markets targeted with the products that are the object of EuBatIn.

(482) In the second screening, the Commission also scrutinized the detailed information requested to the Member States for each specific aid beneficiary and project. The data requested encompass a description of the current and future market conditions with information on expected production and demand levels and expected competition from other market players that are not part of this IPCEI.

(483) On the basis of its analysis of all the available evidence, the Commission has reached the view that none of the aid beneficiaries currently enjoy a market position in the targeted markets of EuBatIn that could suggest possible undue distortions of competition related to the aid measures.

(484) Concerning the six aid beneficiaries identified in the first screening, the Commission has found and assessed the following evidence that dispel possible competition concerns.

(485) Two participating companies, Tokai Carbon and SGL, had a European production share higher than 10% in the artificial graphite product. However, the Commission understands that artificial graphite is mostly sold, in Europe and globally, by Asian and in particular Chinese producers. Taking into account the European and global sales share of these other competitors (both actual and potential), not captured by European production data, the Commission concludes that the current position of both participating companies would not indicate possible undue distortions of competition related to the aid measures.

(486) One participating company, Borealis, has a share higher than 10% in the European production of polypropylene. Borealis within EuBatIn targets the market for separator films for Li-ion batteries. The sales of this product are expected to grow significantly in the next decade and the market is currently dominated by Asian producers with a very marginal European production, including Borealis. For these reasons, the Commission excludes that the aid to this beneficiary raises concerns of possible undue distortions of competition.

(487) Manz is another participating company that has a share higher than 10% for its line of product related to filing machines, while for all the other products, Manz's share of European production is below the threshold of 10%. However, on the basis of more detailed information, the Commission concludes that the markets targeted by Manz as part of EuBatIn are characterized by many competitors and currently mostly Asian competitors are dominating these markets. Indeed, the current sales share of Manz is very limited and also the expected share after EuBatIn is estimated to be very low. For these reasons, the Commission excludes possible undue competition distortions of the aid measures.

(488) Another case that the Commission scrutinised concerns FIAMM. For this case, the Commission notes that the production share of FIAMM is related to the legacy lead-acid products, whereas in EuBatIn FIAMM's target projects concerns Li-on type of batteries. Further, the Commission notes that these latter products are currently produced in large part by a number of other producers, mostly Asian companies, and FIAMM has a negligible share of production in the products that are targeted in EuBatIn. For these reasons, the Commission has no concerns of undue distortions on competition related to the aid for FIAMM.

(489) The last case identified by the screening on production share relates to BMW and is due to its relatively high share in the European production of EV. On the basis of the information provided and the available evidence, the Commission makes the following observations. First, the EV sold in Europe are not only manufactured in Europe but are also sold from non-European producers. Second, the EV are and will be for many years to come still in competition with other type of cars (e.g. cars powered by petroleum fuels or hydrogen cars) and therefore a comprehensive analysis of the competition distortions would have to take into account also the position of BMW in this wider market. Third, the EV market is fragmented and it is attracting the entry of several other players. For these reasons, the Commission does not consider that the aid to BMW unduly distorts competition.

(490) Beyond the above six cases the Commission has also considered more specifically the cases of the aid to Tesla and the aid to Northvolt. As regards Tesla, the Commission considers that the same arguments that apply to BMW apply also to Tesla in particular given that Tesla's European share of sales of EV is lower than the share of BMW. Concerning Northvolt, the Commission considers that Northvolt is equally a new entrant in the market for EV batteries albeit more advanced, as compared to other European new entrants. Nevertheless, the Commission notes that this market is currently dominated by non-European competitors and the same competitors are also expected to be present in the future. Therefore, considering the presence of these other competitors (that will also have production capacity in Europe) the expected share of Northvolt will remain moderate also after EuBatIn. On this basis, the Commission excludes that the aid to these two beneficiaries could unduly distort competition.

(491) The analysis of the detailed information available to the Commission does not identify cases of concerns in relation to possible undue distortions of competition related to dominance or possible foreclosure. In this respect, the Commission concludes that the product markets related to EuBatIn are to a large extent yet to be developed and therefore will expand significantly in the coming years. This is particularly true especially when considering the EEA current situation. Further, with the possible exception of the battery recycling markets, the Commission considers that these markets have a global dimension with many established players and the possibility for many other new players to enter.

(492) As far as the battery recycling market is concerned, the Commission does not exclude that its dimension may be European or smaller. However, despite this market dimension, the Commission has not found indications of possible undue distortions of competition related to EuBatIn. This is in particular

because this market is expected to expand significantly in the coming years, with ample opportunities for other players, both European and non-European, to enter the market and exert a competitive constraint on the aid beneficiaries of EuBatIn. Furthermore, the participating companies that are active the battery recycling market (e.g. Fortum, Hydrometal, Liofit and Little) are currently not involved or only marginally in the recycling of EV batteries, as this market is still in a nascent stage and has yet to be developed to any significant size. Further, given the expected significant increase in volumes and the development of new recycling technologies, the Commission considers that current competitive positions in the battery recycling market do not identify potential competition concerns related to EuBatIn.

(493) Finally, the Member States submit that the total projected battery cell production capacity globally is forecasted to amount to over 1,800 GWh annually in the year 2028. Such projections have been growing for several consecutive years due to accelerating demand for EV for stationary energy storage applications. The Member States further submit that the global demand for EV batteries alone is forecasted to be multiplied by six between 2020 and 2030. In such a scenario of fast growth on the demand side, the Commission considers that EuBatIn will not result in a risk of overcapacity regarding the European production in the markets that are the object of EuBatIn.

(494) The analysis of the detailed information available to the Commission leads to the conclusion that the risks of foreclosure, dominance and overcapacity are limited and that any negative impact on competition is outweighed by the positive effects of EuBatIn. These positive effects of EuBatIn encompass its concrete contributions to the objective of the common European interest (see recitals (341) to (356)) and its benefits of wider relevance to the EU economy that will result, in particular, from the positive spillover effects that will be generated including dissemination of the R&D&I results (see recitals (358) to (370)).

3.3.3.3. Transparency

(495) The transparency requirement, specified in section 4.3 of the IPCEI Communication, is fulfilled (see recital (313) above).

3.3.4. Conclusion on compatibility

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

3.3.5. Reporting obligation

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

(498) As notified by the Member States, the annual execution of EuBatIn activities will be subject to reporting by the participating companies and the Member States. This reporting is three-fold:

- First, the participating companies will report annually the execution of their activities, as regards the technical advancements and individually committed spillovers to the national funding authorities. The reporting period will ideally reflect the annual reporting obligation of the Member States towards the Commission;
- Second, the Member States will provide a summary report (of the companies' execution of their activities) annually to the Commission. As it has been notified by the Member States, a respective 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 published after the initial FG meeting, as well as the respective reporting period; and
- Thirdly, the SB, which has the role to supervise the monitoring and implementation of EuBatIn as a whole (see recital (60)), will report annually to the Commission on the progress of EuBatIn (including through key performance indicators). The reporting period shall ideally follow the reporting of the Member States to the Commission.

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

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

4. CONCLUSION

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

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

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

Your request should be sent electronically to the following address:

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

Yours faithfully,

For the Commission

Margrethe VESTAGER
Executive Vice-President

CERTIFIED COPY
For the Secretary-General

Martine DEPREZ
Director
Decision-making & Collegiality
EUROPEAN COMMISSION

ANNEX I

CLAW-BACK MECHANISM

The aid is capped in nominal terms by the notified and actual eligible costs. Member States will also ensure that the discounted value in 2020 terms of the aid (using the notified WACC as a discount factor) will not exceed the notified funding gap.

The claw-back mechanism will apply to those aid beneficiaries having a notified aid amount, per Member State, above EUR 50 million[34] in total (in case of subprojects[35], for all subprojects together) in that Member State[36].

The basis for the claw-back mechanism (whether at subproject level, if any, or otherwise at project level) will be *ex post* figures, which have been subject to annual approval by an independent auditor. For this purpose, separate analytical accounting (in case of different subprojects, at the level of each subproject) will be required from the aid beneficiaries in the relevant Member State.

Letter of credit

Starting as from 30 June 2027 and then, every five years, until an "End date"[37] to be determined depending on the durations of the projects/subprojects a test will be run ("the test-run") and the following $Surplus_i$ for year i (i=2026, 2031…) will be computed as the sum (positive or negative) of:

(a) the net present value discounted in year "i" (using the notified WACC as a discounting factor[38]) of the actual *ex post* audited post-tax cash flows (including Capex, excluding State aid payments and financing cash flows) from 2020 to year "i"; and

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[34] This threshold of EUR 50 million of aid amount is to be understood in discounted terms in 2020 value terms when notified by the relevant Member State or in nominal terms in the absence of the former. If the aid eventually disbursed to the aid beneficiary is lower than the notified aid amount and lower than EUR 50 million (in discounted terms, in 2020 value terms), the Project will be relieved from this claw-back mechanism. In such case, the Member State disbursing the aid commits to inform the Commission of the occurrence of a lower than notified aid amount and of the inapplicability of the claw-back mechanism within 2 months after final disbursement of the aid.

[35] A subproject is defined as each project for which a separate funding gap calculation has been notified. If that is the case, the claw-back mechanism will be applied at the level of each notified subproject.

[36] Clearly identifiable beneficiary projects/subprojects which are determined as unsuccessful by both the company and the Member State (i.e. commercially non-viable) and are terminated before the End date, will not be subject to the claw-back clause.

[37] The End date (only for the purposes of this claw-back mechanism) is set at the year corresponding to the end of FID + 5 years, or of R&D&I + 5 years for those projects and subprojects with no FID. In the case of multiple FID stages within the same subproject, 5 years should be added from the end of the latest of those FID stages. In case of delays in implementing the project compared to the timeline forecasted in the notification, the relevant end of FID will be the actual one, as verified by the relevant Member State.

[38] This means that for instance, for the test-run in 2027, a cash flow in 2020 will be multiplied by (1+WACC)^(6).

(b) the net present value discounted in year “i” (using the notified WACC as a discounting factor) of the actual aid disbursements from 2020 to year “i”.

The $Surplus_i$, if it is positive, will be multiplied by an allocation ratio “$Share_{State}$”, equal to the lesser between 60% or the net disbursed State aid from 2020 to year “i” divided by the verified eligible costs from 2020 to year “i” (both expressed in nominal terms and relating to the applicable project/subproject, if there are several subprojects).

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

A letter of credit (by a reputable financial institution having investment grade rating from a first-rank rating agency) should cover the repayment obligation at the End date by the aid beneficiary, from the first test-run (that is, mid-2027).

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

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

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

- $Surplus_i$, multiplied by $Share_{State}$ (computed at that test-run) and

- The sum of the actual State aid disbursements between 2020 and that test-run expressed in terms of the year “i” of the test-period. For all the disbursements before that test-run, the discount factor will be the EU reference rate applicable to the Member State concerned according to the Commission's communication on setting the reference and discount rates[39] applicable at year “i”, increased by 100 basis points between the corresponding disbursement and year “i”.[40]

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

The application of the claw-back mechanism will be reported by the relevant Member State to the Commission within 1 month following completion of each test-run and after the End date (e.g. first reporting on application of the claw-back mechanism in July 2027).

Account with annual transfers

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[39] OJ C 14, 19.01.2008, p.6.

[40] NB: Written in the form of a formula, this means that after each test run, a transfer from the company to the Account (respectively from the Account to the company) takes place so that the overall balance of the Account reaches the following

$MAX(0; MIN(Surplus_i;$ State Aidsubproject (in NPV 2020 terms, multiplied by [1+$BaseRate_j +$ 1.0%]^(i-2020)))

Alternatively, the Member State, instead of the letter of credit system described above, may opt for an account-based system. This system will apply exclusively if the two following conditions are both met: a) the account to be used for the purpose of applying the claw-back mechanism is not under the control of the aid beneficiary; and b) computations and transfers to/from the account by the aid beneficiary must take place once every year[41] until the End date.

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

This account-based system must not be more favourable from the aid beneficiary perspective than the letter of credit system[42] and should ensure comparable results[43].

The annual application of the claw-back mechanism will be reported by the relevant Member State to the Commission within 1 month following completion of each test-run (e.g. for projects starting in 2021, first reporting on application of the claw-back mechanism in July 2022 and thereafter every July until the final application after the End date).

[41] Not later than in the first six months of the year following the year of implementation the project (e.g. for a project starting in 2021, by end June 2022 at the latest).

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

[43] The competent services of the Commission will provide to the participating Member States a template in Excel format to assist them in the implementation of this claw-back mechanism, including in the form of an account-based system. This template should allow for comparable results of the account-based system with the “letter of credit” system when discounting both the final payment in the “letter of credit” system and the annual transfers to/from the account with the WACC.

ANNEX II

LIST OF ABBREVIATIONS

AI:	Artificial intelligence
API:	Application programming interface
ASSB:	All solid-state batteries
BMS:	Battery management system
CAPEX	Capital expenditures
CNT:	Carbon nanotubes
C:	Carbon
Co:	Cobalt
Cu:	Copper
DICS:	Distributed imbalance compensation system
DVP:	Design verification plan
EMS:	Energy management system
EoL:	End of Life
ESS:	Energy storage system
EV:	Electric vehicle
FEM:	Finite element method
FG:	Facilitation Group
FID:	First industrial deployment
FRAND:	Fair, reasonable and non-discriminatory
GA:	General assembly
HBS:	Hybrid battery system
HEV:	Hybrid electric vehicle
HPC:	High performance computing management system
HTP:	High throughput platform
HW:	Hardware
IoT:	Internet of Things
IP:	Intellectual property
IRR:	Internal rate of return
KERS:	Kinetic energy recovery system
KPI:	Key Performance Indicator
Li-ion:	Lithium-ion
$LiPF_6$:	Lithium hexafluorophosphate
Li-S:	Lithium sulphur

LFP:	Lithium iron phosphate
LIB:	Lithium-ion batteries
LTO:	Lithium-titanium oxide
Mn:	Manganese
Na:	Sodium
Na/NiCl2	Sodium nickel chloride batteries
Ni:	Nickel
NCA:	Cobalt aluminium oxide
NMC:	Nickel cobalt manganese oxide
NPM:	N-methyl pyrrolidone
NVPF:	Cathode material $Na_3V_2(PO_4)_2F_3$
OEE:	Overall effectiveness efficiency
OEM:	Original equipment manufacturer
OPEX:	Operating expenses
PAB:	Public Authority Board
PCI5:	Phosphorous pentachloride
PO:	Polymer
PVdF:	Polyvinyl difluoridine
R&D&I:	Research, development and innovation
RES:	Renewable energy source
RFB:	Redox-flow batteries
RTO:	Research and Technology Organization
SAPB:	Strategic Action Plan on Batteries
SB:	Supervisory Board
Si:	Silicon
SIB:	Sodium-ion batteries
SME:	Small or medium sized enterprise
SoC:	State-of-charge
SoH:	State-of-health
SW:	Software
TCO:	Total cost of ownership
TMS:	Thermal management system
TRL:	Technology readiness level
VIP:	Vacuum panel system
UPS:	Uninterruptible power supply
WACC:	Weighted average cost of capital
WS:	Work stream(s)