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Deployment of electromobility: how to develop the european battery supply?

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Batteries play a major role in the decarbonisation of the economy, by facilitating the electrification of uses and the shift to renewable energy sources. In 2023, global battery production amounted to 2400 GWh, 7% of which was produced in Europe. China was by far the largest producer with 83% of global production.

The increasing need for batteries, mainly driven by electromobility, has led to a sharp increase in european imports of batteries, which amounted to €27 billion in 2023, slightly above the european production level (€24 billion). In sum, european battery production

capacities – including both cell production and the integration of battery packs – cover just over half of the domestic needs of manufacturers based in Europe.

Given the strategic role of this industry, the European Union has swung into action to strengthen its battery production capacities. Several large-scale projects have been supported and developed in France, in particular in the context of Important Projects of Common European Interest (IPCEIs). In France, the gigafactory projects announced should eventually reach a production capacity of 115 GWh of cells and thus meet the substantial needs of the automotive sector.

1 The electrification of transport has significantly increased the need for batteries in recent years

Batteries are emerging as a crucial element of everyday life and are expected to play a major role in the environmental transition. Indeed, not only are batteries essential for the functioning of the devices that surround our daily lives (smartphones and other personal electronic devices), they are also essential for the electrification of transport and clean mobility. Indeed, combustion engine vehicles account for a quarter of CO2 emissions in France and the electrification of transportation accounts for 17% of the reduction effort needed to achieve France's 2030 emissions targets (SGPI, 2023, 2024). Beyond their central role for mobility, batteries enable the storage of electricity which is key to the development of renewable energy sources, especially solar and wind. Several battery technologies are available, in particular lithium-ion batteries (see Box 1).

Battery prices have fallen sharply in recent decades, thus driving a strong demand. Driven by technical progress and scale effects, the average price of a cell has decreased from almost $1,000/kWh in 2001 to around $100/kWh in 2024 (almost 10% per year on average). This declining trend was temporarily halted in 2021 and 2022, in particular with the rise in the price of the materials used in the cathode. This downward trajectory in battery prices, which is expected to continue in the coming years as the result of new innovations, has strongly supported demand: the volume of lithium-ion batteries used worldwide has increased fourfold since 2020 to reach 2 400 GWh in 2023 (See AIE, 2024).

After several years of growth, sales of electric vehicles (100% electric or plug-in hybrid) in Europe have grown at a slower pace than expected lately. Between January and July 2024, slightly fewer electric vehicles were sold in the EU than in the same period in 2023 (-1.7%). However, total sales, including all types of engines, increased slightly (+3.9%). These figures contrast with the strong sales growth observed in the first seven months of 2023 compared to 2022 (+30.2%). Nevertheless, this slowdown is less pronounced in France, where sales of electric vehicles increased by 5.1% between January to July 2024 and the same months of 2023 (See ACEA, 2023, 2024).

Global battery and battery components production is highly concentrated around Asian producers. Battery production itself is very capital-intensive and the continuous improvement of battery performance requires substantial investments in R&D. Hence, three

BOX 1
What is a battery?

Lithium-ion batteries account for two-thirds of rechargeable batteries sold worldwide and are the dominant chemistry for electric mobility. The global battery market is made up of several technologies with characteristics suited for different uses. We distinguish primary batteries (or single-use only batteries), for low-consumption applications, from secondary (or rechargeable) batteries, which account for 94% of batteries sold worldwide. Among the latter, lithium-ion batteries are the dominant technology, whether in electric mobility or stationary storage (See. Avicenne Energy, 2024).

Lithium-ion batteries are made up of several cells that store and release electricity. The 'cell' is the main component of the battery because it delivers electricity through an electrochemical interaction between two electrodes: the negative electrode, called anode, generally composed of graphite, and the positive electrode, called cathode, composed, for example, of lithium, nickel, manganese and cobalt in the case of the 'NMC' chemistry. The interaction takes place through a conductive material, the electrolyte, that is generally liquid and contains lithium ions, solvents and additives. Then, the cells are put together to make a «module» in which cells are protected from external shocks, heat and vibrations. Finally, what is commonly referred to as a "battery" is the assembly of several of these modules. The whole is managed by an electronic system (Battery Management System, or BMS) and may include other applications such as thermal management, fire detection or remote communication systems. The 'battery' (also referred to as battery pack) is the final form of the battery system installed in an electric vehicle.

Metal-based components account for the majority of the manufacturing costs of cells, which in turn make up the majority of the costs of a battery. In the case of NMC chemistry, cells account for about 70% of the total costs of the battery pack. When producing a cell (and thus the anode and the cathode), a manufacturer has to source various components (cathode and anode materials, separator, electrolyte). Consisting of various metals, these components alone account for 60-70% of the cost of a cell. The cost of these critical components represents half of the turnover generated by the sale of cells (McKinsey, 2024 ; ACC, 2024, Roland Berger, 2022 ; Element, 2022).

Energy batteries* differ in their capacity, i.e. the amount of energy they can store and release after recharging. Capacity is defined as the amount of power that the battery can release in one hour and is measured in kWh. A battery capacity usually ranges from 15 to 100 kWh. The larger the size of a battery and the higher its energy density, the greater its capacity**. The production capacity of a battery plant is the sum of the capacities of the batteries it can produce. Thus, a gigafactory of 15 GWh can theoretically equip 300,000 vehicles with 50 kWh batteries each year.

*** They are different from power batteries whose purpose is to deliver a significant amount of energy over a short period of time (e.g. 30 minutes).**

****The energy density of a battery is defined as the amount of energy that can be stored in a unit of mass or volume (e.g. in watt-hours per litre or Wh/L).**

companies concentrate two thirds of the global market for electric vehicle batteries: China's CATL, the global leader with a 37% market share in 2023, Korea's LG Chem and Japan's Panasonic. Moreover, the upstream stages of the value chain are largely dominated by a few companies and, in particular, Chinese companies, whether it is for the extraction or the refining of raw materials. In 2023, the total capacities of Chinese producers added up to 83% of global production, compared to 75% in 2020. In comparison, Europe and the United States together account for only 13% of global production (7% and 6% respectively) (IEA).

Several factors argue in favour of strengthening EU's productive capacity. Batteries could be a more important input to electric vehicles than motors are to thermal vehicles (in terms of their share of value added). However, as demonstrated by (Mayer et al., 2024), the automotive market is quite intracontinental, with an incentive for proximity between vehicle production and battery supply. According to the innovation Council, strengthening battery production capacity is a way of bolstering the automotive sector, which faces major economic challenges, particularly in terms of activity and employment, both in Europe (european Commission, 2024 ; Draghi report, 2024) and in France (Théma de la DGE, 2022, 2024). Moreover, battery production plays an important role in promoting technological innovations, with spill-over effects for the whole economy. Finally, producing a battery (and its main components) in Europe is likely to reduce its carbon footprint because the electricity consumed by european gigafactories is on average less carbon-intensive than elsewhere. As it happens, the production phase concentrates most of the carbon footprint of an electric vehicle, unlike a thermal vehicle for which the impact is mainly generated during the use phase.

A The european battery industry relies on Asian stakeholders

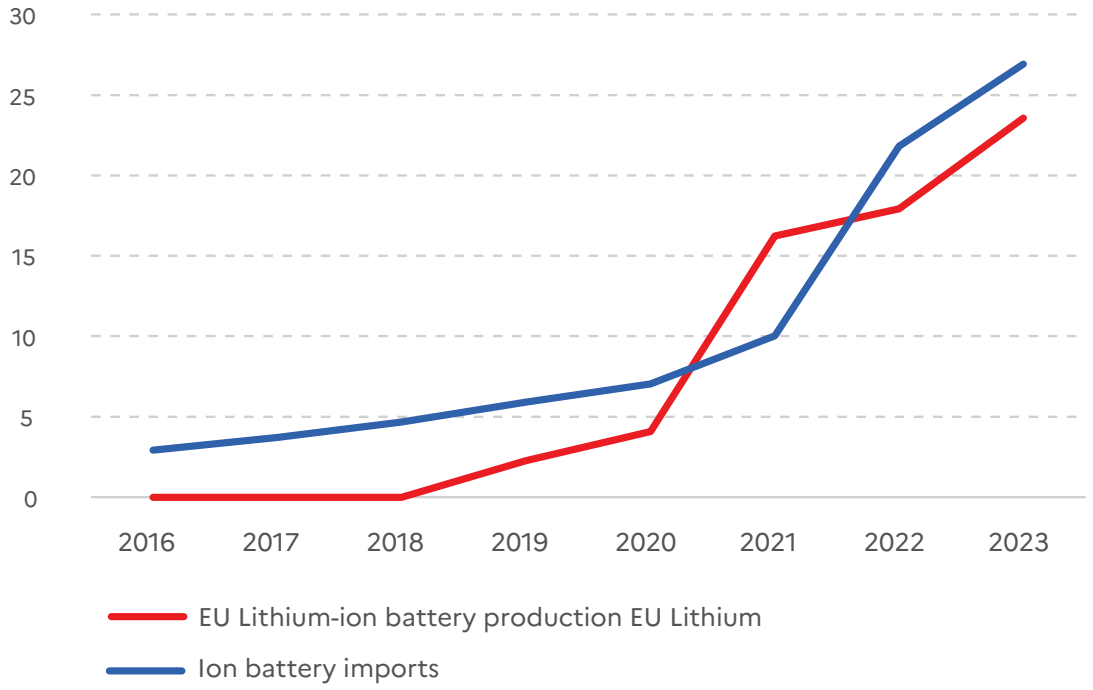
If european battery production has increased significantly in recent years, it is partly due to the presence of non-european players installed in Europe. European battery production has thus reached €24 billion in 2023[1] (+45% compared to 2021). This increase inproduction can be explained by the arrival of large non-european companies: LG in Poland, CATL, Samsung and SK Innovation in Hungary, Tesla in Germany. On the whole, 75% of existing european production capacity comes from Korean companies, with LG's plant in Poland alone accounting for half of this capacity (AIE, 2024). Despite the significant increase in its production capacity, the EU's share in global battery production remains low, at around 7% (IEA, 2024). Nevertheless, according to *BenchmarkMineral*, the presence of these players in Europe is likely to reduce european dependence by rapidly delivering volumes to european car

1 Import and production estimates include several phases of the battery (cells, modules and battery pack). The battery packs taken into account in european production can be produced from imported cells.

manufacturers, currently facing international competition on the electric vehicle market[2].

The growing demand for batteries in Europe has led to a sharp increase in imports. Driven by the needs of the automotive industry, european battery imports reached approximately €27 billion in 2023, which is significantly higher than in 2021 (see Figure 1). Given the highly concentrated nature of battery production, around 90% of battery imports come from three main Asian countries only, China alone accounting for 87% of european imports (see Figure 2).

Figure 1: Evolution of EU battery production and imports (€ billion)

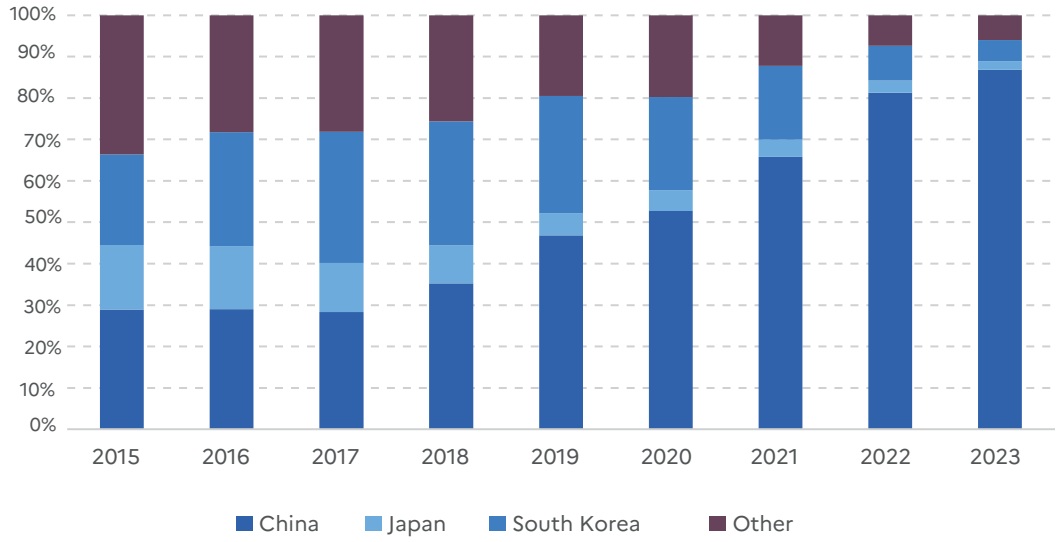


Note: Production and imports of batteries are estimated as the sum of the data relating to the following codes: [27201150; 27201160] Lithium cells and batteries (excluding button cells); and [27202350] lithium-ion accumulators. The most represented category is lithium-ion accumulators, accounting for 98% of imports and 89% of the production in 2023. These product codes bring together several stages of the battery production process (cells, modules and battery pack).

Source: Eurostat.

2 According to T&E, the share of 100% electric cars sold in Europe and imported from China could increase from around 20% to 25% between 2023 and 2024, half of which concern Chinese brands. Between 2015 and 2023,the share of european brand electric vehicles sold in Europe decreased from 80% to 60% (IEA, 2024).

Figure 2: Trends in the distribution of the EU's imports by supplier country



Source: Eurostat

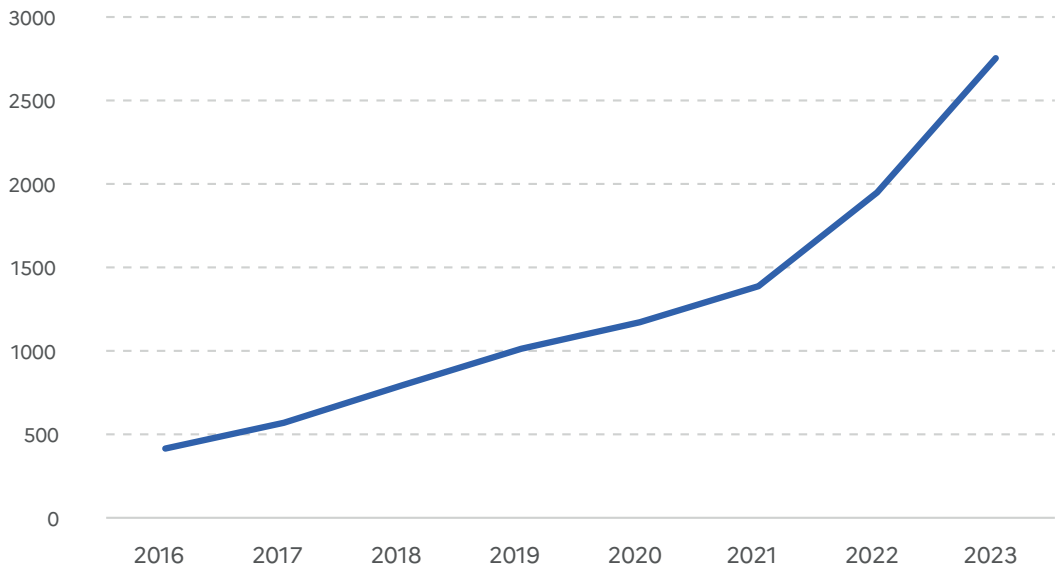
Despite the sharp rise in imports, half of Europe's electric vehicles are equipped with batteries produced in Europe. EU battery production covers around half of its needs[3] (55% in 2023). According to the IEA, with its current installed production capacity, the EU should even be able to equip 80% of electric vehicles produced in Europe. For example, Volkswagen benefits from a close cooperation with two of the world's largest battery manufacturers, LG Energy Solutions and Samsung, whose european production sites supply 95% of their electric cars sold in Europe. However, the dependence of the battery sector is growing with the demand for electric vehicles, especially as the majority of the active materials needed to produce these batteries come from China.

The market for electric vehicles and battery packs is mostly a local market. According to the CEPII, the average distance between the battery pack producer and the car manufacturer is only 683 km. For instance, Germany is the first importer of batteries in the EU with an import value of €21 billion[4], and 62% of its imports come from European producers, in particular from Poland and Hungary. This proximity between battery pack production and EV production is partly explained by the high costs and risks the transportation of the battery packs involves. Consequently, imports from outside the EU are mostly limited to battery cells that are subsequently assembled on the continent into battery packs. This proximity can also be explained by the fact that the design of the battery is highly dependent on the model of the car.

3 Needs here are estimated as the sum of production and imports net of exports based on Eurostat data.

4 This estimate is based on statistical data available on the eurostat website and does not enable the distinction between battery cells, packs and modules.

Figure 3: Evolution of battery imports in France, 2016-2023 (amount in €M)



Note: The amount is estimated as the sum of the data relating to the following codes: [27201150; 27201160] Lithium cells and batteries (excluding button cells); and [27202350] lithium-ion accumulators. French imports are mainly lithium-ion accumulators, accounting for 97% of imports in 2023.

Sources: Customs, Eurostat.

B France is also highly dependent on Asian battery producers, in particular for electric vehicle production

While french production has increased significantly in recent years, dependence on Asia remains significant for electric vehicle batteries. In 2022, french of battery pack production reached around €360 million, increasing by 25% since 2021. However, so far, France produces very few lithium-ion cells, which means that battery packs assembled locally are composed almost exclusively of imported cells.

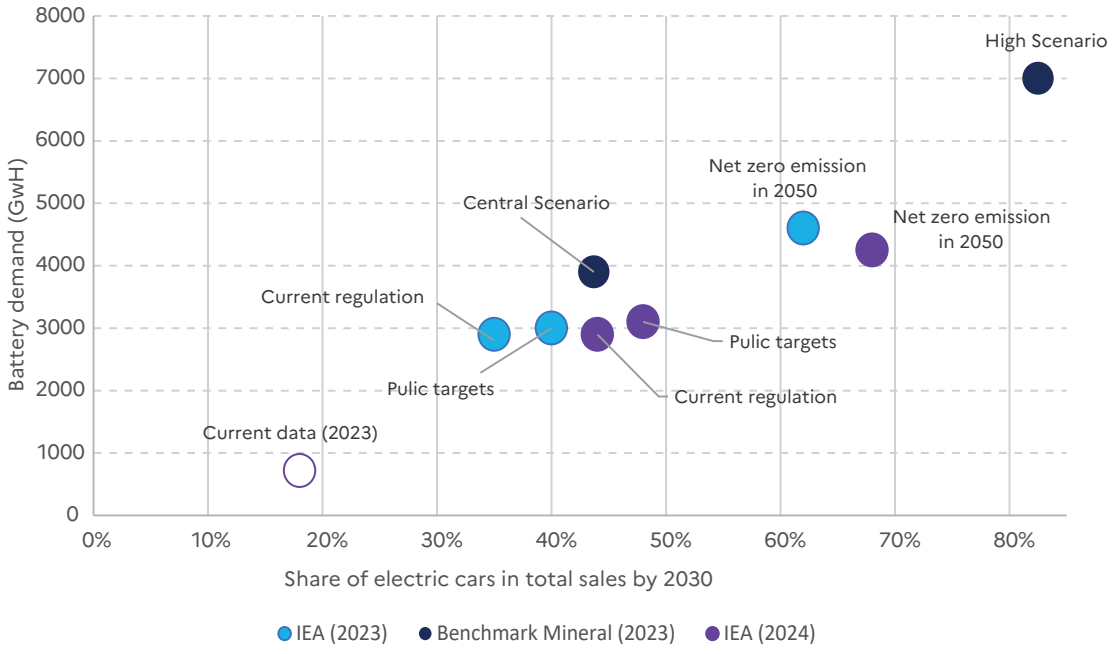
In the context of the dynamic demand driven by electric mobility, french imports have steeply increased in recent years. Since 2016, French imports of batteries have increased sevenfold, reaching a value of €2.8 billion in 2023 (see Figure 3). China remains the main supplier, accounting for 40% of imports, followed by Poland (30%) and Japan (8%). The main importers of batteries in France are automobile and motorcycle manufacturers, accounting respectively for 47% and 5% of french industry imports.

C With transport electrification, global battery needs are expected to increase sharply in the coming years

Global projections of battery demand largely depend on vehicle electrification scenarios. The International Energy Agency estimates the need for batteries by 2030 on the basis of the number of electric vehicles that will be produced and put into circulation worldwide, a projection that remains largely uncertain. The IEA therefore presents two scenarios,

the first based on the implementation of the current regulation and the second on the achievement of the objectives announced by the public authorities (see Chart 4). Both scenarios conclude that global demand for batteries will reach around 3,000 GWh by 2030. The IEA also presents a third scenario that is more ambitious and consistent with the objectives of the 2015 Paris Agreement. In this scenario, sales of non-electric vehicles would be in the minority, which would result in a demand of 4,600 GWh in 2030 for light-duty vehicles and 5,500 GWh for all mobility-related uses. For its part, the specialized consultancy Benchmark Minerals anticipates a demand of 3 900 GWh by the 2030. This scenario relies on the assumption of a 45% market share rate for electric vehicles among all vehicles sold in 2030. Overall, the different scenarios lead to a battery demand ranging between 2 900 and 3 900 GWh which corresponds to a market share rate of electric orhybrid vehicles between 35% and 48%. For comparison, the IEA estimates the demand for electric vehicle batteries to be around 715 GWh in 2023. Future demand for batteries will also be driven by intermittent energy storage needs.

Figure 4: Global battery demand scenarios for 2030 based on the penetration rate of electric cars in new vehicle sales (100% electric or plug-in hybrid)



Note: The IEA scenarios are «Current regulation» (STEPS), «Public Targets» (APS) and «Net zero emission in 20250» (NZE).

Source: For IEA, based on GlobalEVOutlook 2023 and 2024 and GlobalEVDataExplorer. for Benchmark Minerals, according to the publication of august 2023.

BOX 2
Commodity availability constraint

Battery production is highly dependent on raw materials, especially metals, representing a significant part of production costs (depending on the price of these metals). Various metals can be used depending on battery technologies, such as NMC (Nickel-Manganese-Cobalt) and LFP (Lithium-Iron-phosphate), although lithium is essential for most current energy battery technologies. Essential metals, used in the currently dominant chemistry (NMC), include cobalt, nickel and lithium. Global demand for lithium for battery production has increased by more than 30% since 2022, reaching 140,000 tons, and 85% of total lithium demand (IEA, 2022).

Its local production being very limited, the European Union (EU) is highly dependent on imports for its supply of critical metals for batteries. In particular, China, which dominates the extraction and refining of critical metals, controls more than half of the world's lithium, cobalt and graphite processing capacities. The European Commission predicts that Europe will need 18 times more lithium and 5 times more cobalt by 2030, thus requiring investments in storage and recycling to increase the resilience of european production chains. The Critical Raw Materials Act is designed to encourage Member States to diversify supply chains and strengthen the resilience of production chains.

One issue in securing supplies of critical raw materials is that of their future availability. Indeed, these markets are volatile and subject to environmental, social and governance risks. In addition, capacity risks (lack of production leading to price increases or even shortages) can drive significant price fluctuations. Indeed, due to an unprecedented demand for batteries and a lack of sufficient investment in new supply capacities, lithium prices in May 2022 were more than seven times higher than at the beginning of 2021. Because of these security challenges, stakeholders try to strengthen their control over the upstream phases of the entire value chain.

2 In this context, the European Union and France have adopted proactive support policies to strengthen battery production

A The EU and France promote the emergence of a battery supply to deal with the future ban on the sales of new petrol and diesel cars

In line with the ambitious CO2 reduction targets set by the European Union under the Green Deal and Fit for 55, no new vehicle generating CO2 emissions will be sold in Europe from 2035 onwards, (except vehicles running on synthetic fuel). The electrification trajectory of vehicles should then strongly support the demand for batteries.

The European Union has adopted the Regulation on batteries and battery waste, **which aims to promote the sale of sustainable batteries on**

the european market, and to ensure that they are properly collected and processed at the end of their life. It regulates the production and end-of-life management of all the types of batteries sold in the EU, including those produced outside the EU. In particular, it will compel producers to indicate the carbon footprint of their batteries (starting in 2025, for all electric vehicles). From 2028, the Regulation provides for a carbon footprint threshold for electric vehicle batteries, to be defined by the Commission.

The Net Zero Industrial Act (NZIA), adopted by the European Parliament on the 25th of April 2024, sets non-binding, 'green' technology production targets for Member States. The NZIA targets a 90% market share of european producers in EU's battery demand, with a production capacity of at least 550 GWh/year in 2030 (European commission, 2024). To achieve this objective, the NZIA suggests mobilising public procurement by allowing public buyers discretion in the assessment of the non-price criteria when purchasing green technologies, unless the cost gap is above 15%. The Regulation also requires simplified authorisation procedures to facilitate the installation of new plants.

Support for battery production in Europe dates back to 2017. In October 2017, an alliance was created between several EU Member States and industry stakeholders, with the aim of developing battery production capacities and advanced battery technologies in the EU. This was followed by the publication of the European Commission's Strategic Action Plan on Batteries in May 2018 and a Franco-German declaration in December 2018. In April 2019, the European Commission submitted an implementation report while France presented its first « Plan Batteries ». In 2021, the « Stratégie nationale batteries » will follow the Battery Plan as part of the "France 2030" investment plan. At the european level, twelve Member States supported sixty-eight projects for a total of €6.1 billion in state aid, thus supporting €14 billion in private investment, within the scope of two Important Projects of Common European Interest (IPCEI)[5] on Batteries, authorised by the European Commission in décember 2019 and january 2021.

In total, four companies were supported in France through battery IPCEIs, with one battery cell gigafactory project (ACC) and four projects on advanced materials for batteries (Arkema, Tokai Cobex Savoie and two Syensqo projects). In addition to the IPCEIs, two gigafactory projects, led by Verkor et Prologium, received a specific authorisation from the Commission in 2023 and contribute to reinforcing production capacity on french territory. Public support for these seven projects amounts to €2.6

5 The IPCEI is a State aid instrument to promote innovation in strategic and forward-looking industrial areas. It allows at least four Member States to provide national public funding coupled with private funding. National funds can finance the phases of a project that precede production, i.e. research, development and innovation (RDI) and first industrial deployment (FID) (Théma de la DGE N°17).

billion, supporting private investment for more than €10 billion. These projects have in common very significant capacity investments, some of which are supported by the State. The construction and operation of a gigafactory such as that of ACC is the culmination of a long-standing project, marked by the creation of a research centre and then a pilot line, and for which the development of a technology (a product but also a production process) and the search for financing and customers are crucial factors for success. Since battery cell production projects are highly capital-intensive, it takes several years between the investment decision and the start of commercial production. Beyond public support, France has other assets for gigafactory projects such as the cost of electricity, the visibility on its price thanks to the possibility of long-term contracts and its low-carbon footprint, a major factor of competitiveness and therefore of investment decision. The proximity to the port of Dunkirk has also played a role in attracting gigafactories to the Hauts-de-France region. More generally, the early structuring of public research in electrochemistry and materials science (RS2E) and the presence of industrial players already established in the field of vehicle batteries (such as Blue Solutions and Forsee Power) or other use batteries (such as Enersys or Saft, currently owned by TotalEnergies, one of the three co-shareholders of ACC) have contributed to strengthening France's attractiveness.

Beyond these seven projects, almost €550 million was spent on more than 80 projects across the battery value chain. These projects play a major role in reducing european dependencies on raw materials, whether through the extraction or the recovery of imported metals supplying european gigafactories. For example, the Imerys project in Allier should extract lithium under the already existing kaolin quarry and could contribute to the production of around 700 000 electric batteries. Other supported projects aim to develop and industrialise an innovative process for the extraction of geothermal lithium, particularly in eastern France. At the other end of the value chain, France 2030 supports projects on critical metals and recycling solutions, such as the Scrap CO2MET project, which aims to recycle waste from Verkor's future gigafactory through an innovative process developed by the french company mecaware. More generally, the recycling of future batteries will be an industrial challenge as the recycling units under construction will have to scale up sufficiently to absorb the waste from future batteries. Nevertheless, these flows to be processed represent a significant opportunity to reduce Europe's dependence on critical metals through recycling and other key factors (alternative chemicals, vehicle size, innovations to improve the density of the battery pack, etc.) (Carbone4, 2022). Global needs for primary metals could peak around 2035 (RMI, 2024).

Thanks to two additional projects, Verkor and Prologium, France will be able to further increase its battery production capacity, keeping in line with the objective of the France 2030 investment plan to produce 2 million electric vehicles annually. The ACC, Envision AESC, Verkor and Prologium projects should allow for the development of a production capacity of up to 115 GWh per year from 2030**.** This battery production capacity is expected to meet the target of the France 2030 plan for the production of 2 million electric or hybrid vehicles, assuming an average battery capacity of 50 to 60 kWh. By way of comparison, 1.8 million vehicles were sold in France in 2023, including 470,000 electric or plug-in hybrid vehicles while a little more than 1.5 million vehicles were produced on the territory (French Government, 2024 ; Usine Nouvelle, 2024). In addition, post-2030 Blue Solutions project could significantly increase french capacities and contribute to equipping european electric vehicles with new generation batteries. However, France and Europe could remain largely dependent on the upstream segments of cell production, be it the extraction, refining or conversion of raw materials (CEPII, 2024). According to estimates by the european Battery Alliance T&E and McKinsey, european capacities for the production of cathode and anode materials in 2030 will remain well below european demand, while according to the IEA, China would account for more than 90% of global capacities for the production of these active electrode materials.

In addition, new industrial projects can now benefit from the Green Industry Tax Credit (C3IV). Based on a European Temporary Framework, approved by the Commission in january and which entered into force in march 2024, this scheme will enable players in the battery sector to benefit from a tax credit of up to €200 million if the industrial site is located in a less developed area than the rest of the territory (regional aide area type 'c'). In the case of a large company and a project located in

Table 1: State aid committed on the battery value chain since 2019 (grants and repayable advances, EUR million)

Family of scheme	Date of decision (EU ou Fr)	Extraction and refining of raw materials	cell components	Cells and battery systems	Recycling and sustainability	Total (with aid for industrialisation)
Total		65	195	2 780	140	3 250
IPCEI Battery 1 et 2 + assimilated	**Dec. 2019 - Nov 2023**	-	70	2 635	-	2 705
Others projects	**June 2021 - Janu. 2024**	65	125	145	140	545

Source and explanatory notes: The use of batteries is not restricted to electric vehicles. For projects supported under one of the two IPCEI Batteries (and other projects), the aid was approved by the European Commission over a period from December 2019 to November 2023. For the other projects, the expenditure was incurred from June 2021 to January 2024 under the France 2030 investment program. Aid to the manufacturers of the equipment required for the production of the listed products or to service providers for support in industrialisation are added to the total. Some segments were not included in the scope of the analysis as they constituted a downstream segment of the battery. This is particularly the case for charging stations, the assembly of electric vehicles or the production of other components of electric vehicles. The allocation of a project to a segment is indicative because it may differ depending on our technical understanding of the project, of its evolution or of the classification used.

regional aid area of type 'c', the tax credit amounts to 25% of productive investments, which differ from the expenditure for research, development or innovation. For other (non regional aid) geographical areas The C3IV is capped at €150 million and 20% of investments.

Finally, these battery supply support schemes have been complemented by the introduction of the green bonus as of 15 December 2023, which aims to steer the demand for batteries towards those with the most environmentally friendly production and the lowest carbon footprint. This support scheme aims to support the purchase[6] of new 100% electric vehicles whose production has the best environmental performance and the lowest carbon-footprint[7]. It relies on an environmental score incorporating several components, such as the carbon footprint of the battery production, calculated according to a method developed by Ademe and published on 7 October 2023. This footprint increases in particular with the battery capacity (measured in kWh) and the carbon intensity of the electricity mix.

B Europe could cover its own demand for batteries as early as 2025

Projections of battery supply and demand remain highly uncertain. In 2023, european battery production was able to meet half of the continent's needs (T&E, 2024). Looking at scenarios from ten different sources, there is a considerable uncertainty about these projections for 2030: for this set of scenarios, the minimum, median and maximum values of the battery supply and demand at different time horizons are presented, Chart 5.

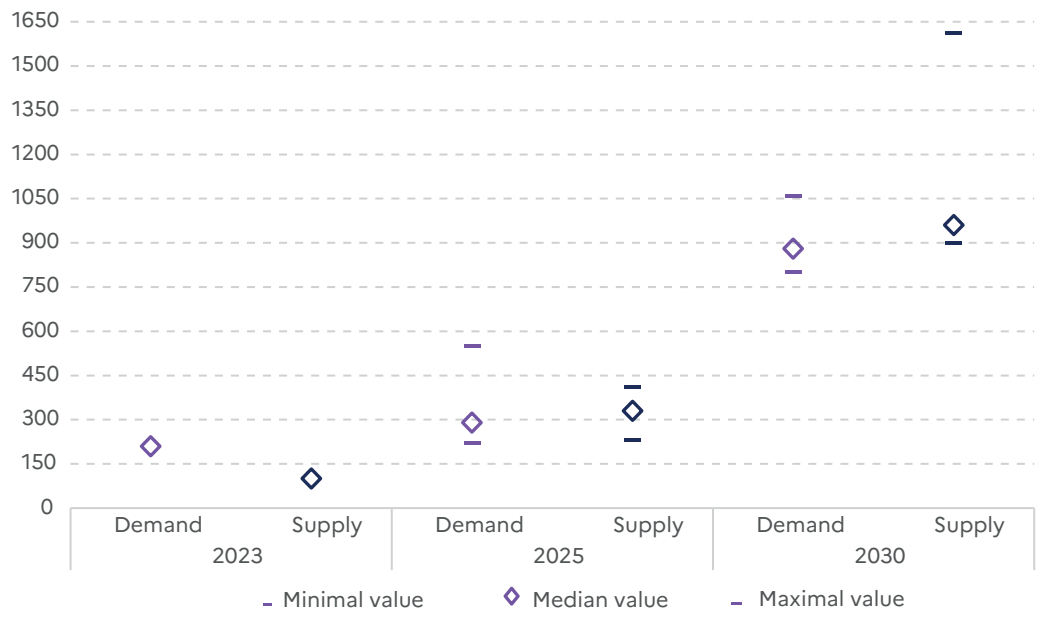
According to these scenarios, if the projects announced by battery manufacturers are not delayed or cancelled, Europe could achieve its objective of producing enough batteries to meet European car manufacturers' demand by 2025 (BenchmarkMineral, 2024). Production could thus exceed the estimated 300 GWh needed to equip all of european electric or plug-in hybrid vehicles. By 2030, if all companies maintain their announced projects, total production could absorb 900 GWh of anticipated demand.

However, a number of challenges will need to be addressed to make such a battery production level on the european territory possible. First, the

6 The aid amount is €4 000 if the reference tax income (RFR) is less than EUR 15 400/year and EUR 7 000 if the RFR is above this threshold. The income conditions for vehicles ordered from 14 February 2024 are summarised here.

7 The list of vehicles that achieved the minimum environmental score was published on 14 décember 2023 and is completed on a monthly basis. It now contains more than 70 models represented by twenty brands. The ten best-selling models in France are generally eligible for the bonus.

Figure 5: Forecasts of supply and demand of batteries for electrical mobility in Europe (GWh)



Note: The minimum, median and maximum values include a published or confidential estimate from a panel of ten sources for projections of battery supply and demand. The battery supply is estimated on the basis of the announced capacity net of the capacity utilisation rate of the plant, and of production losses. Net announced capacity is calculated on the basis of the maximum capacity of the plants, assuming that their construction is not delayed or cancelled. An 85% utilisation rate, based on that of CATL in 2022, is applied to estimate the average utilisation rate of a plant. The value obtained is then reduced by 10% to estimate the part of the production that has not been lost (scrap rate). The demand is estimated from the battery needs of electric vehicles produced in Europe (100% electric or plug-in hybrid cars, buses and trucks).

Sources: T&E (2024) ; European Battery Alliance (2023) ; Christophe Pillot Avicenne Energy (2024) ; European Court of Auditors (2023) ; BMI (2023) ; IAE (2023) ; McKinsey (2023) ; StratAnticipation (2023).

availability of labour and the competitive access to equipment and to other factors of production will be a challenge to the realisation of the announced capacities. Then, producers will have to continuously innovate to maintain the quality of the batteries produced in a highly competitive environment and thus be able to meet the demand for competitive batteries on the market. Moreover, european battery production will depend on the industrial learning acquired by the new gigafactories and the more or less rapid achievement of their target scrap rates. According to Avicenne Energy, these industrial difficulties taken as a whole could result in a realisation rate of announced capacities of around 60% in 2030. Finally, reducing dependencies in the field of batteries implies taking into account the entire value chain, and not only the production of cells.

European production is expected to develop in a highly competitive international context. In particular, China produces volumes of batteries that exceed its domestic needs and are therefore destined for export markets. (Alochet, 2023 ; MIT, 2023) .In 2023, the production of batteries on Chinese territory should have reached 1,100 GWh for an internal demand of only 600 GWh (all-purpose lithium-ion batteries produced,

Avicenne Energy, 2024), even though battery and battery component factories are very far from operating at their maximum capacity (IEA, 2024 ; BenchmarkMineral, 2024). For its part, North America should roughly produce up to its domestic needs, despite the accelerating investment[8] and the limited uptake of electric vehicles.

8 According to BMI, from August 2022 (enactment of the Inflation Reduction Act) to May 2023, the US production capacity announced for 2031 increased by 58% and reached the announced european capacity, which, in turn, hardly increased over the period (3%). Data from MIT or the US government also show an acceleration of investment in the battery sector.

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