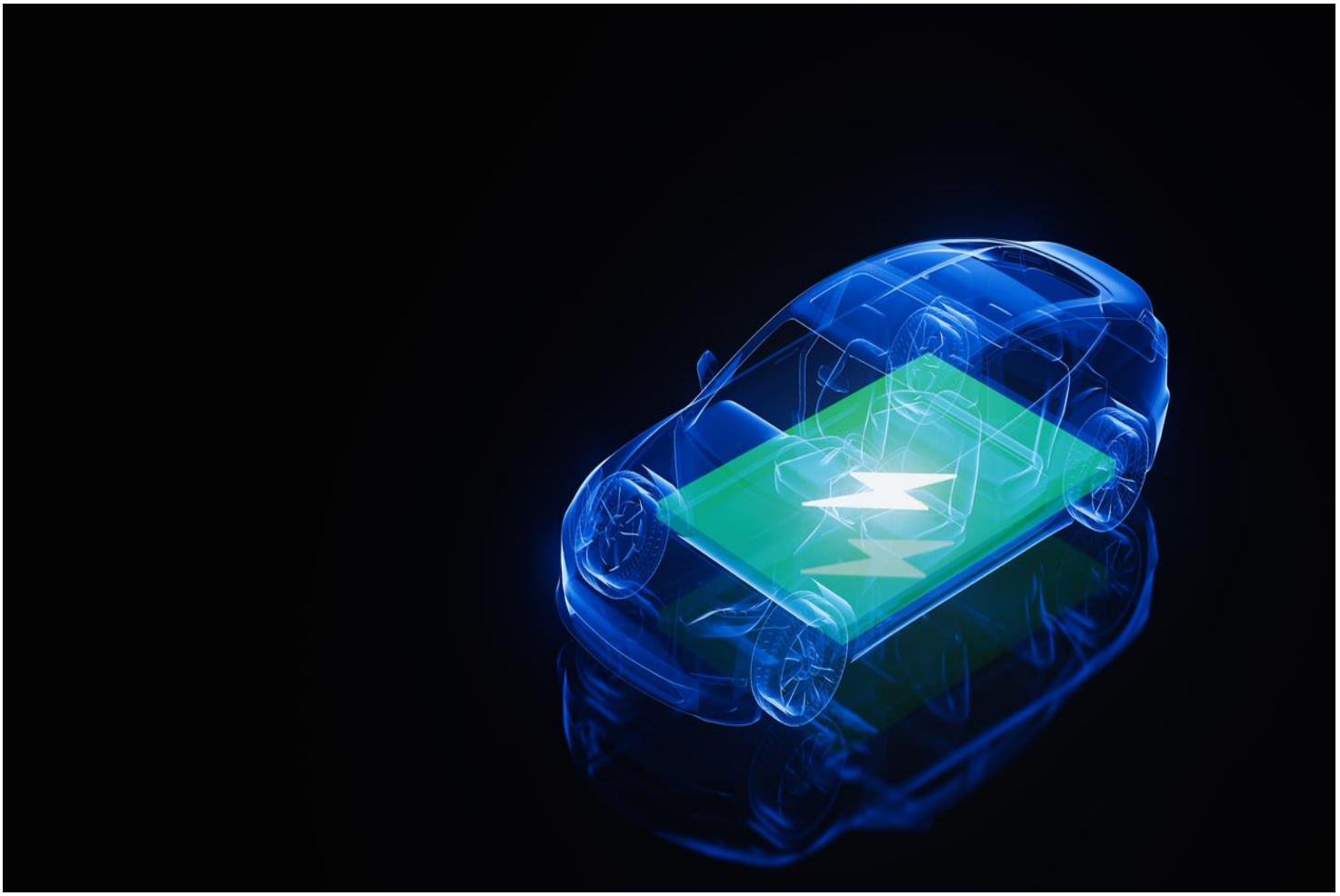
MENON ECONOMICS

REPORT

BATTERY SUBSIDIES IN THE EU, NORWAY, AND THE US



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Foreword

Menon Economics, commissioned by NHO, has carried out an analysis of the state of public support programmes for green technologies in Europe and the USA, in view of recent changes to the respective subsidy regimes. The study, which is the first in a series of three reports, focuses on the battery industry. The series also covers the hydrogen and offshore wind industries.

The Inflation Reduction Act has been hailed as the world's largest subsidy program for the battery industry, having significantly improved investment profitability in battery production in the USA. This public support programme prompted the EU to respond quickly, relaxing existing state aid rules and allowing Member States more flexibility to provide state aid. The analysis provides a detailed examination of the public support programmes in both regions, examining their effects on investment profitability.

The analysis was led by Jonas Erraia. The analytical team consisted of Piotr Śpiewanowski, Einar S. Wahl, Henrik Foseid. Erik W. Jakobsen provided quality assurance.

Menon Economics is a research-based analysis and advisory company at the intersection of business economics, economics, and industrial policy. We offer analysis and advisory services to companies, organisations, municipalities, counties, and ministries. Our main focus is on empirical analysis of economic policy, and our employees have economic expertise at a high scientific level.

We thank NHO for an interesting project. We also thank all interviewees for their valuable input during the process. The authors are responsible for all content in the report.

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May 2023

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Executive summary

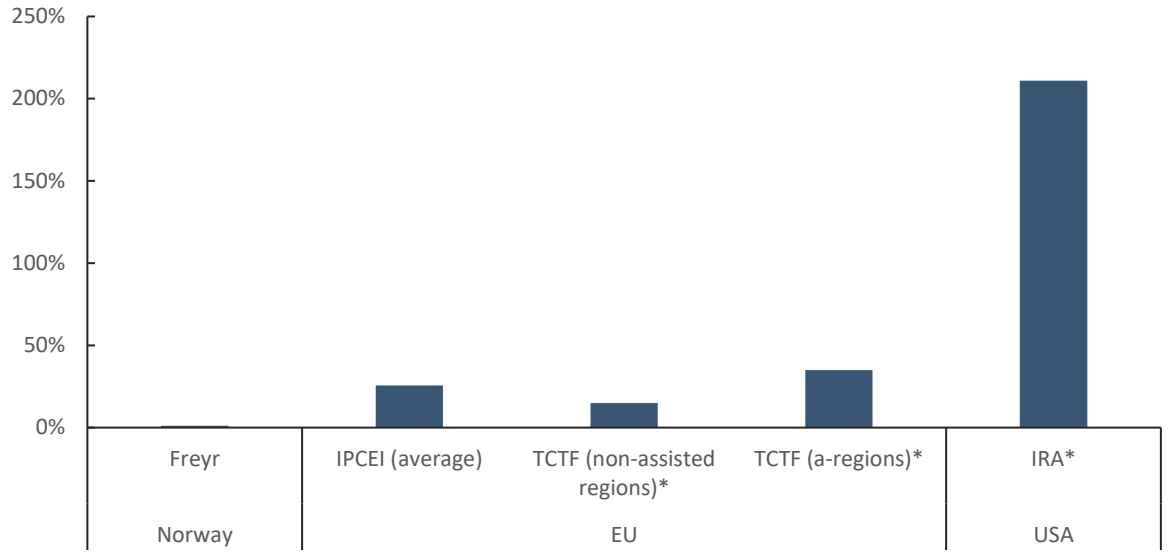
As the world makes the shift towards electric vehicles, there has been an unparalleled rise in demand for batteries in major automotive markets worldwide. However, with China being home to a significant proportion of global battery production and other crucial net-zero technologies, both the USA and Europe have introduced substantial subsidy packages to encourage local battery manufacturing.

We estimate that battery manufacturers in the USA will receive a substantial subsidy of approximately USD 150 billion over the next decade through the Inflation Reduction Act, which was enacted in August 2022. The majority of this subsidy will be provided as a production subsidy, with manufacturers receiving USD 35 for every kWh of battery cell capacity produced, and USD 45 per kWh for producing battery packs, covering approximately 30 percent of production costs. Furthermore, battery manufacturers can benefit from investment subsidies through local support programmes provided by individual states and from public support for both upstream and downstream industries, including electric vehicle subsidies that require locally produced batteries. This clause, however, has been heavily contested by US trade partners. Based on our analysis, battery producers are likely to receive subsidies equivalent to more than 200 percent of their initial investment costs throughout the subsidy period.

The substantial subsidy package implemented in the US has triggered a swift response from the European Union, in the form of a significant relaxation of the strict state aid regulations. Prior to this, public support for European battery producers was mainly offered through fragmented programs focused on research, development, and innovation, along with pilot projects. However, with the introduction of IPCEI, a EUR 6 billion public support framework for the battery supply chain, certain battery producers have received state aid amounting to over 25 percent of their total investment costs. The support can be even greater with the newly modified Temporary Crisis and Transition Framework (TCTF), which enables EEA states, including Norway, to offer higher levels of state aid and in exceptional cases, match the state aid provided in other countries. Nevertheless, in contrast to the US, the application procedure remains complicated and is assessed on a project-by-project basis.

Battery producers in Norway have so far received significantly lower levels of state support, with the total aid received amounting to approximately one percent of their total investment cost, as demonstrated in the figure below. However, Norwegian producers have benefited from significant state loan guarantees. However, it is unlikely that the historical data accurately reflects the level of state aid that battery manufacturers can anticipate receiving in the future. This is due to recent extensions of the support programmes, most importantly TCTF. The figure below presents the expected and historical levels of state aid for battery cell manufacturing.

Figure: Actual and estimated state-aid intensity under various regimes in Norway, EU, and USA. Source: Menon Economics



*Estimated values of state aid intensity

The analysis of public support regimes reveals that the level of subsidies available to US battery producers significantly exceeds those accessible to their counterparts in the EU and Norway. Despite the recent introduction of new aid for European battery producers, this disparity is likely to influence EU investment decisions negatively. As the profitability of producing batteries in the US is considerably higher than in Europe, we anticipate a decrease in expected production capacity in Europe, resulting in slightly higher battery prices to compensate for investors' elevated required rate of return compared to the scenario without IRA. On a separate note, the level of subsidies offered in the US may be above the socially optimal level, thus imposing excessive costs on the taxpayer. We estimate that the per-job-cost of the US subsidy will equal roughly USD 1 million annually.

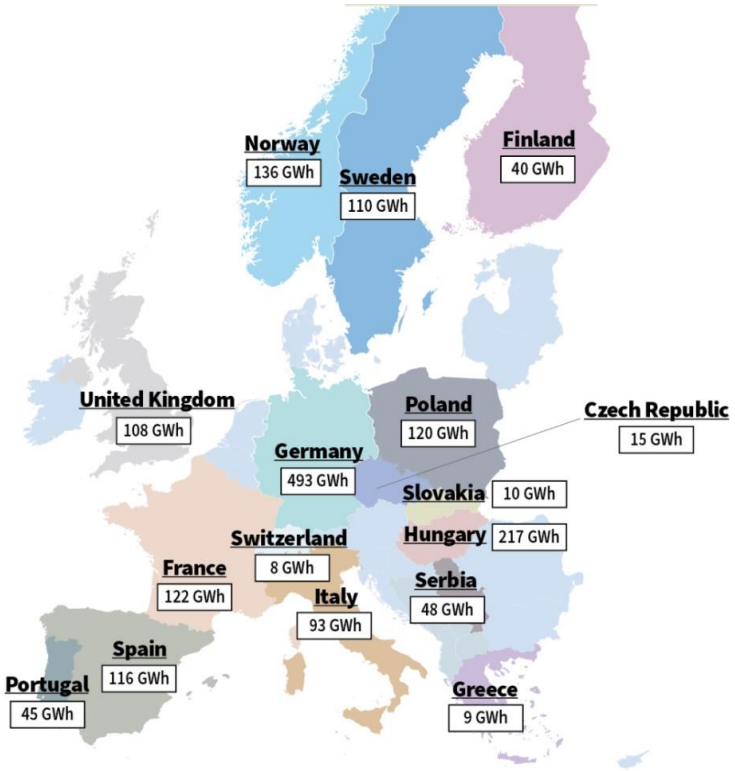
Despite the US offering a higher level of public support, there are compelling reasons to anticipate an increase in battery production in Europe. One of the primary factors is the regionalisation of the battery and car market. Furthermore, Europe enjoys a more secure demand growth for electric vehicles due to the impending ban on fossil fuel vehicles starting in 2035. Several other factors come into play when deciding on investment location, including tax regimes, political stability, access to infrastructure, a skilled workforce, and more, many of which make European countries attractive. Regarding Norway, Norwegian battery producers highlight their local roots, connections to Norway, and access to relatively cheap renewable energy, providing a significant strategic competitive advantage and making it more pertinent to keep certain aspects of production in Norway.

Introduction

With the world transitioning towards electric vehicles, there has been an unprecedented surge in demand for batteries in major automotive markets across Europe, the US and China. Through 2030, the demand for batteries is projected to increase by approximately 30 percent per year, approaching 4,500 gigawatt-hours (GWh) globally, while the battery value chain is expected to expand up to tenfold between 2020 and 2030, generating annual revenues of up to USD 410 billion.

In the US the annual production capacity is expected to grow from 90 GWh in 2022, to 177 GWh by the end of 2023. Considering the already announced battery plant projects and their planed capacity in the United States, Canada and Mexico, annual production capacity is expected to increase to 350 GWh in 2024, and exceed 800 GWh in 2025, before reaching nearly 1000 GWh by 2030.[1,2] Estimates[3] from before the introduction of the IRA predicted that Europe could experience a similar surge in annual production capacity, from an estimated 70 GWh in 2022 to 300 GWh in 2025, 620 GWh in 2027, and 1,375 GWh in 2030. This massive surge in European production capacity is reflected in the 50 gigafactory projects that have already been announced (see Figure 1).

Figure 1: Battery production capacity in Europe in 2030 based on announced projects. [4] Source: T&E



[1] *https://publications.anl.gov/anlpubs/2022/11/178584.pdf*
[2] *Estimate based on planed battery plants announced before November 2022*
[3] *https://www.transportenvironment.org/wp-content/uploads/2023/03/2023_03_Battery_risk_How_not_to_lose_it_all_report.pdf*
[4] *T&E has estimated the capacity of Norwegian production to be 136 GWh by 2030. Morrow stands for 43 GWh, Beyonder for 10 GWh, and Freyr for 83 GWh. Of the planned capacity for Freyr's production in Norway, we can only confirm the 43 GWh at the Giga Arctic factory in Mo i Rana. Although Freyr as a company has announced further capacity expansions the geographical location is yet to be determined. Hence, by our estimation the planned capacity in Norway by 2023 is at 96 GWh.*

For the forecasts to materialise the industry on both sides of the Atlantic needs to overcome several challenges. *Li-Bridge*[5] – a Department of Energy initiative lead by Argonne National Laboratory and involving leading experts in the business and technology of lithium battery manufacturing in North America – has identified seven key challenges facing the industry:

1) Insufficient Return on Investment on Long-Term Projects
2) Lengthy and uncertain timelines to secure permits and project approval, especially upstream
3) Lack of Access to Critical Minerals and Raw and Processed Energy Materials
4) Lack of R&D- and pilot-scale line capacity for the commercialisation of new technology
5) Lack of domestic technical know-how, especially in midstream activities
6) Limited suitable sites served by reliable clean energy
7) A lack of domestic suppliers of key manufacturing equipment and reliance on protective, overbooked foreign suppliers.

The existing and planned public support programmes for the battery industry address those challenges to varying degrees. The Inflation Reduction Act (IRA), touted as the world's largest subsidy program for battery production and the entire supply chain, has led to a significant increase in the expected rate of return for the US battery projects due to production subsidies offered. The legislation also favours US-based producers and according to EU representatives violates World Trade Organisation's treaties stipulating that countries may not discriminate against imported product. The significant change in relative profitability between USA and Europe has started to threaten the industry's growth plans in Europe and in Norway, where the existing state aid regimes until recently focused more on providing subsidies for research and development and pilot projects rather than full scale production. According to a recent report by T&E think tank 68 percent of potential battery production capacity in Europe is at risk of being delayed, scaled down or not realised if further action is not taken.

While the EU has no flagship green subsidy scheme comparable to the IRA, it has a multitude of public support initiatives at EU and national levels. However, in its response to IRA, the EU has recently relaxed state aid rules, at least until end of 2025, allowing Member States to match the incentives offered in other countries.

In the light of the uncertain future of the battery industry, this report provides an overview of the public support programmes for green technology in Norway, the EU, and the US. Firstly, we provide a concise introduction to the IRA and Europe's newest programmes the Net Zero Industry Act as well as the extended Temporary Crisis and Transition Framework relaxing state aid rules for green technology investments. Secondly, we present an in-depth analysis of the public support schemes available to battery producers in two regions. Given the large differences in support within the EU, we exemplify public support for the industry by looking at public support received by select battery projects in Norway, Sweden, France, and Germany. Finally, we conduct a comparative analysis of the profitability of investment in battery production facilities under the various subsidy schemes available in different countries.

It is important to note that the current subsidy landscape for green technologies in Europe and the US is fast-moving and evolving. This analysis represents our best understanding of the content of the various laws, proposed laws, as well as the subsidies already awarded.

[5] *https://www.anl.gov/sites/www/files/2023-02/Li-Bridge%20Industry%20Report_2.pdf, The source*

A brief introduction to public support for green technologies

Public support programs play a crucial role in promoting emerging technologies or industries that offer public benefits but are faced with market barriers. The production and implementation of renewable and low-carbon hydrogen, for instance, require public subsidies to offset the cost differential between these alternatives and fossil fuels, as well as to encourage the necessary infrastructure and technology development for the hydrogen supply chain. As technology matures, the amount of subsidies needed to bridge the gap decreases. As we show in this report the approach taken by the EU and US in determining the value of subsidies for the hydrogen industry differs between the two regions. Those differences may affect investment decisions project profitability.

In the United States, federal support programs such as the Inflation Reduction Act (IRA) often offer fixed levels of subsidy for net-zero technologies. This subsidy can take the form of a direct payment per unit produced for production subsidies or a fixed percentage of investment costs for investment subsidies. The level of subsidies may differ among technologies and change over time, however only at a predefined rate without considering potential changes or other factors that could affect regional differences in project profitability. While this approach has the advantage of being low in administrative burden, it carries a high risk of either over- or under-compensation.

Public support programs for green technology in Europe are generally more complex and fragmented than in the US. While the IRA subsidies primarily focus on mass deployment of green technologies, the main objective of EU programs has traditionally been research and innovation. This distinction is in part due to the European Union's strict state aid rules, which aim to prevent unfair competition between Member States. These regulations require that state aid must not unduly distort competition in the single market and must be necessary and proportionate.

In the past, state aid rules in the EU allowed Member States to allocate funds proportionally to the funding gap, or the difference between the total costs of a project or investment and the amount of private funding available to finance it. To determine the existence of a funding gap, the European Commission requires a thorough analysis of the investment or project, including a detailed assessment of the costs, potential revenues, and the availability of other sources of funding. The analysis should demonstrate that the investment or project would not be viable without the aid, and that the aid is necessary to fill a genuine funding gap. The approach focused on closing the funding gap guarantees the required profitability for the supported projects. However, it often results in lengthy administrative processes and relatively limited funding for mass production of mature technologies thus not enabling speeding up mass deployment of strategic technologies.

The differences between the level of subsidy resulting from the approaches may lead to differences in investment profitability between the regions and thus affect investment decisions. To address this issue, the EU has recently proposed to extend the possibility to subsidise strategic technologies allowing state aid matching subsidies in other regions. The EU has also proposed to support production of renewable energy commodities through subsidies at a level determined at competitive auctions. This mechanism will minimise public funding required to achieve the European hydrogen production goals.

When comparing subsidy schemes across different regions, it is important to understand that the objective of industrial policy is not solely to maximise the value of public support, and subsidies are not the primary determinant of investment decisions. There are various reasons for this. Firstly, subsidies can differ significantly in their design, making some easier to obtain or more extended than others. Secondly, investment decisions are influenced by multiple factors beyond just subsidies, such as local production costs, resource and labour

availability, and expected demand. Thirdly, if subsidies surpass the necessary level to incentivise the desired production, they become inefficient, and taxpayers bear the additional cost.

However, the relative size of subsidies still plays a role since, all else being equal, companies aim to maximise their profits and may select regions with higher subsidies to locate their production facilities. Therefore, while subsidies should not be the sole factor considered, they can significantly impact a company's decision-making process.

Public support for battery production in the US

In the next decade, we estimate that battery producers in the USA are set to receive a significant subsidy of roughly USD 150 billion under the IRA. This subsidy will be primarily provided through a production subsidy, with manufacturers receiving USD 35 for every kWh of battery cell capacity produced, and USD 45 per kWh for producing battery packs, covering approximately 30 percent of production costs. Additionally, the producers stand to benefit from public support for upstream and downstream industries, including electric vehicle subsidies that have a requirement for local content as well as support through local support programmes provided by individual states. The production subsidy is disbursed to all producers and is best regarded as a simple cash transfer through the tax system, though it is not depending on having sufficient tax liabilities to be offset with. A key feature of the subsidy structure under the IRA is that it does not involve lengthy and uncertain application processes.

There are a few public support programs introduced by the US government that aims at supporting the battery industry. In this analysis we will focus on two of these. The first, and by far most important, is the Inflation Reduction Act (IRA). The is the Bipartisan Infrastructure Law (BIL). In total, the White House has stated that through public support programs USD 135 billion will go towards building an electric vehicle future, including critical minerals and battery production.[6]

Brief introduction to the IRA

The 2022 United States Inflation Reduction Act (IRA) is a legislative package that combines green subsidies with healthcare savings and new revenue measures including climate-related spending in the order of USD 400 billion over 10 years. It is a significant step in US climate policy and is expected to reduce two-thirds of the greenhouse-gas emissions gap between current policy and the US 2030 climate target.[7]

Battery producers are among the largest subsidy recipients in the IRA. Official White House estimates suggest that production subsidies to battery producers, a fixed amount per unit of energy storage capacity produced, would amount to USD 30 billion over the next ten years,[8] however other estimates suggest the actual amount would be five times higher.[9] The production subsidies include direct pay provisions which allows projects to receive the full tax benefits through direct payments even without sufficient tax liability to offset with. Some IRA subsidies discriminate against foreign producers including those from EU. However, recent talks between the USA and EU indicate that the discriminatory clauses can be amended in favour of the EU producers.[10]

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[6] *https://www.whitehouse.gov/briefing-room/statements-releases/2022/10/19/fact-sheet-biden-harris-administration-driving-u-s-battery-manufacturing-and-good-paying-jobs/#:~:text=The%20Bipartisan%20Infrastructure%20Law%2C%20CHIPS,and%20processing%20and%20battery%20manufacturing.*

[7] *Kleimann et al. (2023)., How Europe should answer the US Inflation Reduction Act, Policy Contribution Issue n˚04/23, February 2023 available at https://www.bruegel.org/sites/default/files/2023-02/PB%2004%202023_0.pdf*

[8] *https://www.cbo.gov/system/files/2022-08/hr5376_IR_Act_8-3-22.pdf*

[9] *https://www.forbes.com/sites/christinemcdaniel/2023/02/01/the-cost-of-battery-production-tax-credits-provided-in-the-ira/?sh=7e5dcb5f79ef*

[10] *https://ec.europa.eu/commission/presscorner/detail/en/speech_23_1672*

Direct production and investment subsidies

The subsidies provided by the IRA to the battery industry have significantly altered the dynamics of the battery market. The size and accessibility of the public support program have been the driving force behind this change. Producers based in the United States can opt for either production or investment subsidies.

The IRA production subsidy amounts to USD 35 per kWh for battery cells, with an additional USD 10 per kWh provided for battery modules. In 2022, the cost of manufacturing a complete battery module (battery pack) in the US was USD 157 per kWh. As such, the subsidy covers almost 30 percent of the production cost.[11] This subsidy is accessible to all battery manufacturers in the United States and is allocated based on the number of kWh produced, making it specifically targeted at mass production. Battery manufacturers may alternatively receive investment subsidies of up to 30 percent of the investment cost, though they cannot combine these with production subsidies. US battery producers, can, however, also receive investment subsidies from local support programmes provided by individual states.[12]

The public support provisions that impact the battery industry cover four main categories: production tax credit, investment tax credit, consumer tax credit, and domestic content requirements. Tax benefits for the battery industry come in the form of direct deductions from taxes payable, not deductions from taxable income.

The sections of the IRA most relevant to the battery industry are briefly described below and in Table 1.

[11] *EBA Discussion Paper for the 7th High-Level Meeting of the European Battery Alliance*
[12] *As an example, Our Next Energy received in October 2022 USD 215 million from Michigan Strategic Fund against USD 1.6 billion investment in battery gigafactory.*

Table 1: The most significant incentives in the IRA for battery manufacturers.

Type of public support	Description	Requirements and comments
§45X, Advanced Manufacturing Production Credit **Tax credits on the production of battery components and batteries**	Tax credits for qualified components used in batteries: -Electroactive materials: 10% of manufacturing cost -Battery cell: USD 35 multiplied by the capacity of the battery cell measured in kWh -Battery module: USD 10 (USD 45 if the battery module does not use battery cells) multiplied by the capacity of the battery module measured in kWh -Critical mineral: 10% of the production cost[13]	The tax credits in the section can be used independently so that producers of several qualifying products can claim tax credits for each stage of production. Requirement that production must take place in the USA.
§48C, Advanced Energy Project Tax credit **Tax deductions on investments in production facilities**	Tax deduction on a percentage of the investment cost of establishing production facilities for (among others) batteries and battery components[14], electric vehicles and critical minerals	The legal text refers to "energy storage systems and components". We understand this to apply to batteries and battery components, but both we and industry stakeholders are unsure of the interpretation. This is an application-based scheme with a total budget of USD 10 billion, which is awarded according to given criteria. Advanced Energy Project Tax credits cannot be combined with Advanced Manufacturing Production Credits.
	30% of the investment cost	There are requirements for business and production and requirements for wages and the use of apprentices.

Without comparison, the most important part of the IRA for battery producers is the production tax credit (§45X). These tax benefits are granted directly to the players in the battery industry, which has a direct impact on the financial situation of the company. The subsidies are not capped in anyways, neither in terms of the amount of production, the type of battery produced, or the use of the battery. Production must take place in the US, but there is no local content requirement. The subsidy applies from the tax year 2023 until 2029. From 2030 to 2032, the production subsidy will be phased out, so that for 2030 the subsidy will be 75 percent from the current level, in 2031 it will be 50 percent and in 2032 it will be 25 percent. After this, subsidies will be phased out.[15]

Production subsidy offers significantly thus substantial level of support for a large-scale battery production plant. However, an investment subsidy may be the preferred option for battery producers more focused on R&D and pilot projects as it is not based on the number of kWh produced, for other parts of the value chain the investment subsidy can be focused on R&D, pilot projects and mass production. The investment subsidy is application based as opposed to the production subsidy and total programme is capped at USD 10 billion.

There is considerable uncertainty about the cost of this subsidy, as it is based on the number of batteries produced, but the Congressional Budget Office has estimated the subsidy at USD 30.6 billion for the period 2022 to 2031.[16] We consider the likely cost to be significantly higher. USD 30.6 billion worth of subsidies corresponds

[13] The list of minerals defined as critical is available here: https://www.orrick.com/en/Insights/2022/11/Section-45X-of-the-Inflation-Reduction-Act-New-Tax-Credits-Available-to-Battery-Manufacturers
[14] https://www.circulor.com/inflation-reduction-act-detail
[15] https://uscode.house.gov/view.xhtml;jsessionid=F42D93F077C27D9E05C64299513981F3?req=38&f=treesort&fq=true&num=1813&hl=true&edition=prelim&granuleId=USC-prelim-title26-section45X
[16] https://www.cbo.gov/system/files/2022-08/hr5376_IR_Act_8-3-22.pdf

to 100 GWh production capacity. This is below the level of production capacity expected by the end of 2023 this year.[17] Others have estimated the cost of the production subsidies to reach above USD 150 billion.[18] This level of subsidies, is compatible with an annual production capacity of 1,000 GWh by 2030 as outlined in the introduction.[19]

Indirect subsidies

IRA also offers indirect support for the US based battery producers through tax breaks for purchases of EVs. 50 percent of the total tax break amounting to USD 3,750 is conditional on the car battery meeting local content requirements. These tax breaks, which are given to individuals or businesses that purchase an electric vehicle, affect the battery industry in indirect ways. By supporting the demand for electric vehicles, the demand for batteries will increase. This provision can also, at least in the short run, increase the profitability of US-based battery producers in the case of shortages of domestically produced batteries that are required to make cars eligible for subsidies. Recently, some relaxations of the local content have been proposed and negotiations on further concessions between the US administration and various trade partners still ongoing.[20]

Table 2 below shows the main provisions of IRA for electric vehicles. It should be noted that IRA also provides tax credits for investments in electric vehicle manufacturing facilities. These tax credits could help increase the production of EVs in the US and thus increase the demand for EV batteries. Tax credits for investments in manufacturing facilities for EVs are not mentioned in the Table 2 below but are included in Table 1 under §48C.

[17] During the period of full production aid and starting from cell production.
[18] https://www.forbes.com/sites/christinemcdaniel/2023/02/01/the-cost-of-battery-production-tax-credits-provided-in-the-ira/?sh=7e5dcb5f79ef
[19] Assuming 75% capacity utilisation.
[20] https://www.ft.com/content/6b7fdca1-d2ab-41b4-aad1-73b87e2d4bbd

Table 2: Main public support schemes in the IRA for electric vehicles.

Type of support	Description	Requirements and comments
§30D, Clean Vehicle Credit **Tax deduction for vehicles for personal use**	Tax credit of up to USD 7,500 on the purchase of an electric car, of which up to USD 3,750 if the car meets the requirements for critical minerals in the battery and USD 3,750 if the car meets the requirements for battery parts.	- Requirements for critical minerals[21] - Requirements for battery parts[22] - Requirement that the car is assembled (final assembly) in the USA - Several requirements for the car and the battery - Ceiling on income and price of the car
§45W, Credit for Qualified Commercial Clean Vehicles **Tax deductions for commercial vehicles**	Commercial electric vehicle tax credit of up to USD 7,500 for smaller vans, etc. and USD 40,000 for larger vans, heavy-duty trucks, etc. The tax credit is the lesser of 30% of the sales price or additional cost of the electric vehicle compared to the equivalent internal combustion engine vehicle.	- Several requirements for the car and engine - *No* similar requirements for battery or minerals as for passenger cars

In addition to the subsidies mentioned in the paragraphs above, IRA provides subsidies to developers of energy storage technology and homeowners who purchase this technology. This subsidy will have an indirect effect on the battery industry by strengthening the demand for batteries, but we consider the effect to be small compared to the subsidies provided through production tax credit, investment tax credit and the subsidies provided to buyers of electric vehicles.

IRA also provides tax credit for US-based critical mineral mining companies and producers of electrode active materials, an amount equal to 10 percent of the costs incurred with respect to production of such materials, which is likely to decrease to some extent the battery production costs in the US. However, as those products are also traded on a global market it is unlikely that the US-based battery producers would capture the entire decrease in after-tax production costs. In addition, there exists severe bottlenecks in terms of scaling up American mineral production and refining.

Bipartisan Infrastructure Law

The Bipartisan Infrastructure Law (BIL) is a major infrastructure initiative with a total budget of USD 550 billion. It was passed and signed into law by President Joe Biden on November 15, 2021. Parts of the BIL aim to support the green transition in the US, although the scale is much smaller than the IRA.

There are two parts of BIL that has an impact on the battery industry. First, there are two application-based subsidy programs named "Battery Material Processing Grant Program" and "Battery Manufacturing and Recycling Grant Program"[23] that subsidise projects for raw mineral extraction, material processing, production

[21] *Requirements for critical minerals: A percentage of the percentage value of critical minerals must be mined or processed in the United States or a country with which the United States has an effective free trade agreement or recycled in North America. The percentage rate is gradually increased from 40 percent before 2024 to 80 percent after 2026. The United States currently has FTAs with Australia, Bahrain, Canada, Chile, Colombia, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Israel, Jordan, Korea, Mexico, Morocco, Nicaragua, Oman, Panama, Peru, and Singapore (https://www.circulor.com/inflation-reduction-act-detail).*

[22] *Requirements for battery parts: A share of the value of the parts in the battery is manufactured or assembled in North America. The share increases from 50 percent before 2024 to 100 percent after 2028.*

[23] *https://www.congress.gov/bill/117th-congress/house-bill/3684/text*

of battery parts and recycling of batteries. These subsidy programs are aimed at demonstration and commercial scale projects and has a combined budget of USD 7 billion.[24]

On October 19th, 2022, the first round of funding under the "Battery Material Processing Grant Program" and "Battery Manufacturing and Recycling Grant Program" were granted. It provided subsidies for 21 selected projects with a total allocation of USD 2.8 billion.[25] The combined investment cost for all 21 projects is USD 9.1 billion, of which the government share represents 31 percent. The subsidy as a percentage of the project's investment cost was not fixed. The project with the lowest subsidised share was granted 14 percent of its investment cost, whereas other projects were granted up to 50 percent.

Second, BIL indirectly supports the battery industry through the construction of electric vehicle charging infrastructure with a worth USD 7.5 billion. In addition to replacing public fossil fuel buses and ferries in the US with US-made electric versions to a sum of USD 7.5 billion.[26] These measures will increase the demand for EVs. Hence, increase the demand for batteries.

[24] *https://www.energy.gov/articles/biden-administration-announces-316-billion-bipartisan-infrastructure-law-boost-domestic*
[25] *https://www.energy.gov/sites/default/files/2022-11/DOE%20BIL%20Battery%20FOA-2678%20Selectee%20Fact%20Sheets.pdf*
[26] *https://www.whitehouse.gov/briefing-room/statements-releases/2021/07/28/fact-sheet-historic-bipartisan-infrastructure-deal/*

Public support for battery production in the EU

Until recently, public support for European battery producers has been provided mainly through fragmented programs aimed at research, development, and innovation, as well as pilot projects. However, this has begun to shift with the introduction of IPCEI, whereby certain battery producers have received state aid amounting to over 25 percent of total investment costs. With the Temporary Crisis and Transition Framework modified in March 2023, the level of support can be significantly greater. Member States can now offer state support, matching those provided in other countries. However, in contrast to the USA, the application procedure remains complex and assessed on project-by-project basis.

EU responded to the US subsidy package with significant changes to the existing state-aid rules allowing larger public support to mass production of green technology, including batteries.

In March 2023 European Commission proposed to expand the existing Temporary Crisis and Transition Framework that significantly modify the existing state aid allowing significantly increase the amount of public support to green technology projects including battery production. In the same month the Commission proposed also Net Zero Industrial Act, which is aimed at reducing the administrative burden to set up projects and simplifying permit-granting processes. However, the initiative does not provide new sources of financing for the battery industry. Furthermore, the proposal still needs to be agreed by the European Parliament and the Council of the European Union before its adoption and entry into force.

The EU has also launched an initiative to strengthen access to critical minerals through the European Critical Raw Materials Act, but this is not the focal point in this paper. The EU wants to diversify its access to batteries and critical minerals due to the dominance of China in this area, both for economic and national security reasons. Since the US launched its major battery initiative, there has been increasing pressure on the EU to subsidise the industry in order to compete with the US.

The new initiatives significantly move focus of the EU towards the green technology. Until recently, the main support initiatives focused on research, development, and innovations. One important initiative is BATT4U, a battery focused research and development programme funded through Horizon Europe. Other initiatives are two IPCEI (“important project of common European interest”) initiatives offering investment subsidy for mass production containing however significant innovation requirements, and support pilot projects and first industrial application of large-scale production. Those programmes are not directly funded by the EU but are run and funded by the participating countries.

The EU also supports battery production through other programs that are not battery specific. This is through The Innovation Fund, which supports pilot projects and large-scale production with the requirement that it can demonstrate emission reductions, and InvestEU, which is debt financing and loan guarantees for pilot phase and large-scale production, as well as regional support that is often aimed at mass production. The EU has focused more on innovation in the battery industry and provides application-based support on a project-by-project basis, which contrasts with the production support in the US.

Although many of those programmes are aimed at development stages, the majority of the EU public support finances mass production. It is expected that nearly 75 percent of the public aid allocated to all net-zero technologies between 2021 and 2027 will be dedicated to downstream deployment.

Temporary Crisis and Transition Framework

On March 9, the European Commission introduced new measures, to further accelerate investments in key sectors for the transition towards a net-zero economy, enabling investment support for the manufacturing of strategic equipment including batteries. This was done by extending and re-diverting the "*Temporary Crisis and Transition Framework*" (TCTF). The new rules apply also to EEA countries including Norway.[27]

The first possibility of increased state support in the TCTF is increased freedom for Member States to design schemes where companies can receive aid to green tech production facilities. This aid is to be capped at a certain percentage of investment costs, which is a function of the company size, as well as the location of the project. According to the latest regional state aid map, the areas that qualify for regional aid as "c-regions" cover 25 percent of Norway's total population.[28] The Norwegian state aid map does not specify any "a-regions".

Table 3: Maximum state aid amount and state aid intensity under the Temporary Crisis and Transition Framework.

	Maximum amount			Maximum intensity[29]		
	Non-assisted areas	c-regions[30]	a-regions	Non-assisted areas	c-regions	a-regions
Large enterprises	EUR 150 million	EUR 250 million	EUR 350 million	15%	20%	35%
Medium sized enterprises	EUR 150 million	EUR 250 million	EUR 350 million	25%	30%	45%
Small enterprises	EUR 150 million	EUR 250 million	EUR 350 million	35%	40%	55%

In addition, Member States can grant even higher aid intensities if the aid is provided via tax breaks, loans or guarantees.

Moreover, in exceptional cases, where there is a real risk of investments being diverted away from Europe, Member States are now allowed to offer public support exceeding aid intensity thresholds shown above. In such situations, Member States may provide either the amount of support the beneficiary could receive for an equivalent investment in that alternative location (the so-called 'matching aid') or the amount needed to incentivise the company to locate the investment in the EEA (the so-called 'funding gap') whichever is the lowest.[31] The new regime allowing matching subsidies, which can be either cash or tax breaks, will be open until 2025. Subsidies for approved projects can run for longer time periods. This rule applies only to investments taking place in assisted areas. Large parts of Norway classify as assisted areas due to low population density.

However, the single market concerns mentioned earlier remain in place. Before granting state aid, national authorities must verify the concrete risks of the productive investment not taking place within the European Economic Area ('EEA') and that there is no risk of provoking relocation from other EEA countries. Thus, the procedure likely remains lengthy and administratively challenging. Moreover, the decision to award state aid to

[27] *https://www.eftasurv.int/state-aid/state-aid-rules-ukraine-crisis*
[28] *https://www.eftasurv.int/newsroom/updates/esa-approves-norways-regional-aid-map-2022-2027*
[29] *Calculated as nominal aid amount / eligible costs*
[30] *A regional aid map can be found here: https://competition-policy.ec.europa.eu/state-aid/legislation/modernisation/regional-aid/maps-2022-2027_en*
[31] *https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1563*

projects is at the discretion of individual EEA Member States, and each application must be approved by both the national government and the European Commission. This results in considerable uncertainty regarding the availability of state aid for projects seeking funding.

It remains to be seen to what degree will the matching clause be used by Member States. The clause or expectations of it have, however, already been used by battery producers in Europe putting on hold a planned battery plant "waiting" to see how the EU Member states would use the new rules.[32] In May 2023, the German government has stated its intention to offer state aid through TCTF to a battery producer, with the aim of ensuring that the battery production takes place in Germany rather than in the US. The announced state aid would top up aid awarded before through the IPCEI programme. However, at the time of writing, the precise amount of state aid offered has not been publicly announced.[33]

Net Zero Industry Act

The European Commission introduced the Net Zero Industry Act (NZIA) on March 16th, which aims to ensure that at least 40 percent of the European Union's deployment needs for key green technologies are met by domestic production capacity by 2030. However, this target for battery production cannot be consider ambitious enough, as it would only translate to only doubling the existing capacity to around 250 GWh of annual production capacity. While the introduction to the act mentions the European Battery Alliance's more ambitious goal of reaching 90 percent domestic production capacity for batteries, this target is not included in the Act itself.

The Act also proposes improvement in conditions for investment in net-zero technologies by reducing the administrative burden and simplifying permit-granting processes to increase planning and investment certainty. The Act also proposes to improve the use of already existing public support schemes, without providing new funds.[34] The Act incorporates a novel concept of "net-zero strategic projects," which will be accorded priority status to facilitate expeditious permitting processes. These projects may be regarded as being of overriding public interest for permitting purposes, subject to fulfilling the conditions enshrined in EU law. While this provision may not significantly impact the battery industry, as its production is typically confined within limited areas and does not pose a disturbance to neighbouring communities.

The Act encompasses provisions targeted at the development and implementation of education and training programs to reskill and upskill the workforce required for net-zero technology industries. These provisions are designed to ensure that the industry has access to the necessary skills and expertise for a sustainable future. Additionally, the European Commission has introduced the Critical Raw Materials Act, which aims to enhance access to vital minerals necessary for the mass production of green technologies, including batteries.

IPCEI

Important Projects of Common European Interest (IPCEI) is a European public support arrangement that enables Member States to create initiatives for financing of large and strategically important co-operation projects within the EEA. The IPCEI scheme offers the possibility of providing state aid to certain projects that would not otherwise be allowed under the normal EU state aid rules. The arrangement can be used for infrastructure projects and projects within strategically important value chains, and all EU and EEA Member States can participate. The Member States are responsible for setting up, financing, and selecting the projects that become part of an IPCEI

[32] *https://www.ft.com/content/6ac390f5-df35-4e39-a572-2c01a12f666a*
[33] *https://www.bmwk.de/Redaktion/EN/Pressemitteilungen/2023/05/20230512-batterieprojekt-von-northvolt-in-deutschland.html*
[34] *https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1665*

initiative, but the initiative and the projects within it must be approved by the Commission. The Member States and the selected companies must demonstrate that the projects contribute to achieving key strategic objectives.

Since 2014, seven IPCEI initiatives have been established, two for infrastructure and five for strategically important value chains. Of the IPCEI initiatives under strategically important value chains, two have focused on batteries, two on hydrogen and one on microelectronics. Norway currently participates in one of the hydrogen initiatives. In early 2023, the German federal government stated that it intends to expand the latest battery IPCEI initiative for new countries, two years after its start. In addition, the German government is willing to contribute with another EUR 1 billion to new German projects that would like to join the initiative.[35] Though the Norwegian government joined the enlargement process on in March of 2023, at the time of writing it does not seem that Norway will become a member of the initiative.

To qualify as an IPCEI initiative the Commission requires that the initiative; (1) contribute to strategic EU objectives, (2) help overcome market or system failures, (3) fund breakthrough innovation, (4) involve several Member States, (5) generate positive impacts across the EU, (6) involve private funding from beneficiaries, (7) limit state aid to the necessary minimum and (8) include highly innovative projects. To qualify as "highly innovative", projects must have a strong innovative character and add significant value to RDI. Projects involving a "first industrial application" are eligible for state aid under IPCEI.[36] Commercial production is not part of the "first industrial application" and are not eligible for state aid. Upgrades of existing products and production processes are not eligible for state aid under the IPCEI scheme.[37]

The first battery IPCEI initiative was approved in 2019 and named “IPCEI on Batteries”. The completion of the overall initiative is planned for 2031. IPCEI on Batteries has a total budget of EUR 3.2 billion granted by seven EU countries to the 17 participating projects. The state aid has attracted an additional EUR 5 billion in private investments. The initiative focuses on the entire battery value chain, including raw materials, battery cells and modules, battery systems and recycling.[38] For the German part of the initiative, close to 80 percent of the subsidies have gone to battery cell projects.[39]

The second battery IPCEI initiative was approved in 2021 and named “IPCEI European Battery Innovation” ("EuBatIn"). The completion of the overall initiative is planned for 2028. EuBatIn has a total budget of EUR 2.9 billion granted by the 12 participating countries.[40] The state aid approved through the IPCEI initiative has attracted an additional EUR 9 billion in private investments. The initiative involves 42 projects and supports the entire value chain of the battery industry.

Both battery IPCEI initiatives mentioned above have 'claw-back' mechanisms. This means that if the projects turn out to be successful, generating extra net revenues beyond projections, the companies will return part of the taxpayer money received to the respective Member States.[41]

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[35] *https://www.energate-messenger.com/news/229750/another-billion-for-domestic-battery-cell-production*
[36] *A "first industrial application" is defined as an extension of pilot plant, demonstration plant or "first in kind" equipment and facilities of its kind and includes scaling up to series production.*
[37] *https://www.stortinget.no/globalassets/pdf/utredningsseksjonen/utredningsnotater/2022/notat-om-internasjonale-prosjekter-av-felleseuropeisk-interesse---ipcei-2022317.pdf*
[38] *https://ec.europa.eu/commission/presscorner/detail/bg/ip_19_6705*
[39] *Based on the currently disclosed subsidies in the EU state aid register*
[40] *https://www.eba250.com/eu-approves-e2-9-billion-state-aid-for-a-second-pan-european-research-and-innovation-project-along-the-entire-battery-value-chain/*
[41] *https://ec.europa.eu/commission/presscorner/detail/en/ip_19_6705*

Horizon Europe BATT4EU

BATT4EU is a program within Horizon Europe, the EU's seven-year flagship program for direct support of research, development, and innovation. BATT4EU has a financial budget of EUR 925 million over 7 years, from 2021 to 2027. BATT4EU is dedicated to supporting research and development in the battery industry in Europe. The specific goals of the program include increasing energy density, power density, charging speed, lifetime, and safety of batteries, as well as reducing battery prices and increasing the sustainability of raw material supply chains, production, and recycling of batteries.[42] This is an application-based scheme and supports RDI only.

The Innovation Fund

The Innovation Fund is an EU fund that supports the development of commercial demonstration of low-carbon technologies that can help the EU meet its climate goals. The fund is financed through the auctioning of emission allowances in the European Emissions Trading System for greenhouse gas emissions. It is estimated that if the carbon price is EUR 75/tCO2, the financial budget of the fund will be EUR 38 billion for the period 2020 to 2030.[43] The fund supports up to 60 percent of the additional capital and operational costs associated with the project, and can disburse up to 40 percent of the funding based on pre-defined emission reduction targets before the project is up and running, with the remaining 60 percent allocated on the basis of verified emission reductions.[44] Projects are awarded based on five main criteria: efficiency in terms of CO2 emission reductions, level of innovation, maturity of the project, scalability of the project and cost-effectiveness. Additional criteria may also be imposed to strike a balance in terms of geographical location and industry type. The support awarded from the Innovation Fund is for pilot projects and commercial demonstration projects, not for pure R&D projects, as the support awarded is directly related to the amount of greenhouse gases that the project is estimated to cut.

So far, 52 projects have been supported with EUR 2.94 billion, with around 40 percent for large-scale projects (above EUR 7.5 million) and 60 percent for small-scale projects (below EUR 7.5 million). Of the EUR 2.94 billion already distributed, around EUR 162 million has gone to battery-related projects including Northvolt's energy storage systems factory in Poland, Northvolt DWA, which was awarded EUR 75.5 million in 2021.[45]

InvestEU Fund

InvestEU Fund is an EU initiative aimed at supporting investment in innovation and job creation across the EU and was created to bring together several independent financing instruments under the EU. The program is designed to provide long-term financing for projects that contribute to achieving EU policy objectives. This financing is in the form of debt financing, loan guarantees and equity financing. InvestEU is expected to mobilise up to EUR 372 billion of public and private funds, through an EU budget guarantee of EUR 26.2 billion over seven years (2021-2027). The European Investment Bank (EIB), the lending arm of the European Union, will be granted access to 75 percent of this guarantee and will act as the main partner for the implementation of the fund. InvestEU invests in sustainable infrastructure, RDI, digitalisation, small and medium-sized enterprises, and social investment. Over 30 percent of the financing will target the objectives of the European Green Deal and can finance such projects up to 60 percent.[46]

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[42] *https://bepassociation.eu/about/batt4eu-partnership/*
[43] *https://climate.ec.europa.eu/eu-action/funding-climate-action/innovation-fund/what-innovation-fund_en*
[44] *https://climate.ec.europa.eu/eu-action/funding-climate-action/innovation-fund/what-innovation-fund_en*
[45] *https://webgate.ec.europa.eu/dashboard/sense/app/e32ef3f5-0e0e-4be3-8f14-8e2fb5a20aa7/sheet/bac47ac8-b5c7-4cd1-87ad-9f8d6d238eae/state/analysis*
[46] *https://investeu.europa.eu/what-investeu-programme/investeu-fund_en*

Regional Aid

There is currently the possibility under EU and EEA regional aid guidelines[47] to provide state aid to certain regional areas. Regional aid aims to support economic development in disadvantaged areas of Europe, while setting limits to ensure fair competition between Member States. Under these rules, which are exemptions from the regular prohibition of state aid within the single market, regional areas that have either low GDP per capita, high unemployment or low population density (relative to the EU average) can be approved as areas where state aid is allowed. Under these exemptions from the regular state aid rules the aid intensity can be up to 20 percent of the investment cost for large enterprises.[48,49] The availability of regional aid is country specific. So is the phase of production they support, but usually it is commercial production, as the goal of regional aid is to spur economic development in the above-mentioned reginal areas.

Whether this aid is distributed, and which industries that are supported is up to the Member State to decide and is financed by the country itself.[50] Regional state aid has been used to support new battery factories in Poland (EUR 131 million) and Hungary (EUR 300 million for two factories)[51,52] .

Real-world cases in Norway and the EU

Given the complexity of the various schemes and application-based structures, as well as national differences in public support programs for battery producers in the EU, this chapter serves to illustrate the magnitude of subsidies already received by existing battery factories in the region. Specifically, we examine subsidies provided to battery cell companies in Norway, Sweden, Germany, and France. Each of these countries employs a range of public support programs to finance projects at different production phases, including R&D, pilot projects, and commercial scale production. These public support measures encompass subsidies, debt financing, loan guarantees, and equity financing.

In the analysis we classify the support received by battery producers according to the project phase. We distinguish RDI, pilot projects and mass production. These distinctions are often blurred, and the classification is based on expert opinion based on publicly available descriptions of the funded projects as well as the mandate of the funding authorities.

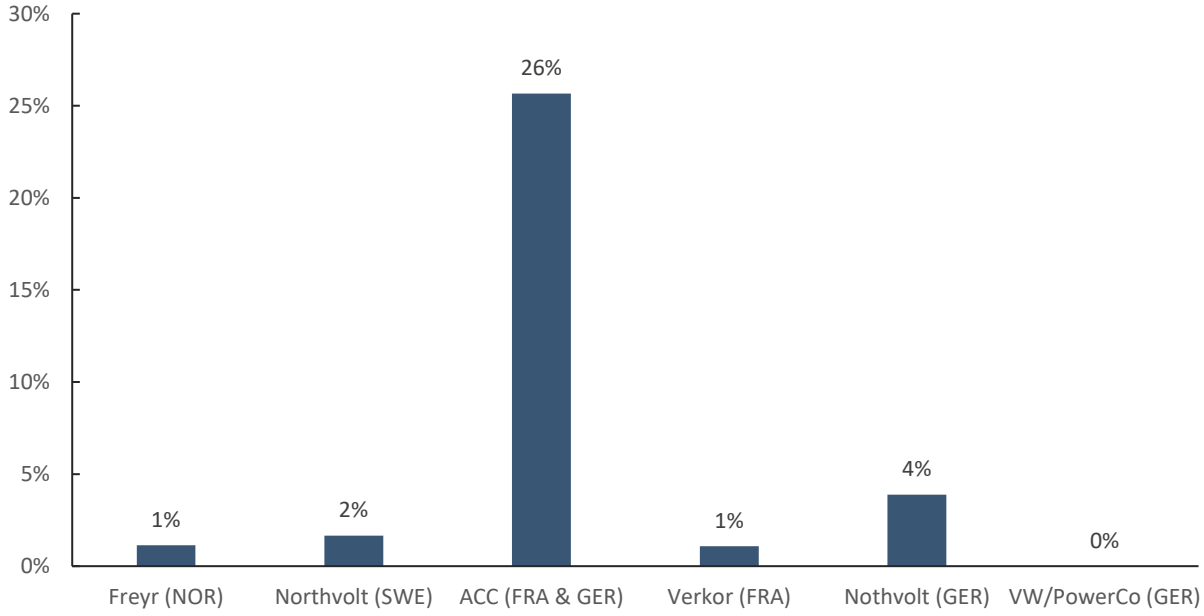
In this section we focus on subsidies but will also mention other public support measures such as equity financing, debt financing and loan guarantees. It is important to note that the nominal value of equity financing, debt financing and loan guarantees are neither comparable to each other nor to subsidies. The part of a loan that can be attributed as subsidies to the company is only the difference between the interest payments on the loan granted and the interest payments that would have been necessary if the company were to obtain a loan from the private market.

The differences in the level of public support between the analysed countries are summarised in Figure 2. The figure that shows only direct subsidies reveals that the level of state-aid is significantly higher for projects financed through IPCEI initiatives than any other public support programs in Europe. Notably, the analysed

[47] *https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021XC0429(01)*
[48] *https://ec.europa.eu/docsroom/documents/42921/attachments/1/translations/en/renditions/native*
[49] *For medium-sized enterprises the aid can be 30% and for small enterprises the aid can be up to 40%. The definition of medium-sized enterprises is less than 250 employees and less than EUR 50 million in turnover. Small enterprises are defined as less than 50 employees and less than EUR 10 million in turnover*
[50] *Certain industries cannot be supported. These are industries that are at odds with the green transition, such as coal mining.*
[51] *https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1265*
[52] *https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1962*

projects in Norway and Sweden received state subsidies that amounted to only one percent of the total investment costs, while the international projects in Germany and France, which were supported through IPCEI, received state aid equivalent to 26 percent of the total investment costs. The French battery manufacturer Verkor, which is not an IPCEI backed project, has only received just over one percent of the total investment cost. Comparable to the battery plants in Sweden and Norway.

Figure 2: Share of state aid in total investment costs for select battery projects in Europe.



Norway

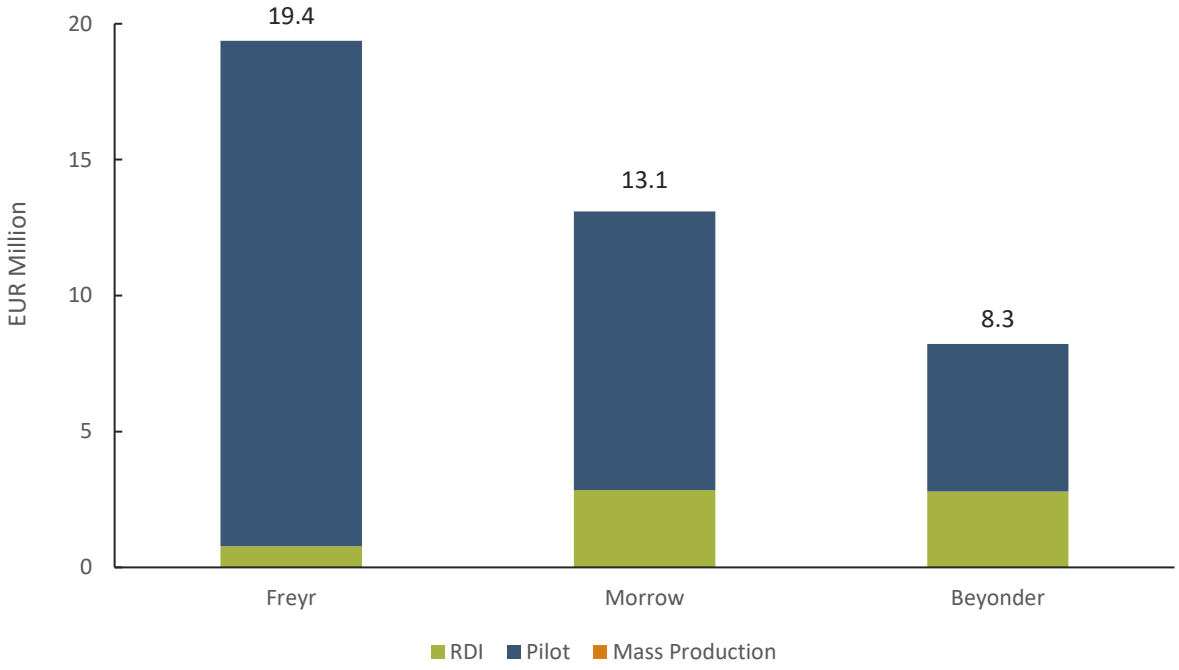
The three major battery cell projects in Norway, Freyr, Morrow and Beyonder, have received funding through several different funding programs, but none are close to having received funding equivalent to what is available under the IRA or IPCEI initiatives.

The funding received by the companies have mainly been from Innovation Norway, ENOVA, SIVA, Export Finance Norway (Eksfin) and EU programs such as Horizon. This has been in the form of subsidies, debt financing, loan guarantees and equity financing. Subsidies to the battery industry in Norway are mainly provided for R&D and pilot projects, while debt financing and loan guarantees are provided for pilot projects and commercial scale production facilities. Norwegian battery producers together with several other companies and research institutes also participated in research projects financed through the Green Platform initiative founded by the Norwegian Research Council.

Figure 3 shows the subsidies received by the three companies and in what phase they have been awarded. This includes the funding through the major support schemes, and it is worth noting that the companies also might have received support from smaller schemes which have not been included.

To date, Freyr is the largest recipient of subsidies with NOK 196 million. This is mainly driven by ENOVA's support of NOK 142 million in 2021 directed to their pilot plant. On average the three companies have received subsidies from Innovation Norway worth NOK 75.6 million, these subsidies were aimed at RDI and pilot projects.

Figure 3: Subsidies to battery manufacturers Norway by phase of production. Source: The Research Council of Norway, Innovation Norway, ENOVA and The Brønnøysund Register ROFS.



In addition to subsidies, Norwegian batteries received support through equity financing, debt financing or loan guarantees through public support programs. Freyr has received a letter of intent for a loan guarantee of NOK 4 billion from Eksfin. Innovation Norway has provided debt financing to Morrow and Beyonder of NOK 150 million and NOK 105 million respectively. SIVA has supported Morrow NOK 322 million to through a joint real estate company which owns the building that will house the battery factory.[53]

Sweden

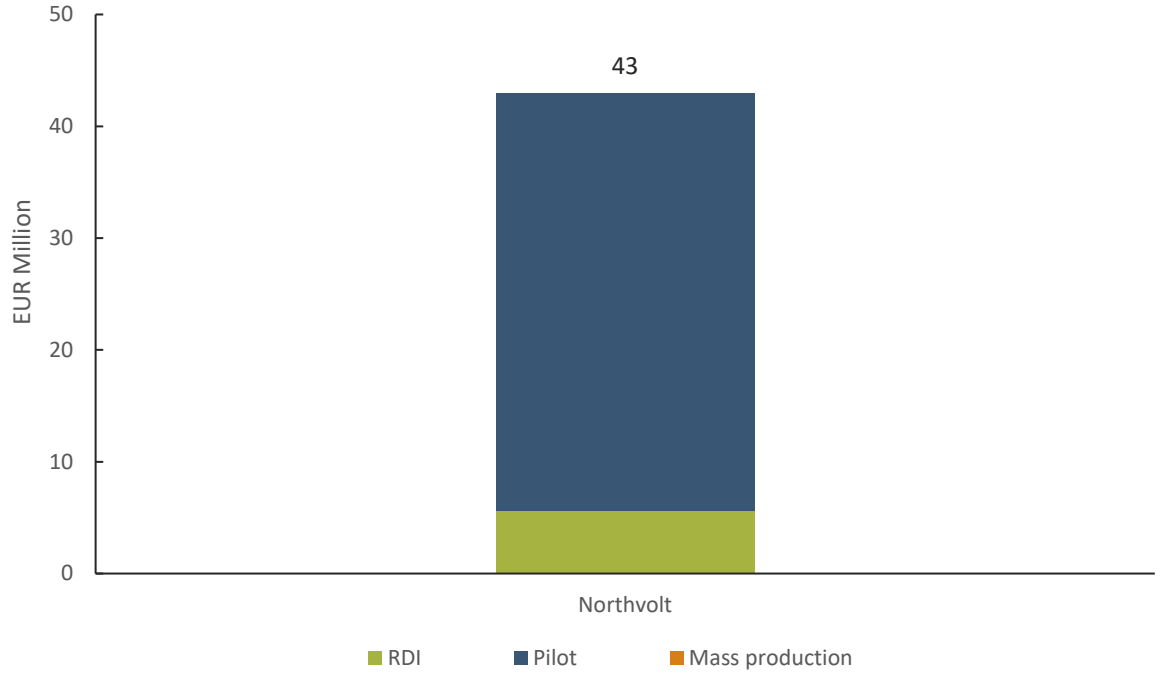
To examine public support in Sweden, we have analysed the case of Northvolt ETT in Skellefteå and their research facility Northvolt Labs in Västerås.

Northvolt has received public support in the form of subsidies, equity financing, debt financing, and loan guarantees. The public support has been granted by Swedish public agencies, the German state and EU financial institutions. The direct support has come from Sweden public support programs, while equity financing, debt financing and loan guarantees have been provided by the EU and Germany. Support has also been provided during several of the company's production phases, with support for R&D, pilot projects and mass production.

Northvolt in Sweden has received a total of EUR 58.8 million in subsidies from Sweden, EUR 9.3 million in equity financing by the EU and EUR 961.5 million in debt financing and loan guarantees from the EU and the German government. In Figure 4 below, we show the amount of subsidies and in which project phase. In addition to the subsidies displayed in the figure, Northvolt also received a subsidy of EUR 15.7 million for installing a recycling plant at its gigafactory from the Swedish environmental protection agency.

[53] *https://siva.no/2022/08/morrow-batteries-og-siva-gar-sammen-for-a-bygge-batterifabrikk-i-arendal/*

Figure 4: Subsidies received by Northvolt facilities in Sweden. Source: EU state aid register and Swecris database.



Germany & France

Germany and France are expected to be among the largest producers of batteries in 2030, with planned capacity in Germany of 493 GWh and in France of 122 GWh. In Germany and France battery producers can receive public support from several sources, but most of the large subsidies are distributed through the IPCEI initiatives. Hence, there is a significant difference between the projects that take part in the IPCEI initiatives and the ones which do not. To illustrate this point, we present a German and French cooperation project named ACC as well as Northvolt Drei in Germany, that were both granted IPCEI funding. In addition, we analyse two projects in Germany and France which did not receive IPCEI funding, Verkor and VW/PowerCo.

ACC

Automotive Cells Company is expected to be one of Europe's largest battery producers by 2030, with its planned capacity of 120 GWh. ACC is an international collaboration between Saft, Stellantis and Mercedes Benz. In France ACC has a pilot line and R&D facility in Nersac Angouleme and one Gigafactory under construction in Billy-Berclau Douvrin. The gigafactory which is expected to launch production in the second half of 2023 will have a capacity of 13.4 GWh, and is planned to scale up its capacity to 40 GWh by 2029.[54] In Germany ACC has planned a gigafactory in Kaiserslautern, which will launch production in 2025 with an initial annual capacity of 13,4 GWh, that will scale to 40 GWh by 2030.[55] ACC is one of the companies that have been awarded large subsidies through the first battery IPCE initiative. In total ACC factories and research facilities in France and Germany has received subsidies of EUR 1.3 billion from the German and French governments. The subsidies from France totals EUR 846 million, where 18 percent is contributed from local regions, and the rest is granted by the French government.[56] Subsidies from the German government totals EUR 437 million to ACC, of these the local region granted 12

[54] *https://www.acc-emotion.com/facilities/billy-berclau*
[55] *https://www.acc-emotion.com/facilities/kaiserslautern*
[56] *https://www.concertation-acc-batteries.fr/telechargement/documents/77de68daecd823babbb58edb1c8e14d7106e83bb*

percent while the German government granted the rest.[57] The total investment cost of the French and German facilities is estimated at EUR 5 billion[58]. This means that government subsidies represent 26 percent of the investment cost.

Verkor

Verkor is a French battery cell company founded in 2020. The company is currently finalising its R&D and pilot facility in Grenoble and expects their first delivery in the first half of 2023. Verkor aims to develop a full-scale battery factory in Europe by 2025 with a capacity of 16 GWh and expected to scale up 50 GWh capacity by 2030. The company's batteries are designed to be used in electric vehicles, renewable energy storage and other applications that require reliable and high-performance energy storage solutions.

The subsidies awarded to Verkor has been small relative to ACC. This is mainly a consequence of the company not being part of the IPCEI initiative. The company has been awarded a subsidy of EUR 3.8 million from the French government. In addition, the company has been granted debt financing from EIB of EUR 49 million and a loan guarantee of EUR 51 million From BPI France. Verkor has managed to acquire a total of EUR 350 million of financing for the construction of their R&D facility and pilot line in Grenoble.[59] This means that government subsidies only represented 1.1 percent of total investment expenditures in its pilot line.

This discrepancy in subsidies is an indication that European battery subsidies are not equally accessible for producers. This is contrasted by the subsidy schemes in the U.S. where production credits are equally accessible for all producers.

Other Projects

In March 2022 Northvolt announced their plans for their largest gigafactory, Northvolt Drei. The facility will be located in Heide, Germany, and has an announced capacity of 60GWh.[60] Northvolt Drei is one of the German projects under the IPCEI EuBatIn initiative. Northvolt has already received a funding notice for a subsidy of EUR 155 million for the German facility through the IPCEI scheme.[61] This subsidy only represents about 4 percent of the total investment cost of EUR 4 billion[62]. This is noteworthy as it is an IPCEI project, which usually attains greater levels of subsidies.

PowerCo, a fully owned subsidiary of Volkswagen group has started the construction of its first Gigafactory in Germany named SalzGiga. The factory is supposed to deliver its first batteries in 2025 and has a planned capacity of 40GWh.[63] VW/PowerCo did not claim any state subsidies for the battery factory in Salzgitter. According to VW Chief Technology Officer, Thomas Schmall, this decision was made primarily for reasons of speed. The requirements of the IPCEI subsidy, for example, would have slowed down the project.[64] This insinuates the bureaucratic hindrances of the public funding programs in the EU.

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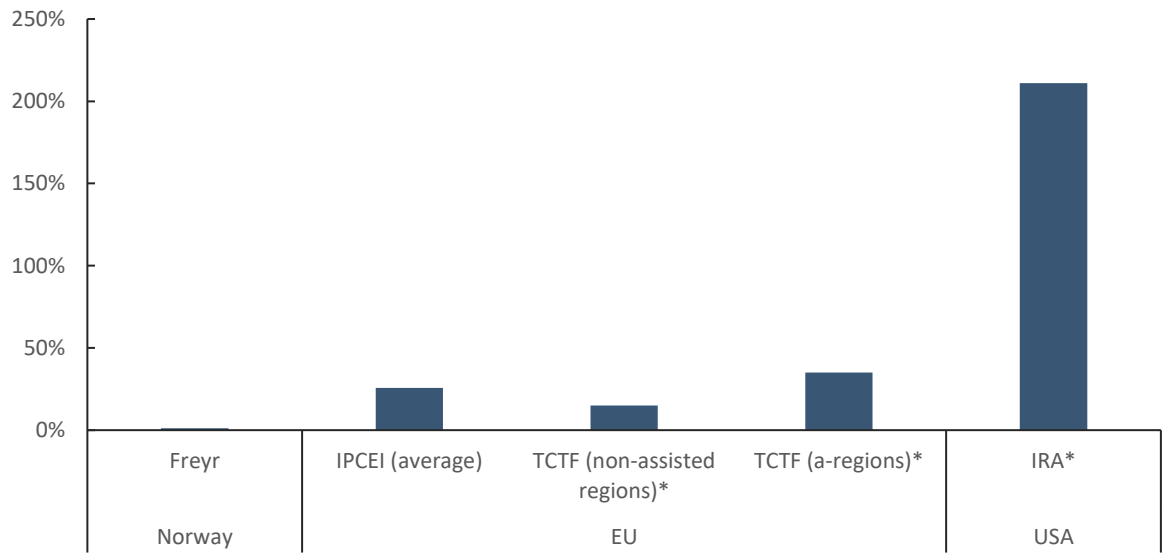
[57] https://www.electrive.com/2021/09/02/franco-german-acc-granted-funding-to-make-batteries-in-germany/
[58] https://insideevs.com/news/530878/germany-acc-437-million-gigafactory/
[59]https://www.reuters.com/business/autos-transportation/verkor-raises-250-mln-euros-fund-ev-battery-megafactory-2022-11-02/
[60] https://northvolt.com/about/
[61]https://www.bmwk.de/Redaktion/EN/Pressemitteilungen/2022/05/20220511-minister-habeck-hands-over-funding-approval-notice-to-northvolt-155-million-euros-to-be-provided-for-battery-cell-plant-in-germany.html
[62]https://www.gtai.de/en/meta/press/northvolt-to-build-4-billion-battery-gigafactory-in-northern-germany-813980#:~:text=%E2%80%9CNorthvolt%20Drei%E2%80%9D%20will%20be%20the,cost%20some%20EUR%204%20billion.
[63]https://www.transportenvironment.org/wp-content/uploads/2023/03/2023_03_Battery_risk_How_not_to_lose_it_all_report.pdf
[64] https://www.electrive.com/2022/07/07/volkswagen-begins-construction-of-battery-cell-factory/

Comparison of EU and US public support regimes

The analysis so far points to substantial differences in funding levels available through different programmes in USA and various public support programmes in Europe. This difference was highlighted in Figure 2 above, where we presented state aid intensity under various public support regimes based on historical data (for Norway and IPCEI) as well as our understanding of the new public support schemes in the EU and USA.

To allow comparisons between investment and production subsidies we present all public support schemes as the net present value of public support as the share of total investment in production facilities.

Figure 5: Actual and estimated state-aid intensity under various regimes in Norway, EU, and USA. Source: Menon Economics



*Estimated values of state aid intensity

The analysis confirms the substantial gap between the net present value of production subsidies offered through IRA and the existing public support programmes in Norway and EU. According to the current rules, a new battery factory in USA could receive as much as USD 2.1 in state aid for each dollar invested in production facilities.[65,66] Thus, a 50GWh battery factory built in USA at a cost of about USD 4 billion is expected to receive, in net present value, around USD 8.2 billion in subsidies. A comparable factory in Norway will, based on observed state-aid intensity in, would receive just about USD 45 million in public support. Public funding has been higher through IPCEI projects, where it has reached 26 percent.[67] Under the new TCTF, public state aid can reach 20 percent in assisted "c-regions" which cover large parts of Norway. However, in such regions the state aid is capped at EUR 200 million per project. Thus, for a large battery project to reach that level of state intensity a project would need

[65] *Calculated under the following assumptions: production start 2025, 90 percent capacity utilisation, 10 percent discount rate, CAPEX costs USD 80 million per GWh.*
[66] *It is important to note that these calculations have been carried out solely for the expected CAPEX, and so does not include any considerations of the OPEX. As the production cost of batteries is 80 to 90 percent of the final price of the battery, the graph for the IRA subsidies does not suggest that battery manufacturers can be profitable selling at a price of zero.*
[67] *Figure based on state-aid intensity of ACC project described in the previous chapter.*

to be split in several stages, which would likely delay the project. For the poorest regions in the EU (so called "a-regions") state aid intensity can reach 35 percent.

The new TCTF rules also offer the EU and EEA Member States the possibility to match the levels of state aid for battery projects located in assisted regions. It remains to be seen if this clause will be used in practice, thus we do not show this on the figure.

Expected effects of the IRA on the future EU battery industry

As demonstrated previously, the subsidy accessible to US producers considerably surpasses the amount accessible to producers in the EU and Norway. Even with the new aid available for European battery producers, this is almost certain to affect the investment decision of investors, and we thus expect the net effect on investment decisions in battery capacity to be negative for both the EU and for Norway. It is simply too profitable to choose production in the US relative to Europe. We have already seen a significant number of announced plans to build gigafactories in the US. As a result, the anticipated production capacity in Europe will decrease, and there will likely be a slightly higher price for batteries in Europe to compensate for the investors' higher required rate of return.

Despite higher level of public support in the US, there are some compelling reasons to expect an increase in battery production in Europe. This is due, in large part, to the regionalisation of the battery and car market.[68] High transport costs for auto-parts, including batteries, have led to the development of intra-regional value chains around automotive clusters. As producers tailor batteries to individual automakers, specialisation has become a driving force behind this trend. Additionally, recent supply chain disruptions have increased the value of supply chain security, which can be enhanced by local production. These factors are exemplified by multiple Chinese producers, including CATL, increasing production in Europe.

Furthermore, there are significant bottlenecks in the US, which restricts the expansion of US production capacity in the short to medium term. These includes labour shortages resulting in higher wages, access to materials and electricity, as well as permitting. Some of these will likely result in delayed capacity expansion, and not least increasing input prices during both the construction phase and operations. In addition, it is clear from interviews that regional investment preferences play an important role. This is confirmed by Norwegian battery manufacturers emphasising their local roots and their ties to Norway, and that they therefore want to keep at least parts of their operations in Norway. At the same time, access to renewable energy in Norway is emphasised as an important strategic competitive advantage that also makes it more relevant to keep parts of production in Norway. Lastly, there are of course a host of other aspect which play a role in determining the location of an investment decision. This includes, not least, the general framework conditions of tax regimes, political stability, access to infrastructure, a skilled work force and so on. Along many of these parameters European countries remain highly attractive.

Overall, we anticipate that despite the considerable subsidy gap between the EU and the US, there will be substantial battery production on the continent by 2030. The EU has announced that it will prohibit new petrol or diesel vehicles on the roads by 2035,[69] which will boost the demand for batteries to 1 TWh annually by 2030

[68] *This is to a lesser degree true for other parts of the battery value chain. Especially for the critical minerals market where the transportation cost is relatively low, and natural competitive advantages due to mineral deposits.*

[69] *https://www.europarl.europa.eu/news/en/headlines/economy/20221019STO44572/eu-ban-on-sale-of-new-petrol-and-diesel-cars-from-2035-explained*

and 1.5 TWh in 2035.[70] The expectation that EU will be a significant battery producing region in 2030 is confirmed by several large-scale investment announcements in Europe since the introduction of the EU's latest support programmes. A notable announcement has come from Swedish cell manufacturer Northvolt, who has confirmed that the support it has received from the German government means it will proceed with its factory in Heide in Schleswig-Holstein.[71] It is, nonetheless, difficult to estimate the net effects of the new subsidy regimes on investments in European battery manufacturing capacity without a full market analysis, something which has not been carried out in this report.

[70] *This includes batteries for ESS and assumes no net-exports of electric cars.*
[71] *https://www.ft.com/content/b27c333e-a3a8-4762-a89d-1768b127c784*

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