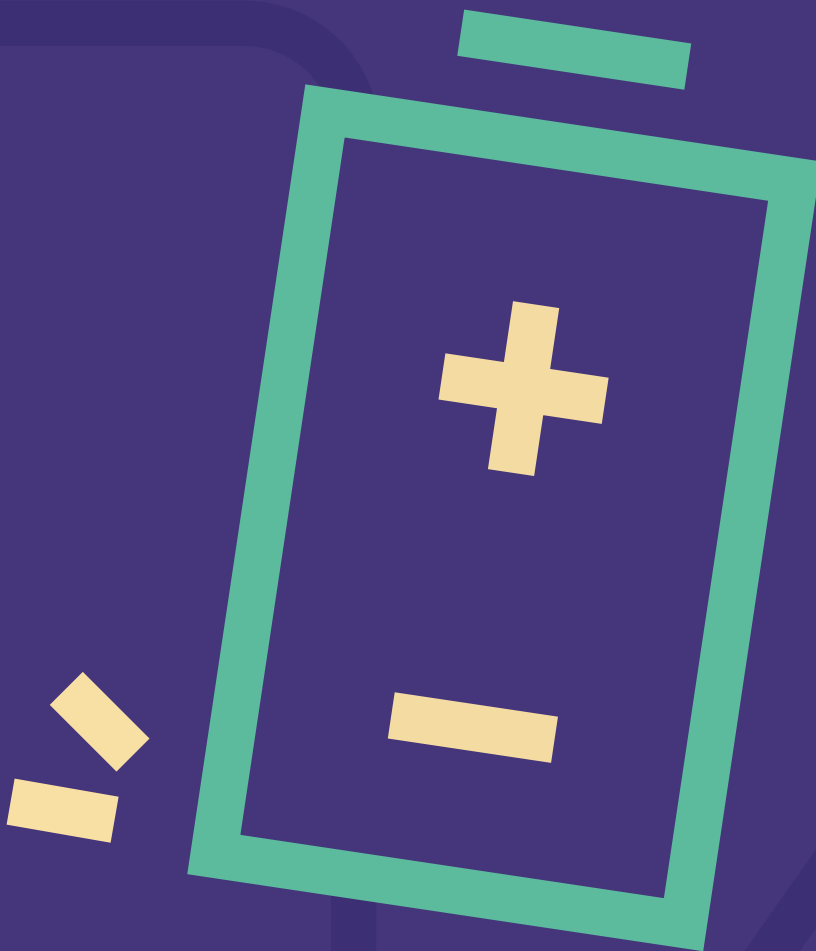


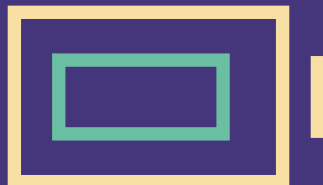


Norwegian Ministry of Trade,
Industry and Fisheries

Strategy

Norway's battery strategy





Charging up together !

The Government has great ambitions for our Green Industrial Initiative. We want to help create profitable and attractive jobs in sustainable industries throughout the whole of Norway and increase mainland investments and exports, all while cutting greenhouse gas emissions. Norway is uniquely positioned to succeed with the green transition, thanks to its rich natural resources, top-class industrial expertise, and the Norwegian working life model, combined with more than 100 years' experience in renewable power, electrification, world-leading offshore technology and continuous development of cutting-edge process industry. These are advantages that provide significant opportunities for value creation in a world that is increasingly demanding sustainable products and solutions. Seizing these opportunities is also about ensuring Norwegian industry remains competitive, in the short term and further ahead.

Batteries are one of the new, major areas of opportunity that are of particular interest and relevance to Norway. The battery industry is growing and developing rapidly around the world, with Europe taking the lead in developing greener and better batteries. Norway already has actors along the complete battery value chain, with three battery cell initiatives already under establishment, in-depth materials expertise from the process industry, and not least experience as a front market from electrification of land and maritime transport. As a result, we are in an ideal starting point compared with many other countries.

Now it is important that we get started, without delay. If we are to succeed with the green transition,

we need to set more ambitious goals, up our pace, improve our implementation capacity, and ensure more systematic collaboration among the relevant players, compared with today. In the Roadmap for our Green Industrial Initiative, we present the value chain for batteries and the other priority areas as a composite whole, outlining our ambitions, policy instruments and some 100 concrete measures, as well as how the authorities will collaborate with the business community to realise these ambitions.

In "Norway's Battery Strategy", we discuss the battery value chain in more detail and present ten actions for sustainable industrialisation, which in aggregate should be powerful enough to attract private capital to the industry. The goal is to demonstrate to Norwegian and international commercial actors and investors the advantages of choosing Norway as a host country for new investments in the battery industry. At the same time, the strategy provides the foundation for Norway's more detailed policy for the battery industry going forwards. If we are to achieve our goals, we need to strengthen industrial collaboration along several axes, and we recognise that a number of policy areas are pivotal to the realisation of the Government's ambitions in the battery area.

I am very much looking forward to the ongoing process. On behalf of the entire Norwegian Government,



Jan Christian Vestre,
Minister of Trade and Industry

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Introduction

The value chain for batteries is undergoing rapid growth and development globally, driven largely by the energy transition, climate change and political goals for industrial leadership in the field. For many years, consumer electronics were the main driver in the battery market, until the advent of the electric vehicle when vehicle batteries became the driving market segment. Battery properties and their areas of application are constantly expanding, often as a prerequisite for renewable power supply and low-emission solutions. Batteries and battery production often interact with digital autonomous technologies, enabling “smart” solutions in a range of fields.

Norway has been an important initiator in changing the battery market, by stimulating the purchase and use of electric vehicles and by promoting the development and use of electric ferries. According to a recent report, Norway is the country in Europe that has the highest readiness level for electrification of the transport sector.¹

Norway currently has the highest proportion of electric vehicles per capita in the world, with around 500,000 electric vehicles on the road. For many years, Norway has served as a front market for car manufacturers and suppliers of associated services, contributing significantly to the high uptake of electric vehicles globally. By the end of 2022, there will be 72 electric ferries in operation along the coast of Norway, and Norwegian actors are spearheading the development of electric-powered boats for the international market.² Because we have a head start in this area, Norway will also be one of the first markets where large volumes of used batteries will become available for collection, reuse and recycling. This puts us in a unique position to share important

1 EV Readiness Index 2022 | LeasePlan ([evmarketsreports.com](https://www.evmarketsreports.com))

2 Electric car ferries in Norway | The Norwegian Climate Foundation's online newspaper (energiogklima.no)



The global demand for batteries is expected to multiply over the coming years, and Norway will contribute significantly to meeting the demand.

experiences with other countries and to further develop this industry in Norway.

Other countries are phasing in the use of electric vehicles and electric ferries, and the global demand for batteries has almost tripled since 2018. Nevertheless, the main growth is still ahead of us. While the total global demand for batteries amounted to 470 GWh in 2021, various players and analysis agencies expect it to be somewhere between 3,600 GWh and over 6,000 GWh by 2030, with the European market alone expected to reach 1,000 GWh by 2030. This development promises significant market opportunities, but also places high pressure on the ability of the value chain to deliver in accordance with the sustainability expectations, and requires more capital and more expertise.

Electric vehicles are currently expected to remain the main driver in the market for batteries. However, Rystad Energy and others predict that approximately one third of the battery market up to 2030 will come from “new” market areas, such as power grid stabilisation, energy supply and energy storage. Other growing markets include ferries, heavier vehicles such as buses and lorries, commercial vehicles used in industry, ports and other logistics, and light-duty

vehicles such as electric wheelchairs, lawnmowers, etc. Work is also being done to start using batteries in aviation (for short distance flights), with the Norwegian airline Widerøe emerging as a key player. This comprises a number of large individual projects that may represent significant opportunities for value creation for the Norwegian industry.

To date, all the market estimates have proven to be too cautious, and the projections towards 2030 are rising steadily. The trajectory also provides grounds for optimism in respect of the efforts to reduce emissions and accelerating the green transition. Production of batteries currently entails significant greenhouse gas emissions and other sustainability challenges. If batteries are produced with more sustainable mineral extraction, based on renewable power and a high degree of circularity along the entire value chain, the potential for environmental benefits from greater use of batteries is considerable.

Europe has long been and continues to be a leading market for batteries, primarily batteries manufactured in Asia. The input factors for batteries have traditionally also largely been produced in Asia, alternatively mined outside Asia for delivery to Asian battery manufacturers. This situation may change

significantly over the next few decades. The EU and the UK are mobilising massively to develop their own battery value chains, with the goal of producing the world's greenest batteries, building up local industry, and avoiding import dependence. The EU and the UK regards the establishment of a European battery production value chain as strategically crucial, to achieve the climate change targets and to ensure the competitiveness of the European automotive industry. Battery production in Europe is expected to account for around 30 per cent of the global production by 2030. US is also working intensively on building up its battery value chain.

For Europe, the battery value chain represents a new growth market. In this context, European actors must be able to handle existing production methods, efficiently and on a large scale, and at the same time work to develop tomorrow's battery solutions. In order to ensure self-sufficiency and to meet its goals for more sustainable batteries, Europe must also

establish sufficient capacity along the entire complex battery value chain from mining to recycling. More and more customers are demanding batteries that are sustainable (including carbon footprint), high performance and low cost. Customers are joining forces with suppliers of the batteries of the future, which can take several years to develop. Many such agreements are currently being signed, meaning that the actors are beginning to consolidate, especially within the production of battery cells and active battery materials.

Norway is well positioned to become a key actor in the development of a more sustainable battery industry, thereby helping to accelerate the transition from the use of fossil energy sources to green power. If Norway seizes the opportunities that lie ahead, the battery value chain could become an additional element of a diversified Norwegian industry, providing future-oriented, green jobs all over the country. Within just a few years, a Norwegian battery value



”If Norway seizes the opportunities that lie ahead, the battery value chain could represent a significant share of the Norwegian industry portfolio , providing future-oriented, green jobs all over the country.”

chain could employ tens of thousands of people in Norway, and turnover could reach NOK 90 billion, possibly more, by 2030, according to an analysis by the Confederation of Norwegian Enterprise (NHO).³

Norway's excellent starting point is particularly related to the production of more sustainable batteries (materials, clean power), recycling, and use of batteries in market areas such as vehicles, maritime, energy production and power grid stabilisation. Thus, Norway will be able to make significant contributions to the attainment of common goals with the EU and other countries related to the green transition and strategic autonomy, in partnership with Nordic, European and international stakeholders. A number of players have already positioned themselves along the battery value chain in Norway, including three separate battery cell initiatives. Thanks to our rich and stable supply renewable power, no other country has the

potential of producing battery components with a lower carbon footprint.

Norway's battery strategy highlights challenges that must be met with political measures to unlock the potential for value creation in the battery sector. The battery strategy addresses this through *10 actions for sustainable industrialisation* with measures that together will be powerful enough to attract the private capital needed to establish factories along the entire value chain in Norway.

3 gronne-elektriske-verdikjeder.pdf (nho.no)

Summary

Part 1 of the battery strategy presents the Norwegian Government's visions for a sustainable battery value chain and the basis for a Norwegian battery strategy.

Part 2 describes the battery value chain, the Norwegian actors and the opportunities for value creation.

Part 3 of the strategy discusses technology development, market conditions, trends, European mobilisation and Nordic co-operation.

Part 4 of the strategy presents the ten actions for the attainment of the Government's goals for the battery value chain.

10 ACTIONS

for sustainable industrialisation

ACTION 1

Leadership in sustainability along the entire battery value chain

ACTION 2

Promote Norway as an attractive host country for green investments

ACTION 3

Enter into industrial partnerships with key countries

ACTION 4

Provide capital, loans and guarantees that mobilise private capital

ACTION 5

Improve access to relevant expertise

ACTION 6

Pave the way for greater access to renewable power

ACTION 7

Contribute to provision of suitable sites and other central infrastructure

ACTION 8

Ensure predictable, efficient and coordinated public processes

ACTION 9

Support pilot municipalities during the growth phase

ACTION 10

Become a leader in tomorrow's battery solutions and leveraging the opportunities afforded by digital technologies

The Government's vision for a sustainable battery value chain



The Government's vision is that Norway will develop a complete and profitable battery value chain, stretching from sustainable mineral extraction to battery recycling. Norway will be an attractive host country for profitable activity along the entire battery value chain and attract major battery investments and giga factories.

In its policy statement, known as "the Hurdal Platform", the Government outlines a number of goals that in aggregate will encourage the establishment of forward-looking industries in Norway.⁴ It states that large-scale battery cell production will be facilitated in Norway, along with industrial activity in a complete battery value chain, including raw materials, components, utilisation, collection and recycling. To achieve this kind of green industrial transition, the state will pursue an active policy by means of a powerful toolbox and ensure good, predictable framework conditions that pave the way for private investment and further growth. Access to land, infrastructure, expertise and affordable renewable power are highlighted specifically in the Platform. It is also announced that the state will actively contribute to ensuring that companies can develop and scale up industrially in Norway.

The Government's battery strategy aims to unlock the significant potential for value creation in the battery value chain in Norway by: 1) highlighting the good preconditions for Norwegian activity along the entire battery value chain, and 2) indicating how the Government will support this kind of development. The battery strategy will be relevant when Norwegian companies, business clusters and the public policy apparatus are marketing Norway as a host country for new investments. The strategy will also be a tool in the further development and prioritisation of policy.

⁴ Hurdalsplattformen [the Hurdal Platform] – regjeringen.no

Building on Norway's excellent starting point, which includes specialist competencies in the process industry, the manufacturing industry, relevant markets, recycling and renewable energy, the Government will prepare for the establishment of the battery value chain as a new major industry in Norway. Norway will be a good partner to the EU in the realisation of common objectives on establishing a complete European battery value chain that takes leadership both in the short term and further ahead in respect of low carbon footprint, sustainability, costs, performance and application. We want to ensure that Norway is an attractive host country for investments in the battery value chain and other green industries. These ambitions will be realised through a range of policy instruments that help attract private capital for activities along the entire battery value chain from minerals, materials, cells, application and reuse, including associated support activities such as charging infrastructure and solutions for automated digital technology.

Although the battery markets, individually and collectively, are significant and expected to grow substantially in the coming years, the battery value chain is still relatively immature, especially in Europe. Actors from other regions have a head start on Europe, and cost pressures, technological developments and fluctuating commodity prices may cause considerable uncertainty for companies looking to establish themselves in Norway. In response, the Government will provide good general framework conditions and implement

measures that will help attract private capital for profitable projects in the battery value chain in Norway. The Government will promote a profitable Norwegian battery value chain that quickly becomes a global leader in terms of sustainability, performance, costs, expertise, technology and application.

Organisation of the work on Norway's battery strategy

Many Norwegian stakeholders has contributed to the building up of a broad knowledge base on the development of the battery value chain. In order to build further on this underlying knowledge, the Government, represented by the Ministry of Trade, Industry and Fisheries (NFD), established a working group in December 2021 to prepare a comprehensive foundation of knowledge for the Government's battery strategy. The working group has consisted of the secretary of Prosess21 and key people from InvestIN (part of Innovation Norway) and the Industrial Development Corporation of Norway (Siva), supported by the governing bodies of these organisations. The working group has worked in dialogue with EIT InnoEnergy and the European Battery Alliance, and NFD. A reference group comprising more than 50 players from within and associated with the battery value chain has provided written input to the working group. In parallel, with the participation of the working group, NFD has arranged several one-to-one meetings with key players in and adjacent to the battery value chain. Two roundtable meetings have been held on the battery strategy: one on 18 February 2022 chaired



The Government has launched its “Roadmap for a Green Industrial Initiative” with 100 actions and measures that will accelerate the green transition.

by the Minister of Trade and Industry Jan Christian Vestre, and one on 22 April 2022 chaired by the Prime Minister Jonas Gahr Støre. The working group was represented at both these meetings.

This preparatory work resulted in a document called *“Underlying knowledge – Basis for a national battery strategy”*.

The value chain for batteries – one of the priority areas of the “Green Industrial Initiative”

The Hurdal Platform highlights the correlation between the Government’s policy on the fields of energy, climate change and environment, industry and trade, with an overarching goal of transforming the economy in a green direction, cutting greenhouse gas emissions, creating profitable and attractive jobs all over Norway, increasing export revenues and developing Norway as a major player within green industry and energy for the future.

A key starting point is that the world is increasingly demanding products with a low carbon footprint and that are produced sustainably with the least possible negative impact on the environment and nature. In this context, Norway is in a unique position to develop profitable green jobs; we have rich natural resources, specialist competencies in a range of

relevant industries, leadership in renewable power and electrification, the Norwegian working model, a skilled workforce and a generally high level of technology acceptance among the population. In addition, Norway has a long history of good collaboration with the other Nordic countries and is well integrated into the European market and international trade in general.

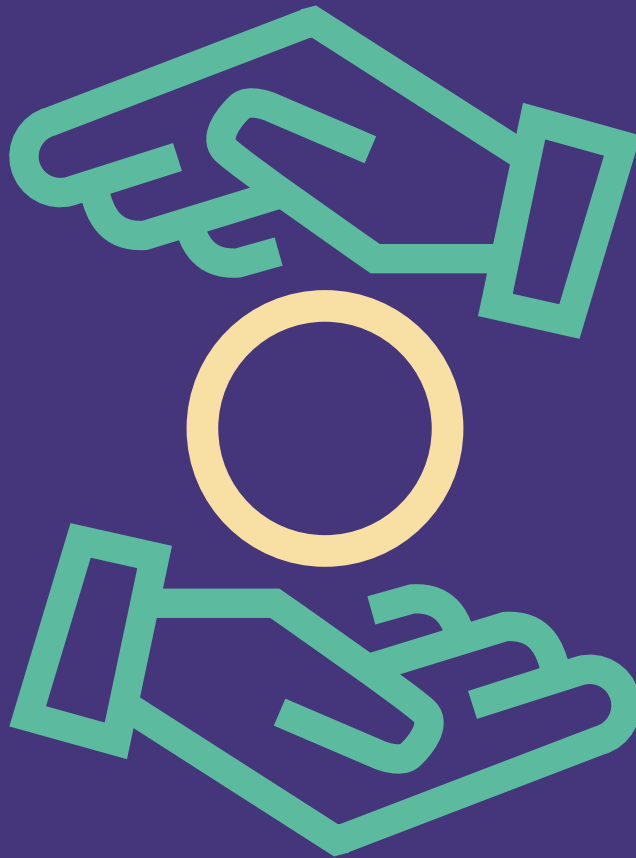
With such a foundation the Government has launched the Green Industrial Initiative to realise the potential for value creation in selected “green” value chains. The value chain for batteries is one of the priority areas. Other priority areas are the value chains for offshore wind, hydrogen, carbon capture and storage, the process industry, the maritime industry, and forests and wood industry. The Government has recently presented a roadmap illustrating its ambitions for the Green Industrial Initiative and the process for how these will be achieved.⁵

Interaction between the public sector and industry is central to the Green Industrial Initiative. Norwegian authorities shall facilitate the use of the entire toolbox, and all the policy instruments must work together collectively. The overarching purpose, however, remains to mobilise private capital.

5 Grønt industriløft [green industrial boost] – regjeringen.no



All the policy instruments
must pull in the same
direction.



The battery value chain, Norwegian actors and opportunities for value creation

The battery value chain

The total market for batteries consists of the entire value chain from minerals extracted from mines and quarries, refined raw materials such as nickel, cobalt and manganese, refined precursors, and active cathode materials, anode materials, battery cells, battery packs and recycling. It also includes suppliers of various battery components, production technology and associated services, for example related to autonomous solutions, digitalisation in general and charging infrastructure.

There is an extensive value chain behind the production of the battery cells and battery packs found in a variety of every-day products. Battery cell factories are the crucial link that can ensure growth along the entire value chain. The location of the different process steps of the value chain depends on access to sources of minerals and materials, as well as various special needs and input factors, such as competencies, power, water, green/brown field sites, transport, etc. for the various elements in the value chain. Together with material suppliers and research and innovation environments, the battery companies established in Norway will form a strong ecosystem, creating a platform for further development of a new high-competence industry.

To ensure a lasting competitive advantage in the battery value chain, it must be possible to trace and document the industry's environmental footprint along the entire value chain. Batteries that can prove high positive impact on preventing climate-change and on safeguarding the environment are likely to be winners, since the EU's proposed new Battery Regulation requires documentation of sustainability credentials. The EU's forthcoming Battery Regulation paves the way for this through a "battery passport" and requirements regarding component information, carbon footprint throughout the entire value chain, and minimum recycled content. There is also reason to believe that future owners of electric vehicles and other battery-powered products will increasingly demand documentation of the product's climate and environmental impact. Thus, all manufacturers (from all countries) must have attention on this going forwards. In view of these factors, Norway will be very well positioned to develop competitive players along the entire value chain, by ensuring low or negative greenhouse gas emissions and maximising the environmental benefits through the use of materials along the value chain.

FIGURE 1

The battery value chain

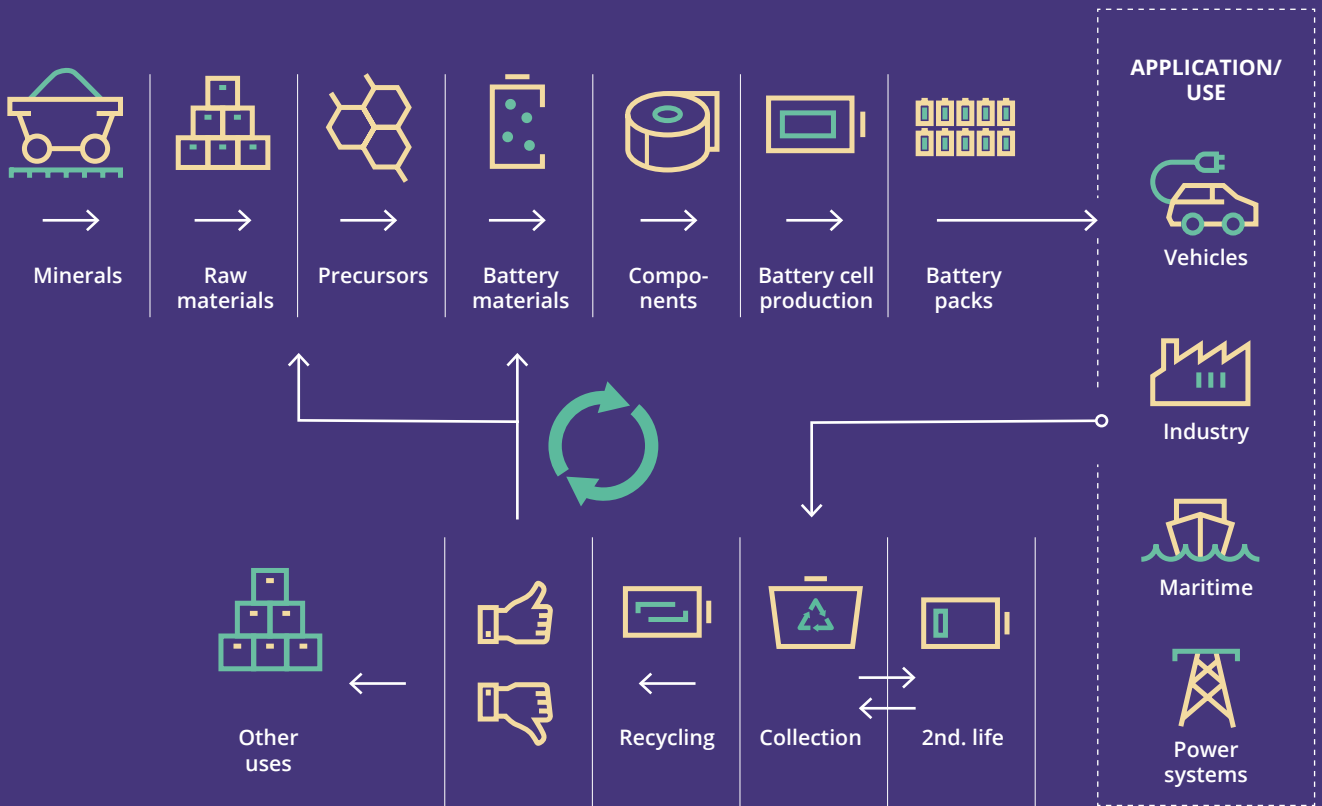


FIGURE 2

Norwegian actors in the value chain



Minerals



Raw materials
Other uses



Precursors



Battery
materials



Components

Skaland  Graphite AS

 Hydro

NIKKELVERK
A GLENCORE COMPANY

 Elkem

Vianode
an Elkem company

 Borregaard

 CENATE

 CEALTECH™

 TiOTECH

Norwegian actors in the battery value chain

The Norwegian battery industry consists of both experienced actors, including product portfolios for electric vehicles and maritime transport, established producers of materials and energy companies, and various newly established companies, including both some large and many small industrial initiatives. The Norwegian battery industry is in the process of consolidation through various joint projects, collaboration through trade associations and emerging cluster collaboration. Considerable activity in research, development, innovation and market initiatives has been initiated by the industrial actors in recent years.

In respect of the raw materials, there is currently limited mineral extraction in Norway that is relevant for use in batteries. One major exception is Skaland Graphite

located in Senja, which is one of Europe's largest and cleanest sources of natural graphite.⁶ However, an overview compiled by the Nordic Council of Ministers shows that Norway and the Nordic countries have great potential for increased production of critical mineral resources and must be regarded as one of the most promising areas in Europe.⁷

Norway is nevertheless a major exporter of a range of relevant materials used in batteries, primarily nickel, aluminium and graphite, but also cobalt, copper and silicon. This provides a good basis for Norwegian industrial companies to produce tomorrow's battery materials (cathode and anode materials). Vianode, which has developed a new process for synthetic anode graphite and has completed a pilot line in Kristiansand, is now in the process of planning an

6 Skaland Graphite AS – Europe's major producer of Crystalline Flake Graphite

7 The Nordic supply potential of critical metals and minerals for a Green Energy Transition (diva-portal.org)



industrial production line with its owners (Elkem, Hydro and Altor).⁸ Cenate is developing and establishing pilot production of unique nanomaterials based on silicon for use in the next generation of lithium batteries.⁹ These materials will lead to cheaper batteries and longer range for electric private and commercial vehicles.

There are currently three initiatives to establish industrial battery cell production in Norway. Freyr is building a pilot line for customer qualification and announced in June 2022 an investment decision for the construction of Giga Factory 1 and 2 located in Mo i Rana called Giga Arctic with capacity of 29 GWh.¹⁰ Beyonder in Sandnes wants to produce a high power

battery, with a manufacturing plant located in Haugaland business park in the municipality of Tysvær. Beyonder's solution combines conventional lithium batteries with capacitor technology to provide cells with significantly higher power than ordinary batteries. Morrow Batteries is planning to build a lithium battery manufacturing plant in Arendal based on today's leading EV battery technology. Morrow recently obtained EUR 100 million to build a company-specific 1 GWh pilot line, and has entered into a partnership with Siemens and ABB.¹¹ Industrial Development Corporation of Norway (Siva) will secure 67 per cent of the required total of 480 million NOK to build the construction of the building for the pilot line.¹² A fourth initiative, based on a partnership between Hydro,

8 Synthetic Graphite Manufacturers | Vianode

9 Cenate Centrifugal nanotechnology

10 <https://ir.freyrbattery.com/ir-news/press-releases/news-details/2022/FREYR-Battery-Sanctions-Construction-of-its-Inaugural-Giga-factory/default.aspx>

11 Morrow Batteries raises EUR 100 million in new investment round

12 <https://siva.no/2022/08/morrow-batteries-og-siva-gar-sammen-for-a-bygge-batterifabrikk-i-arendal/> Morrow Batteries og Siva går sammen for å bygge batterifabrikk i Arendal



Norway has the highest share of electric vehicles per capita in the world.



Equinor and Panasonic to map the possibilities for building large-scale battery manufacturing facilities in Norway, has now been shelved.¹³ In addition to these, Eidsiva Energi has conducted a feasibility study, and Narvik batteri has recently been acquired by Aker Horizons.^{14 15 16}

Norway is an international leader in electrification of transportation and production of battery systems for maritime use. Corvus Energy, Siemens Energy and ZEM Energy all have battery pack production in Norway using imported battery cells. Schive AS assembles battery packs for a variety of applications in industry, defence, subsea facilities and offshore. On a smaller scale, companies such as Evoy and Greenwaves are developing fully electric products for the small boat market.

The battery value chain will also provide new opportunities for other relevant businesses. For example, technology companies and system integrators such as ABB, Tronrud Engineering, Intek and Kongsberg will be able to contribute to the development of solutions for production and use in areas where these companies are already market leaders.

Several start-ups, such as ECO Stor, Evyon, Alternative Energi and Marna Energi, have entered the market for battery-based energy storage systems for households, often in combination with solar and wind power production. Other companies such as Hagal are specialising in the development of technology that enables efficient utilization of used batteries with significantly reduced costs and lower safety risks using single-cell monitoring. Reuse of batteries could be an attractive opportunity for value creation in Norway due to our early introduction and high market share of electric vehicles.

As the number of batteries from used electric vehicles increases over the next few years, Norway may play an important role in developing systems for reuse and recycling of these batteries. Norway has a well-developed collection system, which is a competitive advantage. The battery collection company Batteriretur specialises in the collection and handling of batteries from the transport sector. Hydrovolt, a joint venture between Hydro and Northvolt, recently opened a factory in Fredrikstad and will recycle electric vehicle batteries from the Norwegian fleet.¹⁷

13 Equinor, Hydro and Panasonic conclude Joint Battery Initiative

14 Battery production in Inland Norway – Bellona.no

15 New company to build battery factory in Narvik – Tu.no

16 AKER is investing NOK 200 million in industrial sites in Narvik. In addition, they are focusing on battery production – NRK Nordland

17 <https://hydrovolt.com/europes-largest-electric-vehicle-battery-recycling-plant-begins-operations/>

FACTS:

Norway has been a pioneer in developing the battery market

Norway has set a target that all sales of new passenger cars will be fossil-free in 2025. To achieve this goal, powerful tax incentives have been provided, to encourage people to choose electric vehicles. Zero-emission vehicles are exempt from VAT and registration tax and have a reduced change of ownership tax. In addition, zero-emission cars are exempt from road tax. This policy has contributed to Norway having the highest share of electric vehicles in the world. In the first five months of 2022, electric vehicles accounted for 79 per cent of new car sales, 93 per cent of which were electric vehicles for private use.¹⁸ Other benefits introduced that lead to increase electric vehicle adoption include reduced toll road fees exemption, lower parking, and lower rates on ferries. Under the current system, the individual municipalities decide the reduced rates for electric vehicles within the limits stipulated by the Storting, i.e. that the discount must be at least 50 per cent.

The push to transition to electric vehicles in Norway started as early as 1990 and has contributed to Norway becoming a pilot arena for international car manufacturers. Many automakers have launched their new car models in Norway and have tested new technology in our climatic conditions. Norway has thus contributed to technological advancements and mass production. Today, Norway represents a

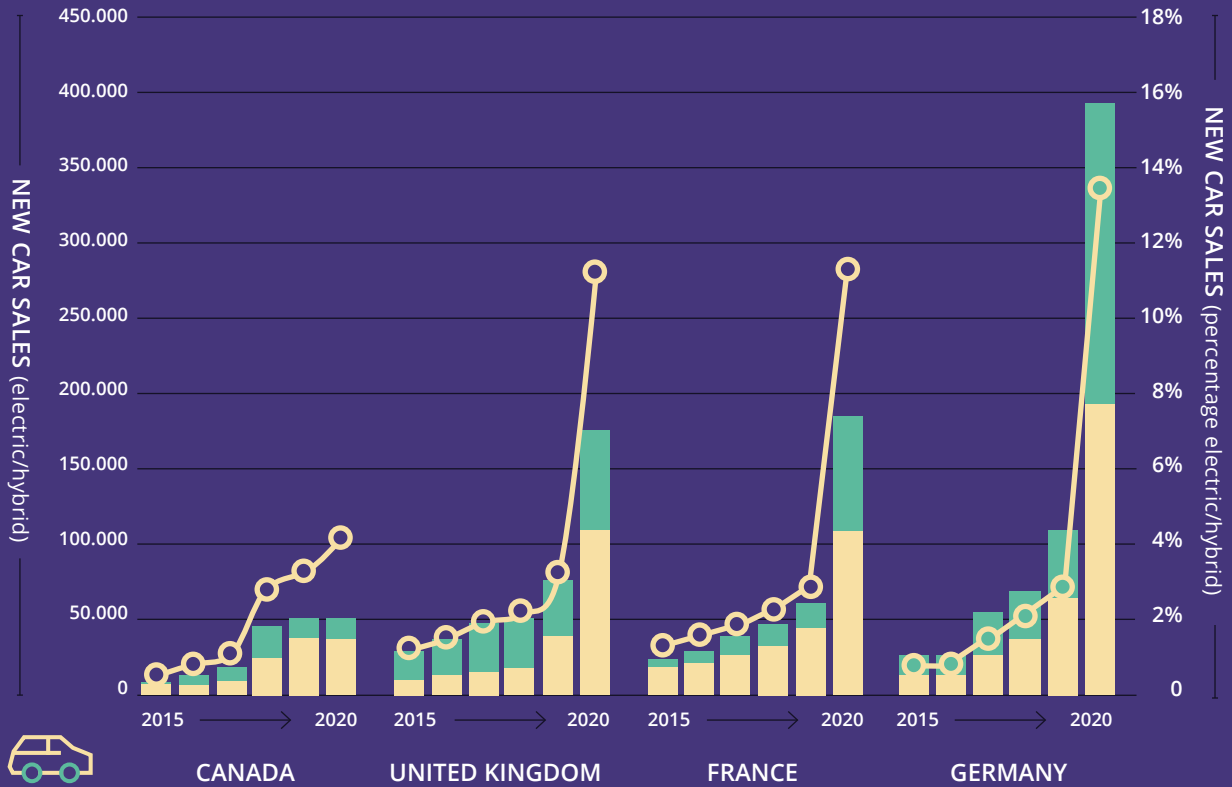
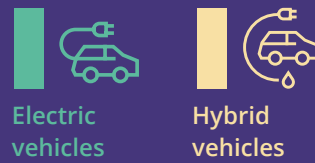
relatively small market for the manufacturers, but remains a “battery pioneer” with a well-developed charging infrastructure and experience in respect of battery life time and second-hand trading of batteries. The changes Norway has contributed to provides experience that is useful for other countries.

Norway’s electric vehicle policy has entailed a significant loss of revenue for the state. In Proposition no. 1 to the Storting (2021–2022) – bill and draft resolution, on taxes, the total tax benefits for electric vehicles in 2021 were calculated to NOK 30 billion. Norway has a relatively high level of tax on passenger cars and has promoted zero-emission vehicles through tax exemptions. Thus, it has become financially advantageous for consumers to buy zero-emission vehicles despite low production figures and a limited selection of models. In other countries, tax exemptions will often result in a smaller “discount” on the retail price, meaning new electric vehicles have been relatively expensive compared with traditional fossil fuel cars. The uptake of electric vehicles on the continent is thus more as a result of emission ceilings for car brands, leading to manufacturers having to develop a range of new electric vehicle models. The share of electric vehicles in European countries is therefore expected to be implemented more rapidly than we have experienced in Norway.

¹⁸ Sales figures are bad news for the 2025 van target – Norwegian Electric Vehicle Association

FIGURE 3

Prevalence of electric passenger vehicles in selected countries, including the number of cars sold and as a share of the total passenger car fleet. *Source: IEA*



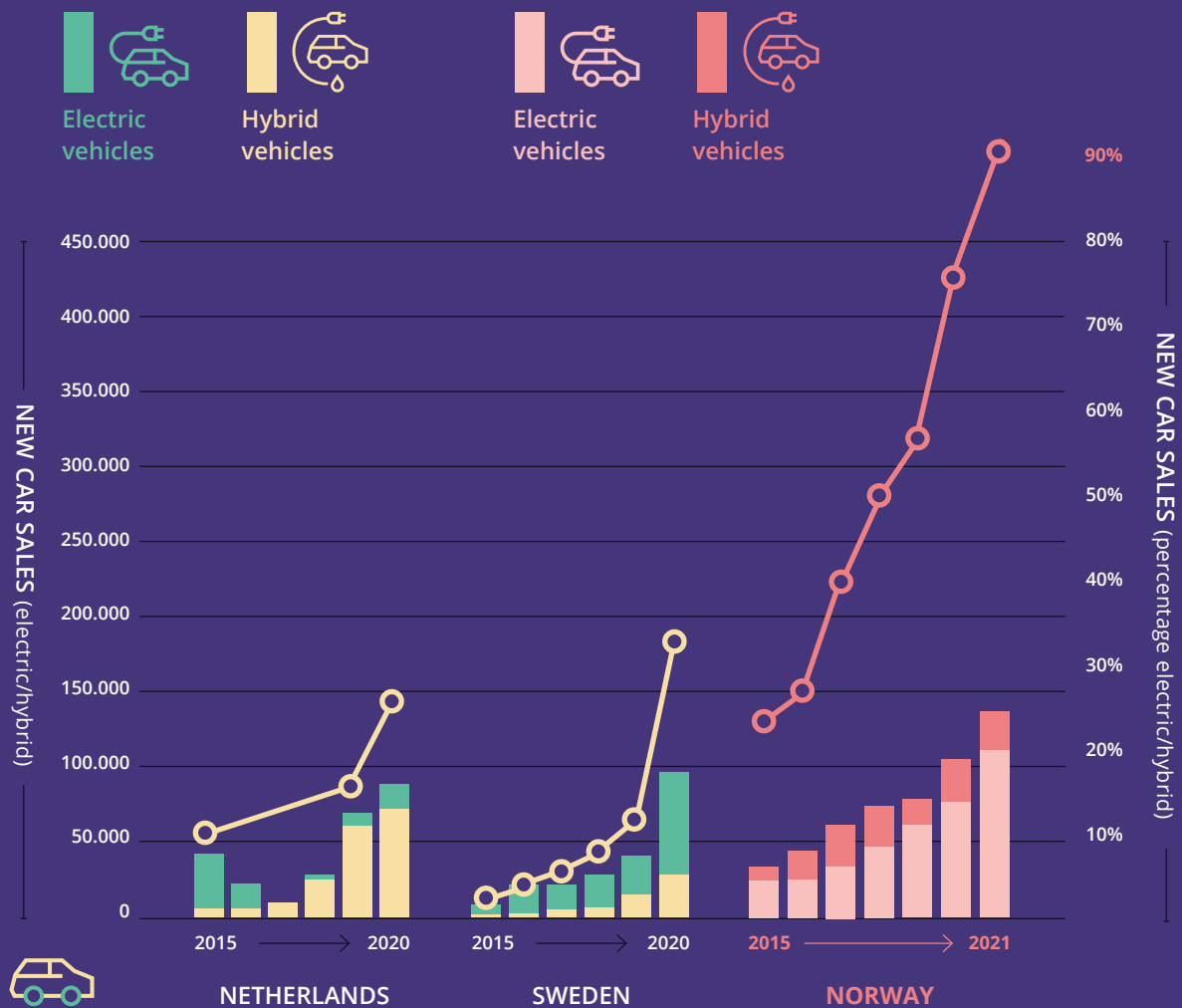
Studies on advantages and value creation opportunities for the battery value chain in Norway

Electrification in general and battery technology in particular offer a large number of business opportunities. Various rough estimates have been made of the value adding potential of a battery value chain in Norway. The Confederation of Norwegian Enterprise (NHO)'s report "Grønne elektriske verdikjeder" [Green electric value chains] published August 2020, estimates that facilitating for investment in the

battery value chain in Norway could lead to a turnover of around NOK 90 billion in 2030 and NOK 180 billion in 2050, most of which will be for export. The report estimates 3,500–7,400 jobs created, directly or indirectly, to a battery cell factory with a capacity of 34 GWh, which could correspond to around 9,000–22,000 jobs, if the three existing battery cell players realise their plans in Norway.¹⁹

In its report "Recommendations for industrial investment in batteries in Norway", the Confederation of

19 Tomorrow, Freyr and Beyond



Norwegian Enterprise (NHO) stresses that: “Norway offers several advantages and can deliver on requirements for highly skilled labour, continuous innovation and high yield production. The battery value chain entails an opportunity to connect Norwegian process industry with the manufacturing industry and to build on our long experience from materials technology, metallurgy, electrochemistry and high-tech industrial processes. We have strong technical-industrial and academic environments that have a tradition of collaborating closely with industry. We have a number of major, leading

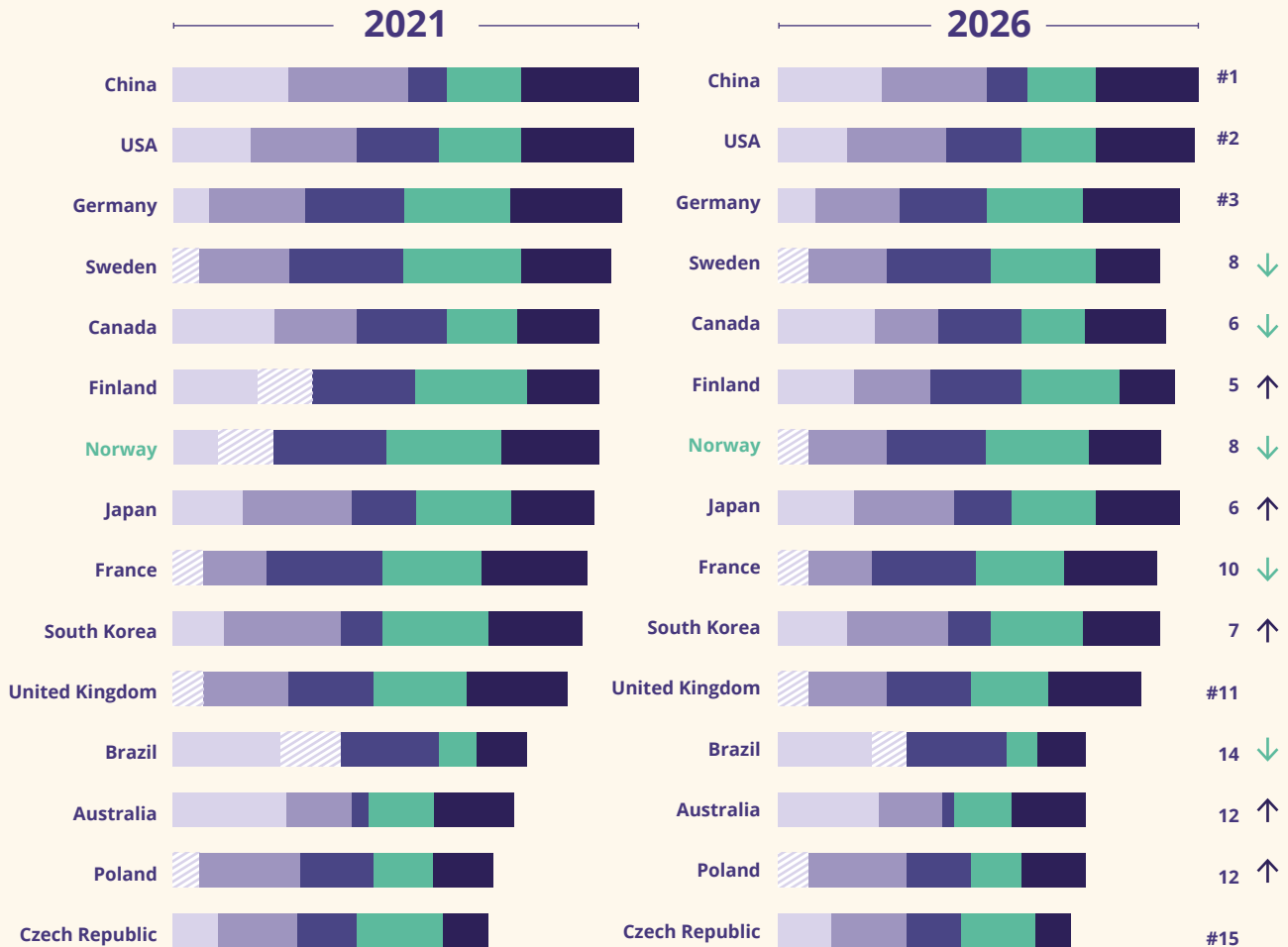
companies with extensive experience in electrification of the transport sector and maritime operations. We also have opportunities to take industrial positions in order to reap the benefits of Norway’s position in the electric vehicle sector, especially in the field of recycling. Norway has companies that have proven to be highly competitive in the global market, accompanied by a complementary ecosystem of expertise.”

In February 2022, McKinsey published the report “Norge imorgen” [Norway tomorrow], proposing an

FIGURE 4

Global ranking of various countries' attractiveness for investments in the battery value chain

Source: BloombergNEF



Raw materials



Production



Environment



Regulations Innovation
& Infrastructure



Battery needs

ambition of establishing 200 GWh battery cell production in Norway, predicted to result in a GDP increase for Norway of NOK 40 billion, and that the industry would employ a total of 33,000 people in 2030.²⁰ This ambition involves more than doubling the announced capacity of the three Norwegian battery cell initiatives. McKinsey emphasises that: *“Norway has a possible competitive advantage in terms of costs through a combination of access to cheap renewable power and high productivity based on industrial expertise. This can also translate into lower costs for the production of active materials and cells. Compared with Germany, which is a key actor in Europe, Norwegian production costs may be 6–9 per cent lower.”*

At the high-level meeting on batteries on 22 April 2022 chaired by the Prime Minister of Norway, the European Battery Alliance presented an overview, prepared by BloombergNEF, comparing the attractiveness of various locations for activity in the battery value chain in 2021 and predictions for 2026.²¹ The overview confirms the impression that Norway, like

our neighboring countries Sweden and Finland is particularly well suited for attracting private capital to the battery value chain.

The document *“Kunnskapsgrunnlaget – Underlag for en nasjonal batteristrategi”* [Underlying knowledge – Basis for a national battery strategy] presents a strategic SWOT analysis of strengths, weaknesses, opportunities and threats for the establishment of industrial activity within the battery value chain in Norway. The analysis is based on a number of working meetings organised by Prosess21, Confederation of Norwegian Enterprise (NHO), Battery Norway and Energi21. It is emphasised that several of the points in the strategic analysis are not specific to Norway and that individual elements in the analysis may be a weakness for many European countries, such as a lack of lack of competencies in battery technology. Similarly, many countries have stable political frameworks or need to import various raw materials.

20 Norway tomorrow | McKinsey

21 <https://www.regjeringen.no/no/aktuelt/toppmote-om-gront-industriloft-og-batterisatsing/id2909721/>

FIGURE 5

Analysis of strengths, weaknesses, opportunities and threats (SWOT).

Source: The analysis is based on working meetings organised by Prosess21, the Confederation of Norwegian Enterprise (NHO), Battery Norway and Energi21

Strengths

- Renewable emissions-free power at competitive prices
- Expertise in process/material/energy-intensive industry with high utilization of resources and materials
- Norway is a leader in the electrification of the EV-fleet – unique age and composition of the Norwegian EV fleet / Norway as a pilot arena
- Stable political governance
- Skilled workforce, flat organisational structures, collaborative employer/employee processes
- Good collaborative environment among the various actors in the industry
- Strong, internationally oriented R&D centers
- Private–public partnerships
- Member of the EEA
- Green reputation

Opportunities

- Increased and more diversified exports, to counterbalance our dependence on oil and gas
- Strategic partnership with the EU
- Increased value creation and employment pr. consumed MWh
- Specialised competence-intensive products in an extended value chain
- Domestic maritime market
- Energy storage (ESS) in a fully electrified power system in collaboration with power-grid owners
- Battery recycling
- Low employee turnover
- Significant investments in battery value chain
- Nordic collaboration
- The EU's Battery Regulation favours the Nordic countries

Weaknesses

- Lack of competencies (in terms of volume, specialisation, and skills development)
- Limited influence on development of regulations in the EU
- Limited companies that supply original equipment manufacturers (OEMs)
- Less actors in high volume manufacturing
- Lack of industry-oriented business policy
- Scarce resources related to attracting foreign investments
- Time-consuming licensing processes (energy, emissions, regulation)
- National capital actors with less experience in capital-intensive industrial manufacturing (excluding oil and gas)
- Expected shortage of skilled workers
- No production of active cathode materials

Threats

- Customs EU/UK from 2027
- Time – the race has already started
- Lack of relevant raw materials (spec. cathode)
- Norwegian/EU collaboration remains reactive
- Cost competitive industry
- Enable to master new technologies with imported competencies
- Lack of excess electrical power
- Rigid policy instruments
- Not prepared for massive investments – conservative capital environment
- Exports of used electric vehicles
- Mining – NIMBY (Not In My Back Yard)
- Remaining a supplier of commodity products
- Chinese manufacturers are better
- Brown reputation



Norway is a leader in the electrification of the EV-fleet – unique age and composition of the Norwegian EV fleet.



The battery value chain will contribute to a more diversified industry sector in Norway and increase the green investments.



A green strategic industrial partnership with the EU will position Norway as a partner in the green transition and strengthen opportunities to create jobs throughout Norway.



Norway has expertise in energy intensive process industry with several established actors producing with low carbon footprint material that are essential for the green transition.

Advancements in technology, trends and European mobilisation

Competition, qualification processes and advancements in technology

The energy output of lithium batteries is expected to level off in the years to come, as it has gradually been possible to improve properties within today's materials chemistry. It will be difficult, perhaps even impossible, to satisfy future energy storage requirements by simply optimising today's battery solutions. New solutions must address safety, costs, longevity, output and charging time. It will be important to develop solutions that provide the necessary flexibility for heavy vehicles and for energy storage systems (ESS).

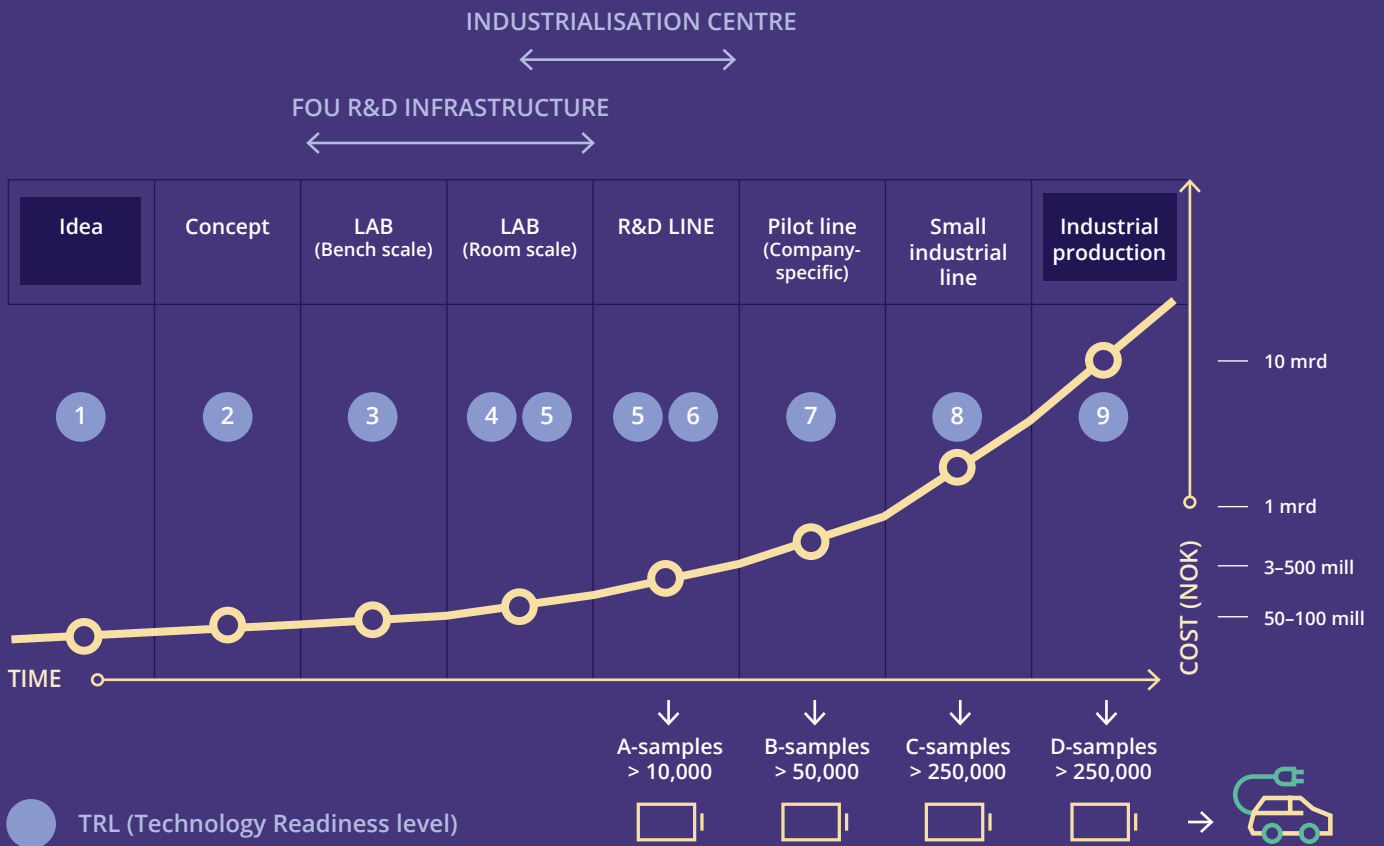
A battery company will often experience tough competition in terms of quality, price and reliability and with demanding international customers. Due to their experience, Asian companies have a head start on most European actors, and several of them will want to establish battery production in Europe. At the same time, the battery value chain is immature, and the market is growing in scope and complexity. The sector is developing at an accelerating pace, with an increasing number of technologies and opportunities for tailoring for various applications. Going forwards, significant market changes are expected resulting in consolidations, integration within the value chain and developments in battery technology.

New actors in the battery value chain will have to initiate production based on current available technology. Stage gate qualification processes require the producer to prove manufacturing at industrial scale level at the same time meeting a stringent set of qualification criteria. Research and development must primarily focus on tomorrow's battery solutions required by the market in years to come (improved output, lifetime, material combinations, safety, etc.), and these developments must often take place in parallel with production based on current technology and material solutions.

The different actors in the battery value chain have varying needs for piloting, depending on whether they are to qualify a product (battery) and/or materials (including recycled variants of materials). In general, all players will need to have their product or material verified by producing a series of batteries. The size of these series will depend on what is to be qualified (materials or entire cells) and where in the qualification/ verification process they are (early development or final qualification). To qualify products for the automotive industry, there are stage gate qualification processes over three to four years that follow a plan for launching of a new car model or platform. The costs for a company-specific pilot line can amount to several billion kroner, and the manufacturer will usually have to bear the risk.

FIGURE 6

Pilot solutions for battery development depending on level of development in the form of TRL (Technology Readiness Level)



The battery market

Globally, the battery industry is growing rapidly and changing significantly. The demand for batteries has almost tripled since 2018, and is predicted to be 14–20 times higher in 2030 than it is today globally and 7–12 times higher in Europe.²² The growth in demand is expected to increase exponentially from around 2025, and supply-side shortages in the battery value chain are expected.

To date, batteries have largely been manufactured in Asia. In 2018, 97 per cent of all electric vehicle batteries were manufactured by three countries: China, Japan and South Korea. In 2019, China and Japan accounted for 75 per cent of all battery cell production and 60–90 per cent of the production of the various active battery materials. Through the 2020s, global production will increase sharply, and a significant build-up of capacity for battery cells is expected, especially in China and Europe. The European battery industry is currently undergoing a major mobilisation, driven by the EU's goal of strategic autonomy. The EU has a clear ambition to bring production closer to the European carmakers and have control over the battery value chain for

the European market. The reason for this is that batteries are regarded as core technology for the green digital transition. To achieve this, the EU as a whole and individual European countries are actively pursuing an industrial policy in which regulation and comprehensive financial support are pivotal. Battery production in Europe is expected to account for around 30 per cent of the global production by 2030. A similar mobilisation is also underway in the US.

The market is defined in terms of the energy content of the battery cells produced per year, measured in gigawatt hours (GWh). Large battery cell factories are commonly referred to as “giga factories”. The size of these factories varies, and the energy density of the battery cells varies according to its area of application. Accordingly, it is not simply a case of adding up the capacity of the various battery cell factories. For example, Morrow Batteries is planning to build three “giga modules” in Arendal that together will have a capacity of approximately 43 GWh, and which will be able to supply batteries equivalent to 700,000 electric vehicles per year. The pilot plant that Morrow recently announced will have a capacity of 1 GWh of battery cells per year.

22 Source: The European Battery Alliance and others

FIGUR 7

Overview of global production capacity of battery cells, broken down by regions; development 2020–2025–2030

Source: Benchmark Minerals Intelligence

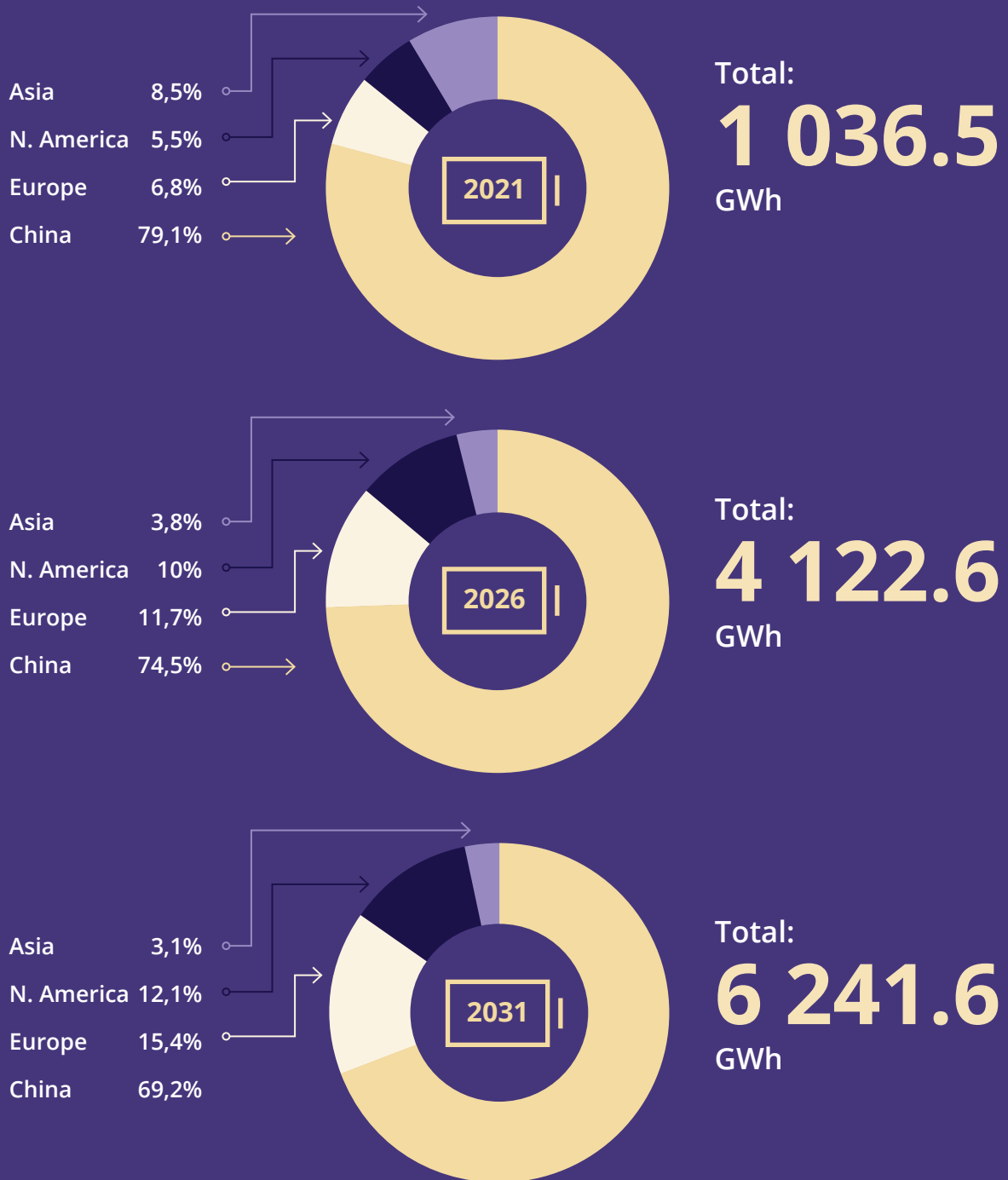
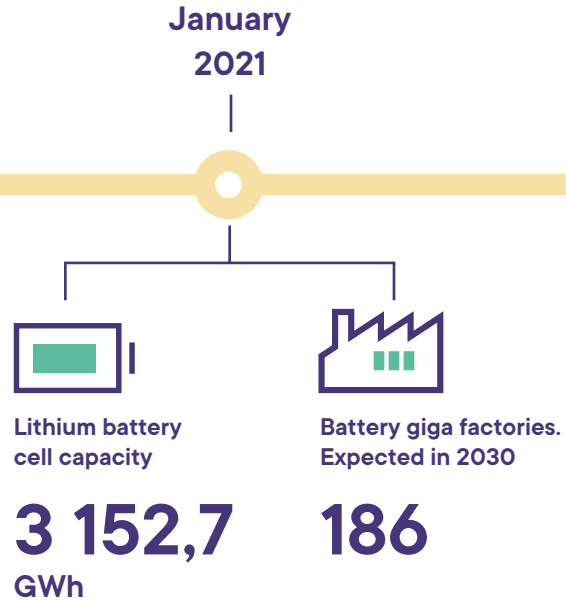


FIGURE 8

From the European Battery Alliance showing market data (expectations for global battery cell production in 2030)

Source: Benchmark Minerals Intelligence

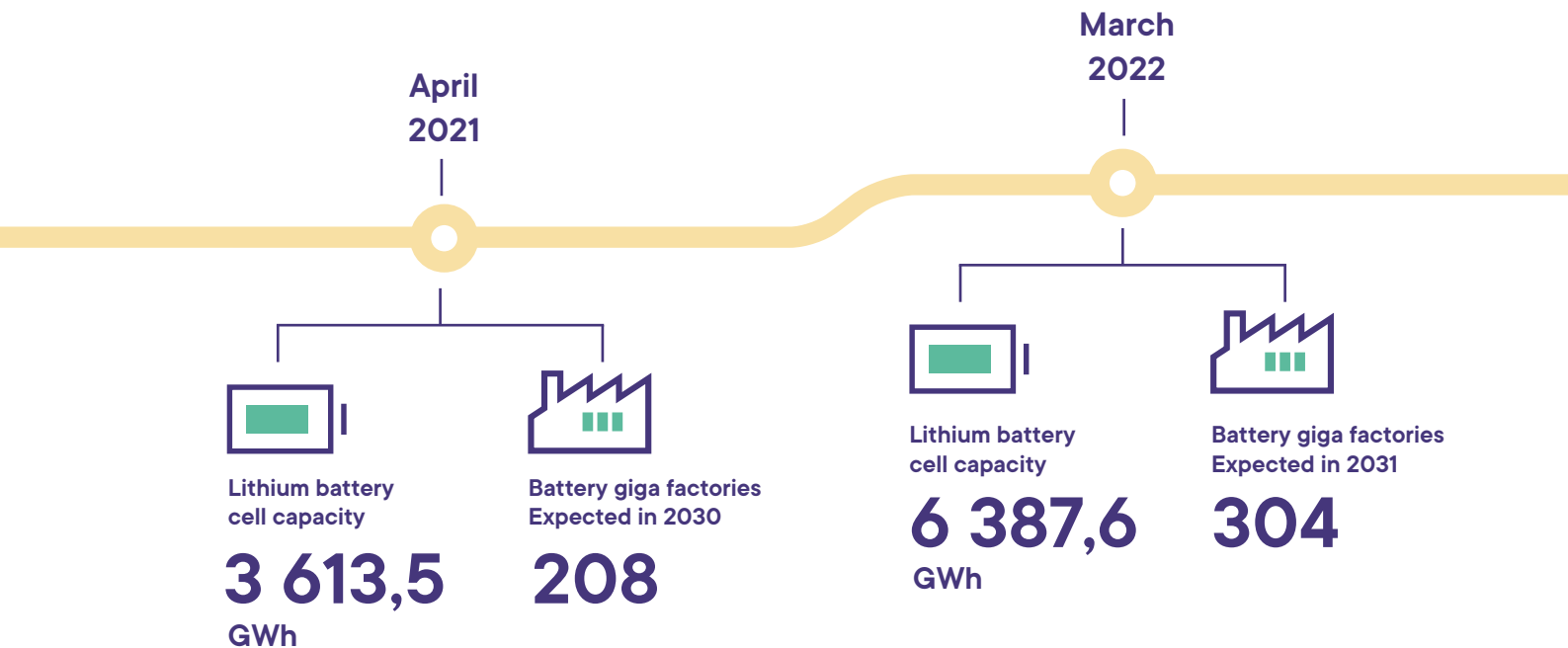


Estimates of the global demand from batteries in 2030 range from 3,600 GWh to over 6,000 GWh. By comparison, the total global demand for batteries was 200 GWh in 2018 and 470 GWh in 2021. Rystad Energy has estimated the battery storage needed in 2030 in order to meet the UN IPCC's 1.6 °C scenario to 9,000 GWh, of which 2,600 GWh is stationary energy storage. The European market is currently dominated by the demand in the automotive sector and is estimated at an annual production in 2030 of approximately 1,000 GWh, which will be enough to power 12–15 million new electric vehicles. In 2017, the European Battery Alliance (EBA) set an ambition to meet this total market, which was estimated as having a turnover of EUR 250 billion by 2025. In March 2022, these estimates were updated to EUR 625 billion in 2030.²³

The market development of batteries is driven by the increased focus on decarbonisation of society and the associated need to develop environmentally friendly, sustainable solutions. Technological developments in the battery value chain have also enabled efficient production of more sustainable batteries for a range of applications.

The transport sector, and especially batteries for passenger vehicle, remains the main driver in the market and for policy developments, and is expected to account for two-thirds of the market by 2030. In connection with the 26th UN Climate Change Conference in Glasgow in 2021 (COP26), 30 countries and six of the world's largest carmakers signed a declaration on zero-emission cars and commercial vehicles, pledging to work towards 100 per cent sales of zero-emission

23 Joint Statement EBA HL Industrial Meeting 23 March 2022-Final1.pdf (hubspotusercontent-na1.net)



vehicles by 2035 in developed markets and by 2040 globally.²⁴ By 2030, Denmark, the Netherlands, Scotland and Sweden, among others, will ban the sale of new light-duty vehicles with internal combustion engines, while Norway has a target of 100% of new passenger cars being fossil-free by the end of 2025.

Batteries are also increasingly in other transport segments, such as in the maritime, heavier vehicles such as buses and lorries, commercial vehicles used in industry, ports and other logistics, and light-duty vehicles such as electric wheelchairs, lawnmowers, etc. Work is also under way to use batteries in aviation (for short distance flights). Batteries are also crucial for power grid stabilisation, energy supply and energy storage. By 2030, batteries for energy

storage are expected to account for almost a third of the demand for batteries. The energy crisis in Norway and Europe in 2021–2022 may raise awareness of the role batteries can play.

Experience to date shows that the overall demand for batteries is growing more rapidly than expected, and estimates are therefore constantly being updated.

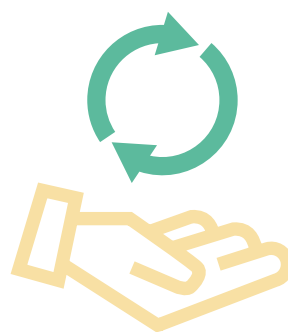
The EU's battery ambitions and the Battery Regulation

The European Commission placed batteries at the top of the EU's political agenda in 2017.²⁵ At that time, industrial actors in the EU accounted for only 3 per cent of the global production and depended heavily on imports. One of the first measures implemented

24 COP26 declaration: zero emission cars and vans – GOV.UK (www.gov.uk)

25 Building a European battery industry – European Battery Alliance (eba250.com)

”Norway will actively contribute to the building of a complete European battery value chain.”



by the EU was the launch of the European Battery Alliance (EBA) in 2017. EBA was tasked with facilitating cooperation among key players in the industry and strengthening dialogue and consultation with the European Commission. In 2019, the EU also released a *Strategic Action Plan for Batteries*. It set out six priority areas, including ensuring access to raw materials, building a full battery value chain in Europe, becoming a global leader in battery research and development, introducing strict sustainability requirements, and defining political frameworks within (and outside) the EU.

In order not to be dependent on Asian companies, the EU needs to establish its own activity based in European companies. The technology will be transferred (from Asia), updated, and improved (in terms of energy performance and sustainability). This places high demands on coordination and cooperation among the EU's 27 member states. For Europe, with its many different countries and cultures, to enable competitiveness towards China, the EU must collaborate on development in this area to ensure that it is targeted, coordinated

and effective. The EU's approach must therefore be regarded as a cluster approach where the individual efforts, through collaboration and distribution of roles, will complement each other and together constitute an engine to drive the growth ambitions.

The EU's battery ambitions are discussed in *European Green Deal* and the EU's circular economy strategy.^{26,27,28} In the “Fit for 55” package, the European Commission proposes the phasing out of internal combustion engine in 2035.²⁹ In 2019 and 2021, the European Commission launched two *Important Projects of Common European Interest* (IPCEI) with a combined state aid budget of EUR 6.2 billion, which together are intended to unlock EUR 14 billion in private investments.^{30,31} The IPCEI scheme will support innovative projects in selected areas that require a coordinated cross-border effort. This is a central arena for the connection and coordination of European projects in the battery value chain, among others. IPCEI projects are supported by national funds, but are governed by special state aid rules that allow higher levels of state aid and support for

26 REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE, THE COMMITTEE OF THE REGIONS AND THE EUROPEAN INVESTMENT BANK on the Implementation of the Strategic Action Plan on Batteries: Building a Strategic Battery Value Chain in Europe – Publications Office of the EU (europa.eu)

27 https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf

28 https://ec.europa.eu/environment/circular-economy/pdf/new_circular_economy_action_plan.pdf

29 <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021DC0550&from=EN>

30 State aid: Commission approves aid in battery value chain (europa.eu)

31 State aid: €3.2 billion public support battery value chain (europa.eu)

start-ups. Support under this scheme assumes that the benefits of the project for Europe as a whole outweigh any market-distorting effects of the funding. The European Commission justifies this move on the grounds that the initiatives have strategic value for Europe as a whole, will contribute to extensive innovation and will promote growth, competitiveness and employment.

In December 2020, the European Commission presented a proposal for a comprehensive new Battery Regulation that is scheduled to apply throughout the EU's internal market from 2023.³² The new Regulation has been formulated such that it actively promotes the development of a circular, green battery industry in Europe that is able to compete internationally. The Regulation promotes sustainability in a holistic way with requirements that apply to all parts of the battery value chain, including the mineral extraction phase. The proposed Regulation sets several product requirements for batteries that are to be offered on the market in the EU. Requirements will be set on carbon footprint reporting, and maximum carbon footprint thresholds will be introduced. The requirements for the collection of batteries will be tightened to ensure the availability of secondary raw materials in the European market, with a long-term goal of a 100 per cent collection rate. The Regulation will make

it statutory to use recycled materials in the production of new batteries, and battery manufacturers will have to report on the proportion of recycled content used in the production of new batteries. It will also introduce explicit environmental and social requirements related to the procurement of minerals and contain guidelines on how electric car batteries can be re-purposed after they can no longer be used in electric cars. The Battery Regulation will set requirements for access to and sharing of information linked to each individual battery through digital solutions such as QR codes and a battery passport, including information about the origin of the battery's raw materials, including ethical aspects. Following its adoption, the Regulation will be sent to the EFTA bodies, which will then decide whether the Regulation is to apply in the EFTA countries. European manufacturers point out that the EU's Battery Regulation must be implemented promptly and specifically request that the 2023 deadline be met.³³

In March 2022, the European Battery Alliance (EBA) held a high-level industrial meeting in Brussels, bringing together key stakeholders along the entire battery value chain and representatives from the European Commission.

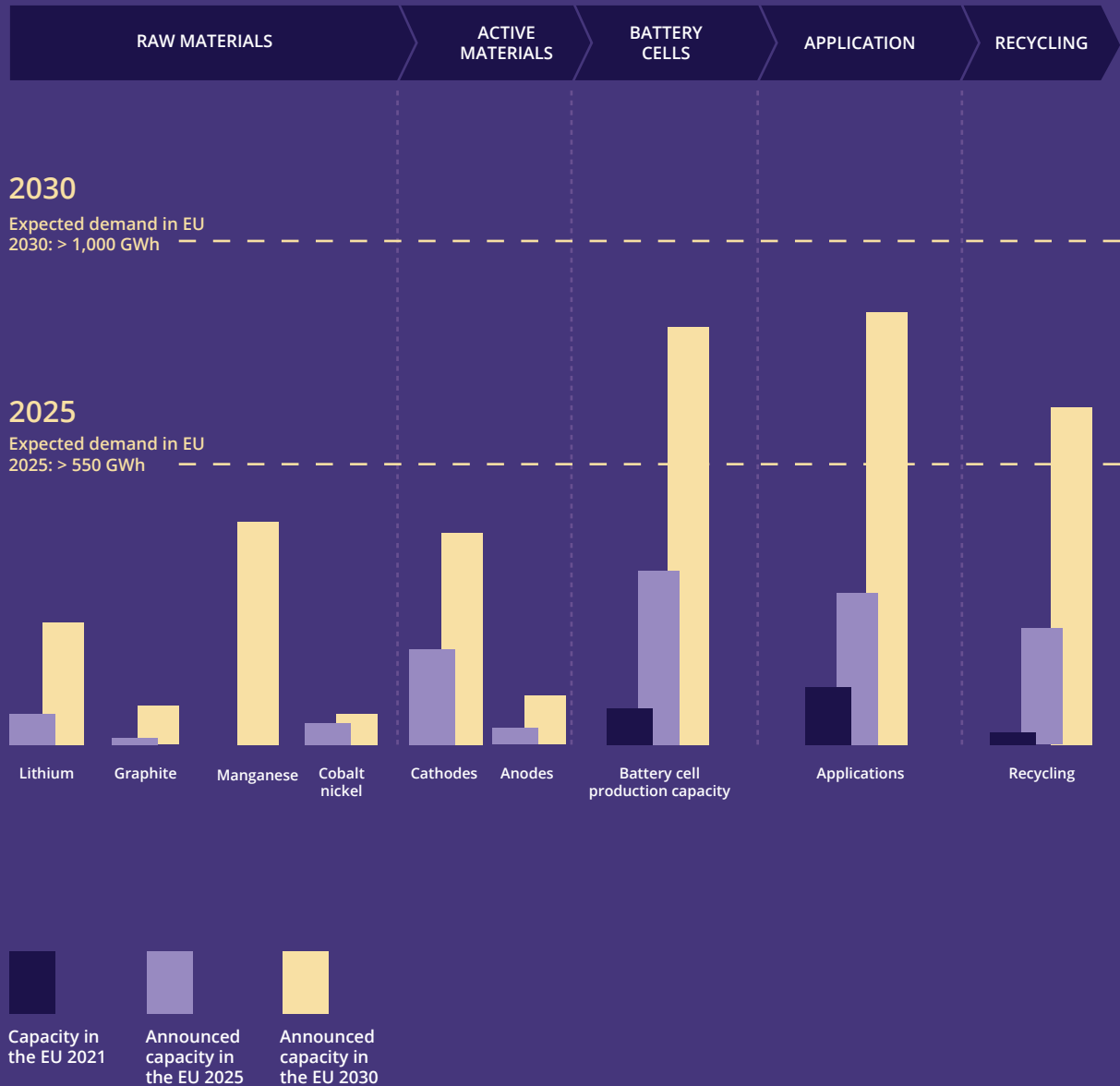
32 New EU regulatory framework for batteries (europa.eu)

33 Open Letter – Battery Regulation (industry) (transportenvironment.org)

FIGURE 9

Illustration of self-sufficiency in the European battery value chain compared to expected demand in 2025 and 2030.

Illustration recreated from the European Battery Alliance



The participants reaffirmed their commitment to building a robust, sustainable and competitive battery value chain in Europe and the need for an expedited action plan to fill the remaining gaps until 2030.³⁴ The summary from the meeting underlined the need to strengthen the work with upstream suppliers in the value chain, especially related to access to raw materials and the establishment of battery materials capacity. It also identified a need for efforts downstream on recycling and after-use solutions, as well as considerable demand for skills development. This highlights that the EU has limits in respect of its control over access to raw materials and may therefore be vulnerable to price fluctuations and shortages (cf. Figure 9). The EBA emphasises the need for rapid implementation of the EU's Battery Regulation so that the competition for customers takes carbon footprint and environmental aspects into account, as opposed to price alone. The need for rapid implementation of relevant statutory provisions is also underlined in the "Fit for 55" package, along with the need to update *the European Strategic Action Plan for Batteries*. In connection with the war in Ukraine, the European Commission has presented the RePowerEU plan, outlining the steps the EU will take to ensure it is no longer dependent on Russian gas "well before

2030". The EU will counter this challenge through an ambitious approach to the green transition, including strengthening Europe's position in key green industrial value chains, expansion of renewable energy production, increased electrification in industry, construction and transport, and a more diversified energy supply. This plan further underpins the already high ambitions for a European battery value chain.

Nordic collaboration

As a whole, the Nordic region is in an excellent position for a growing European battery value chain. Norway, Sweden and Finland have actors in all parts of the value chain with the possibility for an influx of foreign investment. These countries also have complementary comparative and industrial strengths that, collectively make the region an attractive host, insofar as increased collaboration among players in the battery value chain and with customers is considered an important key to success. The EU's Battery Regulation is favourable for the Nordic countries and will lay the framework for activity in the value chain. The European Battery Alliance (EBA) expects the Nordic Region to establish itself as one of three centres of gravity for the European battery industry, alongside Germany and Hungary.

34 [resource.html \(europa.eu\)](#)



Norway's industrial partnership with the EU highlights increased collaboration on batteries as a priority area.

In 2020, Sweden introduced its *"Fossil-free Sweden"* initiative in collaboration with EIT InnoEnergy³⁵, outlining the national battery strategy.^{36,37} EIT InnoEnergy emphasises the need for national strategies that can complement EU strategies. From the public side, the Swedish Energy Agency, the Swedish Environmental Protection Agency and the Geological Survey of Sweden (SGU) will coordinate their public systems to support companies in Sweden by the end of 2022. In June 2020, the Finnish Ministry of Trade and Industry appointed a working group to develop a battery strategy for Finland, supported by a secretariat with representatives from Business Finland, the Geological Survey of Finland and the Technical Research Centre of Finland (VTT). The purpose of the strategy was to strengthen the innovative ecosystem

in the battery industry, accelerate sustainable and carbon-efficient economic growth in Finland, and support the attainment of the climate change goals for the transport sector.


Increased collaboration among the Nordic countries may provide opportunities to strengthen the Nordic battery value chain in an international context. In April 2021, Innovation Norway, Business Finland and Business Sweden signed a memorandum of understanding on a joint Nordic collaboration on work to promote trade in the battery area, among other commercial subjects. The ambition is to work closely together on selected initiatives where the synergies of acting as a unified force are cultivated.

35 EIT – European Institute of Innovation and Technology

36 Start – Fossilfritt Sverige [Fossil-free Sweden]

37 [Strategy_for_sustainable_batter_value_chain.pdf \(fossilfrittssverige.se\)](#)

 Under construction/in operation

 Planned, partially financed


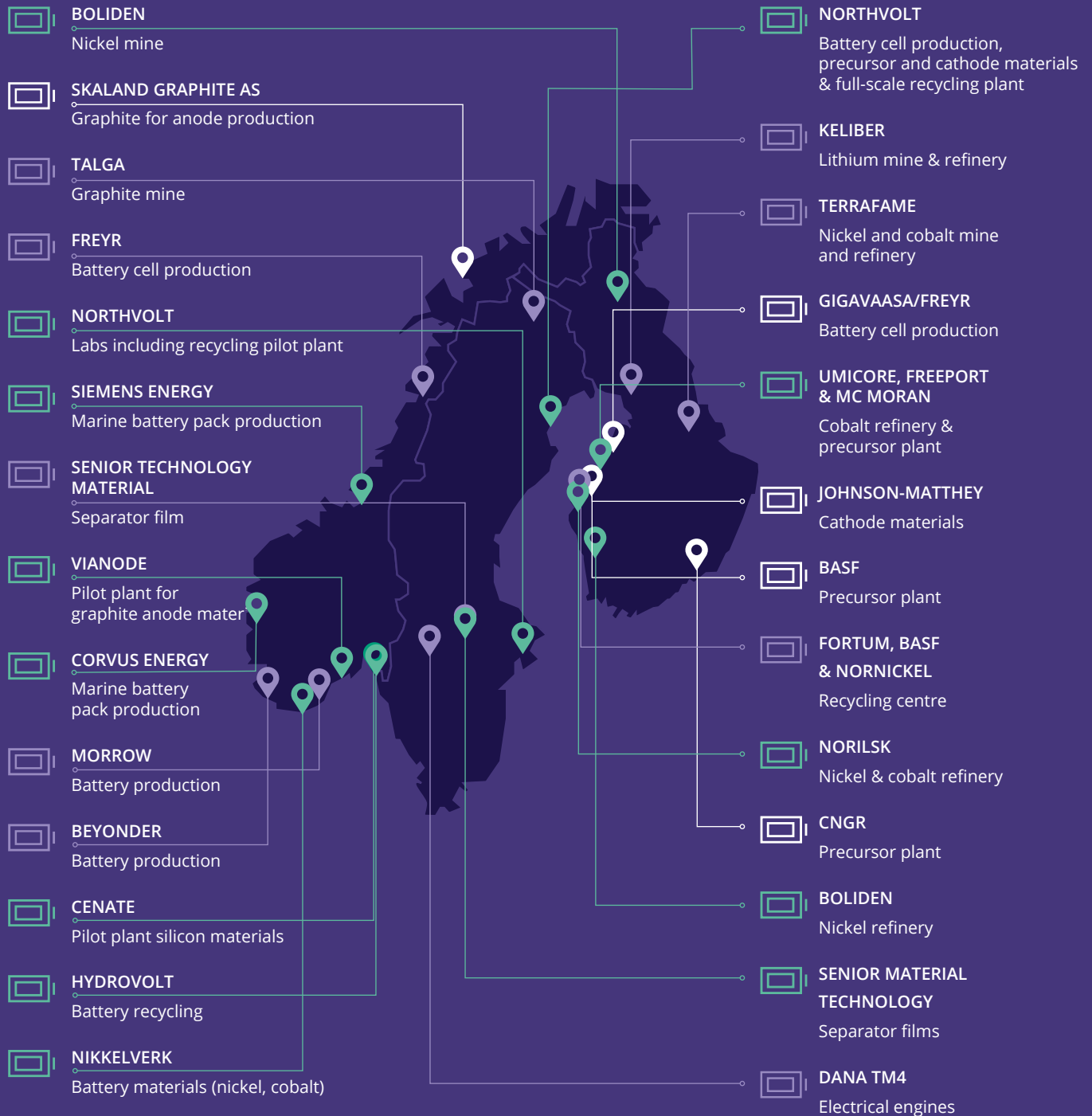
 Announced, financial status unclear

FIGURE 10

New major industrial projects in Norway, Sweden and Finland



10 ACTIONS

for sustainable industrialisation

In the Hurdal Platform, the Government emphasizes that it will pursue an active policy to restructure the economy that will help create commercially viable, green jobs all over Norway, strengthen mainland investment and increase exports other than oil and gas by 50 per cent within 2030. As a sub-goal on the road to net zero emissions and a low-carbon society, the Government has set a goal to restructure the entire economy by 2030. This is formulated in the Hurdal Platform as a goal of cutting Norwegian emissions by 55 per cent compared with 1990. The restructuring goal is discussed in more detail in the white paper on the Revised National Budget (Report no. 2 to the Storting (2021–2022)). The goal is to mobilise as much private capital as possible for the green transition.

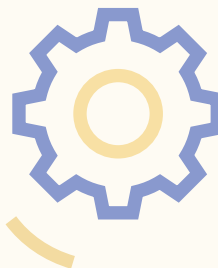
Companies that want to establish themselves in the battery value chain have many of the same needs as other businesses. They usually need a plot of land, competent workers, financing, raw materials, power supply and other infrastructure, suppliers of technology and support services, market access and access to research and development facilities. Being part of a larger ecosystem of research environments, education, partners, suppliers, customers and

competitors will also provide advantages, especially in respect of competitiveness over time. As a business exposed to strong competition and with a high share of exports, the battery industry will also benefit from a generally low level of costs and responsible economic policy.

At the same time, there are aspects of the battery value chain that require special attention – primarily *speed*, *size* and *risk*. Another characteristic of the battery value chain is that the market is largely driven by political objectives of strategic autonomy.

Speed is linked to the strong growth in demand and customers' demand for more sustainable, tailored batteries. It takes time, often several years, to realise the battery solutions of tomorrow, and a number of players are currently in the process of establishing themselves in joint development agreements with customers. Parallel to this, European industrial actors must learn how to produce batteries based on current technologies and materials, efficiently and profitably, on a large scale, for sale on the market. A strong mobilisation is currently underway in Europe, with a range of initiatives being established along the value chain, including several in Norway. There

”Success will depend on speed, size and risk management.”



is currently considerable competition for positioning, including attracting investors, partners and customers, and although the market will grow sharply in the years to come, not all the initiatives in the battery value chain is likely to be realised.

Battery operations, particularly the production of materials, battery cells and recycling, are *capital-intensive activities* with a long investment horizon and are also often *physically large* in order to benefit from economies of scale in production. The realisation of these kinds of factories therefore often requires large sites, a significant number of employees, considerable financing and significant consumption of input factors such as power, raw materials and minerals.

Battery production is a complex business. In order for production to be profitable, the players must be able to handle complex chemistries in a large-scale and automated production lines. Today's leading battery technologies are starting to reach their optimum, and various technology races are under way to develop tomorrow's battery solutions, with a wide range of different characteristics. It is uncertain which of the technology solutions that will be

adopted and which of the players that will be able to produce them efficiently. Several factors come into play, including the applied technology, the competencies of its employees, which partners they align, the needs of the specific customers, market developments and political regulations. Together, these factors constitute *risk factors* for players who want to become leaders in an immature European battery value chain.

The work on the battery strategy has highlighted the prerequisites, opportunities and barriers to the realisation of the potential for value creation in a Norwegian battery industry. The Government will address these factors through *10 actions for sustainable industrialisation* that will be powerful enough to attract the private capital needed to establish factories along the entire value chain in Norway.

The significance of the respective policy areas will vary over time and in different contexts, and the various players all have their own particular needs.

FIGURE 11

10 actions for sustainable industrialisation in the battery value chain



ACTION 1

Leadership in sustainability along the entire battery value chain

Our targets and goals for reducing climate emissions acceleration a green transition and taking care of the nature will require sustainable battery production with low or no greenhouse gas emissions. Norway is committed to cutting its greenhouse gas emissions through the Paris Agreement and its collaboration with the EU. Climate change and nature preservation must be seen in context, to ensure that important nature and ecosystems are not lost in order to achieve climate change goals. Conservation of nature is also an important climate change measure – through its ability to absorb and store carbon and through the ecosystem services it provides that make us more resilient to climate change. Changes in land use may also lead to emissions of greenhouse gases, and Norway has an obligation to account for emissions from changed land use.

This ensues from, among others, the EU's Sustainable Finance Action Plan and the EU Taxonomy for Sustainable Activities. The taxonomy includes criteria for battery production and the location of industrial buildings. The taxonomy is therefore important for the planning of production and deciding where factories are to be established.

The EU's forthcoming Battery Regulation is considered as EEA-relevant. The proposed Regulation, which is part of the EU's enhanced product framework, will impose requirements on batteries in several areas beyond their directly environmentally potential damaging properties, through requirements regarding recyclability lifetime content of secondary raw materials, and other requirements related to sustainability throughout the life cycle. The current legislation is primarily aimed at preventing and mitigating directly environmentally harmful activity in the form of pollution, waste and products that are hazardous to health or the environment. In order to be able to implement the Battery Regulation in its entirety, the applicable statutory basis in Norwegian legislation must be updated so that we can fulfil Norway's obligations under the EEA Agreement.

Developments in the battery industry emphasize the need for energy and climate change transition and the political goals for industrial leadership in the field. Batteries can enable significant cuts in emissions in the transport sector, which currently account for approximately one fifth of greenhouse gas emissions worldwide, and also enable transitions in a number of other areas, towards an energy system consisting of



Developments in the battery industry emphasize the need for energy and climate change transition and the political goals for industrial leadership in the field.

more variable energy sources. However, production of batteries currently entails significant greenhouse gas emissions and other sustainability challenges. The challenges pertain to environmental, social and economic sustainability.

Batteries is largely manufactured in Asia, using significant quantities of power, largely from fossil sources, especially for the production of materials, which is an energy-intensive industry, and the production of battery cells that also requires a lot of energy. Like other process industries, material production often generates significant greenhouse gas emissions using today's technological solutions. At the same time, the battery value chain uses minerals that have often been extracted in countries with poor standards in respect of corruption, pollution and working conditions. In addition, the battery industry often requires large facilities in order to benefit from economies of scale, resulting in negative impacts on nature. These challenges will potentially increase in line with the growing demand for batteries.

The greenhouse gas emissions of producing today's batteries for electric vehicles are currently roughly the same as emissions from the production of the

car itself. Over their life cycle, electric cars emit significantly less CO₂, with actual emissions dependent on the number of kilometres driven. Their carbon footprint also depends on whether the car is charged with renewable energy or not. This underlines the importance of electric vehicles having a long service life, for example through car sharing, and the batteries having a long service life and being recyclable. The need for materials generated from linear material flows is significantly higher than what it is currently possible to recycle through circular material flows, as long as the need for batteries is increasing. Over time, this will eventually balance out, but it will take many years.

Although the developments we are facing in the future in connection with greater use of batteries are largely positive, there is considerable potential for environmental benefits if batteries are produced with more sustainable mineral extraction, based on renewable power and with a high degree of circularity along the value chain.

In order to ensure a long-term competitive edge in the battery value chain, it will be necessary to ensure that sustainability remains a lasting advantage by being

able to document major climate and environmental benefits. The EU's proposed new Battery Regulation paves the way for the introduction of these kinds of requirements through a "battery passport" and requirements regarding component information, carbon footprint throughout the entire value chain, and minimum recycled content requirement. In view of these factors, Norwegian actors will be very well placed to develop competitive products through processes with minimal or negative greenhouse gas emissions and maximal environmental benefits through the use of materials along the value chain.

Decisions on changes in land use must take into account the consequences in respect of climate change, the environment and local communities, and be based on holistic assessments that ensure that the Green Industrial Initiative is implemented in a sustainable manner. The use of industrial areas and infrastructure in existing industrial parks can both reduce the development costs and preserve nature and reduce greenhouse gas emissions. Restoration of nature in areas where there has previously been activity may also contribute to a better balance in the natural capital accounts.

Sustainable mineral extraction



Norway is aiming to develop the world's most sustainable mineral industry, facilitate profitable reuse and recycling of raw materials, and work closely with Europe to safeguard critical value chains.

McKinsey highlights the huge volumes of minerals that will be required to switch to the new zero-emission technologies, such as electrification of transport via hydrogen and batteries.³⁸ Increased circularity will be essential to ensure the resources that are already in circulation are used, but in a growth phase, there will be high and rapidly increasing demand for materials necessary for the green transition.

³⁸ The raw-materials challenge: How the metals and mining sector will be at the core of enabling the energy transition | McKinsey



”The potential for environmental benefits is considerable, if batteries are produced with more sustainable mineral extraction, based on renewable power and a high degree of circularity along the entire value chain.”

Minerals currently used in the battery value chain mainly originate from countries such as Australia, Brazil, China, Indonesia and several countries in Africa. As previously described, tomorrow’s batteries and the requirements that follow from the EU’s Battery Regulation will entail a higher degree of recycling, use of new minerals and materials, and refraining from using minerals and materials that have been extracted and produced with low sustainability standards.

The European Battery Alliance has highlighted the need for a stronger European effort upstream in the battery value chain through improved recovery of “battery minerals” and increased processing of “battery raw materials”, combined with increased European activity downstream in recycling and after-use solutions (cf. Figure 9).

In a 2021 report the Nordic Geological Surveys have shown that Norway and the Nordic countries have great potential for further production of critical minerals, concluding that they must be perceived as one of the most prospective areas in Europe.

With the exception of Skaland Graphite on the island of Senja, which is one of Europe’s largest and cleanest

sources of natural graphite, there is currently very limited extraction of minerals in Norway that is relevant for use in batteries. Norway also extracts quartz for silicon production for use as an anode material. Imported nickel matte from Canada is refined into nickel, copper, cobalt and platinum-group metals at the Glencore nickel plant in Kristiansand.

The mineral industry is capital-intensive, and it usually takes seven to ten years (and often even longer) from a deposit being found commercially viable until a mine or quarry is fully developed. Furthermore, mining projects involve encroachments into natural ecosystems, and in some cases have a negative impact on other business activities (incl. reindeer husbandry), entailing conflicts of interest.

The Government, through the Ministry of Trade, Industry and Fisheries, is working on a new mineral strategy, which will be presented during 2022. In this strategy, we will make arrangements to ensure the mineral industry in Norway can contribute to the UN Sustainable Development Goals through the extraction of minerals that are necessary for electrification and the green transition in a manner that is environmentally, socially and economically sustainable. We will assess whether there are areas that

are suitable for mining, and areas that are not, based on considerations including encroachments on the natural environment, landfill options and other considerations. We will seek new knowledge about different types of landfills, including assessing the future of marine landfilling. We will work to ensure that the industry can become more circular, by reusing surplus masses as much as possible rather than landfilling them, based on the understanding that everything has value in the circular economy. We will consider setting increased requirements for the reuse of surplus masses, look at increased research efforts, and assess whether incentives or fees that contribute to less landfilling will be expedient. And we will explore how a larger part of the value creation in the mineral industry can once again be local and national.

Measures:

- ☀ The Government will work to ensure that Norway contributes to the development of a sustainable European battery value chain with high performance, high resource utilisation and environmental benefits, and a low carbon footprint.
- ☀ The Government will present a mineral strategy during the course of 2022 with the aim of

developing the world's most sustainable mineral industry in Norway. Given the importance of minerals for the green transition, it is natural to consider the work on the Green Industrial Initiative and the mineral strategy together.

- ☀ The Government will make arrangements to ensure that the players in the Norwegian battery value chain implement the UN Sustainable Development Goals in their activities.
- ☀ The Government will consider new regulations and improved information sharing on product content in the industry. Follow-up of the EU's strategy for the circular economy will play an important role in this context.
- ☀ The Government will contribute to the development of European value chains for critical raw materials including extraction, processing and recycling through measures that include green industrial partnerships with the EU and selected countries. The aim is to ensure the involved parties predictable and stable access to these kinds of raw materials over time.

ACTION 2

Promote Norway as an attractive host country for green investments



The Government will work to ensure that Norway is an attractive host country for profitable activity along the entire battery value chain and to attract large battery investments and giga factories.

All countries are competing to establish themselves in the green industry of the future, including in the battery value chain, due to the significant opportunities for value creation afforded by the ongoing electrification of society.

The European Battery Alliance has recently estimated that the total European turnover (annual GDP/ added value created) in the battery value chain will amount to EUR 250 billion in 2025 and EUR 625 billion in 2030.³⁹ The Confederation of Norwegian Enterprise (NHO) states that the processing of raw materials and production of components are the parts of the value chain with the greatest potential

for value creation, and that presence in large parts of the value chain will be an advantage and help trigger the largest possible turnover for Norwegian players.⁴⁰ McKinsey has estimated that Norway can attain a market share in Europe of up to 20 per cent for battery cell production, 15–20 per cent for further processing of raw materials and 20 per cent for active battery materials.⁴¹

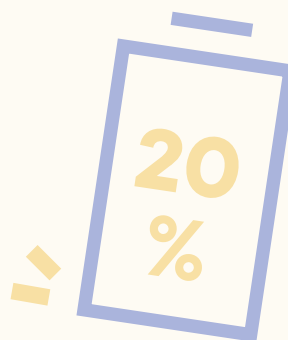
The Government's goal is for profitable, future-oriented industries to establish themselves in Norway. This will help contribute to a restructuring of the economy in a green direction, increase export revenues, and create profitable, attractive jobs all over Norway. To tap into the potential for value creation, we must be able to attract private capital and expertise. In brief, we need to be perceived as an attractive location for industrial development. This includes being able to offer the best business opportunities for an industrial initiative through a combination of good location factors, such as access to renewable power, suitable sites, competent labour, complementary centres of expertise, markets, predictable public processes and an acceptable cost level.

39 Joint Statement EBA HL Industrial Meeting 23 March 2022-Final1.pdf (hubspotusercontent-na1.net)

40 gronne-elektriske-verdikjeder.pdf (nho.no)

41 Norge-i-morgen_McKinsey.pdf (norgeimorgen.no)

”McKinsey has estimated that Norway can achieve a battery cell production market share in Europe of almost 20 per cent.”



Norway's attractiveness as a host must be nurtured and further developed, but must also be communicated. Today, Innovation Norway (both the *InvestIN* function and the overseas offices) is the Government's main tool for paving the way for international investments in Norway and positioning Norway as an attractive country for investors. In addition, Innovation Norway has an extensive network of overseas offices that ought to be used to a much greater extent for marketing and to open doors for establishments and investments in Norway.

Measures:

- ✧ The Government will work to ensure that Norway is a good host country for investments in green value chains in Norway.

Measures through the export reform presented in the Norwegian export strategy

- ✧ The Government has established the National Export Council to provide advice and input to the Minister of Trade and Industry and formulate proposals for major strategic export initiatives. The Council will consist of representatives from the business sector and the social partners (i.e. employer and employee organisations).

- ✧ The Government has established a secretariat for the National Export Council, where representatives from the social partners, relevant ministries and policy implementing bodies are invited to contribute. This collaborative forum is the first of its kind, intended to ensure that the business community and social partners are included in the entire ecosystem related to the export initiative.
- ✧ The Government has given Export Finance Norway (Eksfin) a broad mandate to promote increased exports and export-oriented investments. Eksfin can provide loans for export-oriented investments and finance projects in Norway that aim to handle climate change and have export potential.
- ✧ The Government will establish an application-based scheme in Innovation Norway where companies can apply for support to attend trade fairs and joint business promotion activities.
- ✧ A new national brand programme called “Made in Norway” has been launched to enable industries, clusters and companies to take international positions based on Norway's strength as a brand through the development of a national competence-raising programme and development of more efficient tools.

ACTION 3

Enter into industrial partnerships with key countries



Norway will work closely with our international partners to accelerate the green transition.

The Government's vision is for Norway to work closely with our international partners to speed up the green transition. The restructuring we are currently undergoing is of a scope and complexity that requires increased collaboration in terms of access to capital, technology, raw materials, labour, suppliers and markets. Stronger partnerships between countries can lay the foundation for this kind of development. However, it will be corporate alliances and collaboration between companies in the respective countries that will bring the ambitions to realization. The EU and individual European countries are natural partners for Norway in the work to realise the ambitions for the battery sector, which largely overlap. At the same time, we need to strengthen the Nordic cooperation and build and further develop partnerships with key countries in other regions.

Norway is defined as a "third country" in the EU-UK Trade and Cooperation Agreement (TCA). This Agreement sets clear restrictions for the use of input materials from third countries so that a finished product can be defined as originating in the EU or the United Kingdom and thus be entitled to duty-free trade between the two areas. For electric vehicles, there is an additional requirement that from 1 January 2027 the battery pack must be manufactured in the EU or the UK. This will pose a challenge in connection with the use of Norwegian-produced batteries in electric cars for export between the EU and the UK.

The Norwegian Government is entering into a green industrial partnership with the EU. The aim of this partnership is to promote mutual interests and benefits between Norway and the EU in the areas of industry, energy and climate change. The partnership is also intended to contribute to development in a direction that safeguards our interests. The IPCEI (*Important Project of Common European Interest*) scheme is an example of industrial initiatives in the EU that might be relevant for the Norwegian battery industry. Any support for IPCEI projects must be weighed up against other measures in the ordinary budget process.

”Increased collaboration is the key to achieving rapid restructuring, and Norway and the EU recently agreed to strengthen and expand their industrial cooperation on batteries and raw materials.”



A green industrial partnership with the EU could address several strategically important issues for the EU and Norway. What Norway can “offer” within the battery value chain is a pilot arena for electrification of the car fleet and associated infrastructure and access to raw materials (graphite, silicon, nickel, cobalt, copper and aluminium) – all based on renewable energy and thereby enabling production with the lowest possible carbon footprint. Norway and the EU recently agreed to strengthen and expand their industrial cooperation on batteries and raw materials.⁴²

The issue of custom duty on batteries produced in Norway resulting from the EU-UK free trade agreement is an example of the kinds of problems we want to avoid. Although the automotive market is large and an important driver of the battery market, the battery value chain also consists of a number of other large individual segments, each of which represents significant opportunities for value creation for Norwegian industry. Norwegian players may therefore be able to sell a number of components and solutions that are not affected by the post-Brexit customs issue, thereby contributing to the development of a European

battery industry, where sustainability at every stage of the value chain is key.

Germany is one of our most important trading partners. Greater collaboration with Germany on the green transition is therefore a high priority for the Norwegian Government. Germany and Norway have agreed on a structured dialogue in the field of energy and industrial transformation. The dialogue will build on over 40 years of close collaboration on energy and take it forward in a green direction. In addition to cooperation on hydrogen, offshore wind and CCS, batteries are one of the areas discussed in the joint Germany–Norway statement published in March 2022. Work is now being done on concrete joint activities between Germany and Norway to follow this up and pave the way for the development of common green value chains. With its leading position in the automotive industry, Germany is a key part of a European battery value chain, and closer cooperation between Norway and Germany is expected to be of mutual benefit to businesses in both countries.

42 <https://www.regjeringen.no/no/aktuelt/norge-og-eu-enige-om-forsterket-industrielt-samarbeid-om-batterier-og-ravarer/id2920991/>



Norway and the EU both want to continue the work to find a solution to the post-Brexit battery customs issue.

The Government has issued a joint statement with Sweden on bilateral industrial and trade cooperation.⁴³ The opportunities for collaboration within this statement will be specified in more detail and include offshore wind, carbon capture and storage, hydrogen, batteries and minerals. Norway, Sweden and Finland have complementary value chains, especially in connection with the battery value chain, and all three have unique advantages that are expected to attract competitive players.

We are also working on an initiative to develop Nordic value chains in green industries, with the aim of making the Nordic region a fully integrated domestic market for competitive green industrial solutions that can then be exported to third markets. This initiative will also help ensure attainment of the Nordic Prime Ministers' Vision 2030 of making *"the Nordic region the most sustainable and integrated region in the world by 2030"*, thereby making the Nordic countries leaders in the green transition and building a stronger green and sustainable brand internationally.

In 2021, the EU and the United States established a Trade and Technology Council (TTC), which will look

into strengthening value chains and input factors in strategically important areas, including rare earth minerals and semiconductors. The outcomes of this work will also have implications for Norway. Norway is not a party to the TTC, but the Norwegian authorities will follow the work through official contact with the authorities in both the EU and the US.

Measures

- ✦ The Government will develop strategic industrial partnerships with the EU and important individual countries to position Norway as a partner in the green transition and strengthen opportunities to create jobs throughout Norway.
- ✦ Through Innovation Norway, the Government will further strengthen the broad Nordic co-operation on the development of the battery value chain.
- ✦ The Government will continue to investigate the possibilities and assess the need for various forms of participation in the IPCEI on batteries.
- ✦ The Government will continue its work to find a solution to the post-Brexit battery customs issue.

⁴³ Vil styrke næringslivssamarbeidet med Sverige etter pandemien [Strengthening business cooperation with Sweden after the pandemic] – regjeringen.no

ACTION 4

Provide capital, loans and guarantees that mobilise private capital



The Government will mobilise as much private capital as possible for the green transition and will provide government risk mitigation to accelerate industrial investments in Norway.

Access to capital plays a pivotal role in the realisation of projects in the battery value chain and for the realisation of the Green Industrial Initiative per se. The individual projects have different financing needs depending on their specific situation, including the business and financing model, ownership, and where in the development process the individual companies are.

Most of the investments in the battery value chain will be financed by private capital, but public funding instruments may play a key role in attracting this capital and helping realise projects. The work on the battery strategy has shown that the capital market in Norway generally functions well, and profitable projects can expect to receive funding. The work has also shown that many of the existing public funding

instruments are efficient and effective. However, even a well-functioning capital market may be insufficient for certain market segments or categories of investments. Various forms of market failure can contribute to socio-economically beneficial projects not being profitable for private investors and thus not being financed and realised.

The work on the battery strategy has revealed that there are two phases in particular where access to capital is particularly scarce: i) Piloting on an industrial scale and ii) Construction of large factories. During the piloting phase, there is often considerable risk associated with the companies and projects, especially when there is a high level of uncertainty linked to the technology, etc. Private investors tend to sit on the fence until the risk has been reduced, i.e. the pilot phase has been completed and commercial contracts have been signed.

It can also be challenging to get financing for the construction of large-scale factories, such as battery cell production, production of battery materials and the production of recycling plants. It may therefore be appropriate to assess on an ongoing basis whether the private initiatives within the battery value chain should be met by new financial instruments, provided by the state, to meet the actors' needs, especially in the industrial piloting phase.

Some projects in the battery value chain differ from activity in most other industries by virtue of their *size* and their *financing needs*. The production of battery materials, battery cells and to some extent the recycling of used batteries is very capital-intensive, and the players will often want to build large factories in order to reap economies of scale. Each project can involve financing needs amounting to tens of billions of NOK with a very long pay-back period. The investment needs challenge the ability of both the capital markets and the public policy apparatus to realise the projects.

Another challenge is *speed*. The major industrial projects in the battery value chain are often “impatient” and want to move forward quickly with their business plans. This urgency is partly a result of political goals and expected growth in demand, but is also linked to establishing a position with customers, suppliers, investors and competitors. Impatience represents a dilemma for investors and the public policy apparatus. On the one hand, rapid progress could provide the players with an advantage by being ahead of the game in a relatively immature European battery market. On the other hand, there are technological and commercial risks

associated with being at the forefront of technology developments and/or raising capital before the player has proven that it can succeed at every step of the development project. This poses a major challenge for the investors and the ability of the public policy apparatus to assess the players’ projects, including their feasibility. As an example, some of the major industrial projects are planning to raise capital for a full-scale factory before the pilot plant has been completed.

The green transition will require large investments in technology and industry, and we see a number of new investment projects that can be realised in Norway in the years to come. The Government must be a driving force and an active facilitator in the development of new, profitable industries. Private capital will lead the way, and the Government’s goal is to mobilise as much private capital as possible for these projects. Norway shall have internationally competitive schemes for risk mitigation for, commercially profitable green industry projects.

”The need for government loans, guarantees and equity for the green industrial transition towards 2025 is estimated to NOK 60 billion.”



Measures

- ✧ The Government will provide targeted risk mitigation, primarily through guarantees and loans for, commercially profitable projects within the seven priority areas of the Green Industrial Initiative, including a range of different loans, guarantees and equity. The Government will return to the details in the annual state budgets.
- ✧ The Government will dimension the public policy apparatus to meet the growing need for guarantees and loans for green industrial projects. Increased government risk mitigation presupposes good projects and private investment appetite. The public policy apparatus estimates that the need for this kind of government risk mitigation for the green industrial boost could be in the order of NOK 60 billion by 2025.
- ✧ The Government will continue to strengthen Eksfin's role in facilitating major new projects in green industrial development. The Government will explore the need for increased budgets, the opportunity to take increased risk, and look at possible targeted schemes to help realise several large, green industrial projects in the years to come.
- ✧ The Government will review the entire public policy apparatus to further focus efforts towards the green transition in the business sector and support the Green Industrial Initiative.
- ✧ The Government will devise parameters to measure the public policy apparatus' contribution to the Green Industrial Initiative and track developments over time.
- ✧ The Government will review the recommendations of the Expert Committee for Climate-Friendly Investments and consider further measures to stimulate more profitable climate-friendly investments.
- ✧ The Government will review the Tax Committee's assessments of how more correct environmental pricing and other economic instruments can contribute to better resource utilisation, circular production and consumption patterns, and stimulate value creation based on circular solutions.

ACTION 5

Improve access to relevant expertise

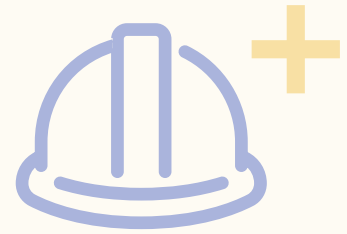


Norwegian industry needs access to competent workers. Continuous competence development will be facilitated through tripartite cooperation, and the Government is actively pursuing a policy to ensure as many people as possible are included in working life.

Norway has rich natural resources, but our most important resource is a workforce with relevant skills and expertise. A sufficient supply of people with the right skills and expertise will be a key factor in realising the Government's ambitions for the battery value chain in Norway. Competencies must be continuously maintained and developed in the companies. In order to maintain competitiveness over time, it is important to have good Norwegian research environments and centres of expertise within the battery value chain, particularly in partnership with other players in the Nordic region and Europe.

Companies in the battery value chain will need many types of expertise in a wide range of fields. Most employees in the battery value chain are expected to have a vocational background, but there is also a need for technologists with in-depth knowledge of battery technology and associated manufacturing technologies. In addition, activity in the battery value chain will trigger demand for subcontractors, service functions and a variety of services locally, each of which will have its own needs for specialised competencies.

”Many Norwegian companies are at the forefront in terms of efficient use of resources, automation and digital technology. These companies have employees with strong theoretical and practical competencies at all stages of production, and the employees often operate with a high degree of autonomy.”



Norway has strong centres of expertise in materials technology, metallurgy, electrochemistry and industrial processes. We also have a number of leading companies with extensive experience in electrification of the transport sector and maritime operations. In addition, we have strong technical-industrial and academic communities linked to these environments that have a tradition of collaborating closely with industry. The work culture in Norwegian industry is characterised by flat hierarchies, with short distances between the management, engineers and skilled workers, and a widespread culture of cooperation both within the individual companies and between the employers, the employees and the authorities. Many Norwegian businesses are at the forefront in terms of efficient use of resources, automated solutions and other digital technology. The companies have employees with high theoretical and practical competencies at all stages of production, and the employees often operate with a relatively high degree of autonomy. All in all, the Norwegian working life model means that many enterprises can do more work with fewer employees, resulting in a high level of productivity in Norwegian industry. These are all experiences that can easily be transferred to the battery value chain.

Building on our experiences from the petroleum industry, we know that we will need to draw on foreign expertise, experience, technology and capital in the build-up phase of a Norwegian battery industry. The goal is to quickly establish domestic expertise in this area. There will be a need for workers to undergo further and continuing education, and Norway will have to educate a significant number of people in disciplines needed within the battery value chain. Good career prospects and the fact that the industry is part of the green transition will probably be weighty factors for young people choosing an education.

Most European countries face similar challenges in that they lack both level of expertise in relevant specialist areas and large enough volumes of candidates to meet the battery players' expected future competence needs. The EU has estimated that approximately 800,000 employees will need to be trained and re-skilled by 2025 to meet the expected growth in electrification through battery technologies.

BattKOMP is a project to map and analyse the competence needs associated with a large-scale drive to develop the battery industry in Norway



The goal is to quickly establish domestic expertise in this area.

initiated by the social partners, represented by the Norwegian Confederation of Trade Unions (LO) and the Federation of Norwegian Industries (Norsk Industri) (chair), and Prosess21.⁴⁴ The BattKOMP project has brought together relevant players from the industry in close interaction with the education sector, with support from clusters in an extensive collaboration. The project is divided into three parts: Part 1 of the project has mapped the players' expected *competence needs* at different levels of education in the battery value chain in Norway. Part 2 has mapped *existing programmes and expertise that the educational institutions have today*, from apprenticeship certificates to higher education, and then compared this and the findings from Part 1 in the form of a "gap analysis". Part 3 of BattKOMP, which has not yet completed, will look at possible new measures to ensure the necessary knowledge upgrades (in terms of gaps in content and volume needs) for the battery industry of the future in the education sector and academia in general. Once Part 3 is completed, a comprehensive recommendation will be prepared to build the necessary capacity with the required depth in the various programmes of education that are relevant to the actors in the battery industry. The recommendation will be aimed at the educational institutions and for use in policy development.

On a general level, the BattKOMP mapping survey shows that the higher education sector can provide much of the education and competencies needed by the battery value chain in terms of further and continuing education. The gap pertains to the lack of scale the available education. BattKOMP reveals that there is a significant competence gap, since most of the people who will be recruited to the battery value chain in the coming years will need extra upskilling from vocational colleges. It has not been mapped to what extent upper secondary schools can provide vocational education programmes that are relevant to the industry. BattKOMP highlights the need to build competencies as a national "team", where the different environments supplement and reinforce each other and together ensure the commercial players' competence needs in different phases are met.

The recent Regional Reform gave the county authorities greater strategic responsibility for the regional competence policy. The county authorities must assume a more coordinated responsibility for the competence policy in the county, including by ensuring a good match between demand on the labour market and the provision of education and competencies available in the county.

44 BattKOMP – The Federation of Norwegian Industries (Norsk Industri)

The Government has followed up some of the BATTkomp recommendations by continuing the tripartite *Industry Program* for competence development for the industry and the building sector. Through this industry programme, several vocational colleges have received support to develop vocational training for the battery industry on Norwegian: ("*Batterifagskolen*"), which is a further education programme aimed at skilled workers who want to work in the battery industry. These programmes have been developed through collaboration between the vocational colleges and industry. The Government intends to present a White Paper on competence needs in spring 2023. This White Paper will present the Government's priorities and policy going forwards to meet the competence needs of green industries such as the battery industry.

Measures

- ✦ The Government will consider the recommendations of the BattKOMP project once Part 3 is completed. This will form an important knowledge basis for assessing current competencies, the competence needs and the various forms of education and training that are needed locally, regionally and nationally to align with the Government's objectives for the battery value chain.



Once Part 3 of the BattKOMP project is completed, a comprehensive recommendation will be prepared to build the necessary capacity with the required depth in the various programmes of education that are relevant to the actors in the battery industry, aimed at educational institutions and for use in policy development.

ACTION 6

Pave the way for greater access to renewable power

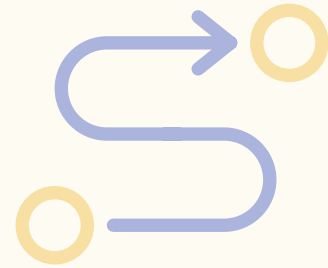


Norwegian industry needs access to clean, reasonably priced renewable energy. Renewable power production must therefore be increased in step with further development of the electricity grid, lead times must be reduced, and energy consumption must be made more efficient.

Green Industrial Initiative requires a well-functioning and reliable power system. Access to affordable clean power has been an important competitive advantage for Norwegian industry for many decades, and the Government wants to ensure it remains this way. On the continent, power generation still has a significant carbon footprint from fossil fuels through the transition from coal to gas. Norwegian power production is unique in a European context, and Norway already has close to fully renewable electrical power generation system.

Going forwards, access to power at reasonable prices will be of significant importance for investment decisions in industry, especially for power-intensive industries. The Government will therefore pursue an energy policy based on the view that access to renewable energy is a competitive advantage for Norwegian industry. The Government's goal is that it is only socio-economically beneficial investments in grids, increased power production and energy efficiency that will be realized, both to avoid unnecessarily invasive, irreversible damage to nature and to limit the cost to the users of the grid.

”The Government will increase its capacity to ensure faster processing of applications for licences & permits.”



Norway still has a power surplus in years with normal weather conditions, but the demand for power is expected to increase rapidly as a result of the establishment of new green industrial projects with significant power needs and consumption and the widespread electrification of society in general. This requires strengthened transmission capacity in the power grid, increased power production and a power system that has the ability to meet the needs during peak load periods. Today, there is already limited capacity for establishment of new businesses in several places in Norway.

A high number of applications for connection to the grid in recent years has led to a case processing backlog at grid companies and energy authorities, further extending lead times.

The power situation since autumn 2021 has shown that a power surplus does not guarantee low power prices. There is a great need for knowledge about how the changes in the power markets in our neighbouring countries and our connection to these markets affect the Norwegian power supply system, and also about the extent to which limitations in transmission capacity within Norway and to our

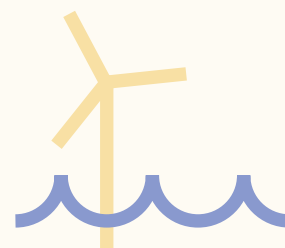
neighbouring countries have contributed to this year's power situation and how these factors may affect future developments.

This situation is not unique to Norway. Many other countries have high ambitions for the development of green value chains, entailing increased electrification and thus higher demand for renewable power. Norway is nevertheless in a much better position than most other countries as a result of our rich natural resources, long experience in renewable power generation and high degree of electrification in industry and society at large.

Norwegian power's low carbon footprint is highly attractive to the players in the battery value chain, since the EU's battery regulation sets requirements regarding documentation and will introduce CO₂ limits in the future. Norway can already offer actors emission-free renewable power for their projects. For many players in the battery value chain, access to clean power is more important than the price. In a few years, this advantage may diminish due to increased renewable power development in many other countries.



Access to renewable power will constitute a competitive advantage for Norwegian industry.



The Government has appointed a broad-based *Energy Commission* that will assess future energy needs, study the possibilities for new energy production, assess the experiences with the Energy Act over the past 30 years, and provide a basis for long-term energy policy choices for Norway, among other things. In addition, the Government received the Grid Development Committee's report on 14 June 2022. The proposals in these documents will form an important basis for the Government's further work on concrete measures that can ensure affordable power at the right time.

Measures

- ✧ The Government's ambition is to strengthen the capacity of the power grid and to shorten the licence processing time.
- ✧ The Government will consider the recommendations from the Energy Commission and the Grid Development Committee once they are ready. In light of the Grid Development Committee's recommendations, the Government will assess whether projects can be prioritised for grid connection based on various criteria such as maturity, high value creation potential or climate impact.

- ✧ The Government will increase case processing capacity to contribute to faster licensing of grids and power generation.
- ✧ Through concrete measures, the Government will facilitate better fixed-price agreements for private individuals and companies. Amendments to the resource rent tax are among the measures.
- ✧ The Government is paving the way for a large-scale development of offshore wind, with the ambition of taking the process of facilitating profitable production of offshore wind power a major step forward. Offshore wind has great potential for increasing power production in Norway, and the Government's ambition is to allocate areas equivalent to 30 GW by 2040, with targets that include industrial development, innovation, technology development and increased emission-free power production. The Government's ambition will correspond to around 75 per cent of the capacity in the Norwegian power system today. An investment in offshore wind of this magnitude will allow for the use of various grid solutions.
- ✧ The Government will increase hydropower production, including on the basis of the Storting's

decision on a cash flow tax for hydropower and by continuing to prioritise the upgrading and expansion of existing hydropower plants in the licensing process. There is still some potential for completely new hydropower plants.

- ✧ The Government will permit the development of wind power in places where there are good wind conditions and local acceptance. Due consideration must be given to safeguarding important natural assets. The Government has announced that it will resume the processing of licences for completely new wind power projects, and has asked the Norwegian Water Resources and Energy Directorate (NVE) to receive new applications for processing. The consent of the host municipality is a prerequisite. The Government wants a larger share of the value creation to benefit local communities.
- ✧ The Government will assess the ambition in the Hurdal Platform of setting a target for solar energy production by 2030 after the Energy Commission has submitted its report. Solar power is expected to play a larger role in the Norwegian power supply system towards 2040. Recent years' technological advancements and falling costs have

contributed to increased interest in this form of energy and in establishing large solar power plants in the future.

- ✧ The Government will facilitate the development of locally produced energy in Norway, including solar energy, by measures that include conducting a survey of regulatory barriers to local energy production. The Government wants to take a closer look at how local energy production linked to local consumption in industry and commercial properties can help avoid the need for new grid investments. Among other things, the Government will consider whether new buildings should produce part of their own power needs.
- ✧ The Government will take steps to ensure affordable clean power remains a competitive advantage for industrial players in Norway.
- ✧ The Government will consider extending the power purchase guarantee scheme under Eksfin so it is also available to players in the battery industry that have high electricity consumption.

ACTION 7

Contribute to provision of suitable sites and other central infrastructure



Norwegian industry needs access to good sites, efficient infrastructure and high-speed internet. Green industrial establishments must be well-anchored and as gentle as possible on the surroundings in terms of not harming nature, the environment and wildlife, and promoting local social meeting places.

Access to industrial areas with adapted infrastructure is necessary to secure start-ups for the battery value chain. This applies in particular to the production of materials, battery cells and recycling. Projects in these areas may need sites in the range of 10–100 hectares as well as power supply of up to several hundred MW. In addition, where facilities will be located will often be assessed on the basis of access to sources of minerals and materials, as well as various special needs and input factors, such as competencies, power, water, transport, etc. for various elements in the value chain.

Several of the initiatives in the battery value chain that have been started in Norway have already decided their industrial site where regulation has been carried

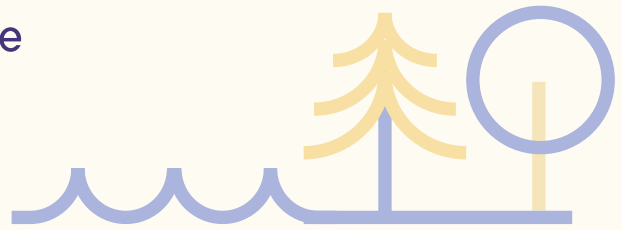
out or is in progress and where aspects such as adaptation of infrastructure are already under way. This is the case for the three battery cell initiatives Freyr, Morrow and Beyond, the material manufacturer Vianode, and the battery recycler Hydrovolt, for example. At the same time, more start-ups in the battery value chain are expected in the future, and these will require green- or brownfield sites.

Establishment in Norway will ensure a low carbon footprint due to access to renewable electricity. Access to harbors with storage facilities and access to water for cooling systems are also important competitive advantages that Norway can offer. Furthermore, it is required to minimise transport and make maximum use of energy flows (heat). Often it will be useful to consolidate players within the value chain – not least from a sustainability perspective – so that logistics related to goods, expertise and energy can be utilized in symbiosis. Reuse of brownfield areas will be essential to ensure sustainability. Moreover, these kinds of areas are often pre-regulated, already have the necessary infrastructure, and can have a favourable location in relation to co-location in the value chain and other positive synergies.

Norway's decentralised settlement pattern also facilitates a well established physical and digital infrastructure, such as power grids, roads, ports and broadband. Norway's long experience with power-intensive industries also means that several industrial sites offer good



The Green Industrial Initiative will take nature conservation and biodiversity considerations into account.



grid capacity. Establishment in existing industrial areas or on vacated industrial sites also has the advantage of reducing the need for nature intervention.

Regional and local authorities, together with existing industrial parks, can actively contribute to the development of strategic industrial areas and sites with the necessary land, energy solutions and competitive shared functions, in order to position Norway for the green industry of the future. Local municipalities and industrial sites are already experiencing increased interest from suppliers to cell factories in the Nordic countries.

Established industrial parks in Norway have considerable expertise in the facilitator role, but may have limited opportunities for further expansion. In the years to come, suitable sites that are currently linked to the petroleum industry may become vacant and available for new establishments in the battery value chain.

To the extent that new sites are needed, the location and adaptation of these should be assessed on the basis of the needs of the specific industrial establishments, transport needs and access to infrastructure, co-location synergies and the consequences for nature, the environment, agriculture, reindeer husbandry and local communities. Use of valuable natural areas and agricultural land must be avoided as far as possible. Land is expected to be in high demand, and it is important to avoid competition between regions and

municipalities leading to development of more land than is necessary. This kind of “race” might lead to loss of important biodiversity, increased greenhouse gas emissions from deforestation, and negative consequences for other important public interests. The county and municipal authorities must therefore assess land use holistically in their general planning.

Industrial Development Corporation of Norway (Siva), is the Norwegian state’s instrument for development of business clusters and centres of expertise throughout the country, with a particular responsibility for promoting growth in outlying regions. Through its property investments, Siva lowers entry barriers where market mechanisms make entry especially difficult, including for major industrial property projects. Siva can contribute to the preparation and adaptation of industrial sites at an early stage in the zoning process.

Measures

- ☀ The Government will assess whether Siva, together with Invest in Norway (InvestIN), can be tasked with facilitating establishment of industrial projects in Norway and assisting the industry in preparing industrial sites.
- ☀ The Government will present a national strategy for the preparation of green industrial areas and industrial parks with internationally competitive advantages all over Norway.

ACTION 8

Ensure predictable, efficient and coordinated public processes



The business community must meet a forward-looking and well-coordinated public administration that is concerned with finding good solutions and that actively facilitates the realisation of green and socio-economically beneficial industrial projects throughout the whole of Norway.

Establishment of large industrial enterprises requires adaptation of land areas, infrastructure, licences (as applicable) and necessary permits. The central government, county and municipal authorities are often involved in these processes. Norway can accelerate the growth of the battery value chain through measures that reduce uncertainty related to how long the processes take and feasibility. Prompt, well-coordinated processing of applications related to land, power, licences, permits and financial support through various instruments can improve the predictability of the process for the relevant actors.

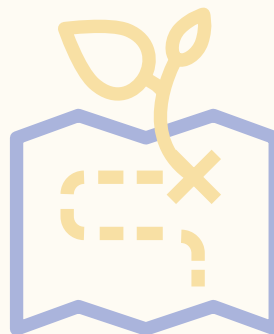
The list of permits required to establish an industrial activity or expand an existing one is extensive and is intended to ensure a democratic and prudent process. Industrial activities that can lead to pollution must have a permit pursuant to the Pollution Control Act. The procedural rules for applying for a permit shall ensure adequate knowledge to enable the authorities to assess whether a permit can be granted and on what conditions. Permits are site-specific addressing local environmental conditions. New industrial sites can only be established in areas set aside for such purposes, and it must therefore be considered whether the proposed project complies with the current land use plans. Otherwise, a zoning plan will have to be prepared, and it may be necessary to assess the location in the land-use element of the municipal master plan. It is the municipality that makes decisions on land use, by virtue of its role as planning authority pursuant to the Planning and Building Act. If a plan or project may have a significant impact on the environment or society, an impact assessment must be undertaken. If an industrial company will need access to a large amount of power, connection to the power grid is required, entailing a series of permit processes. If a company is going to use experts from outside

the EEA, a residence permit may be required, which involves processing through the Norwegian Directorate of Immigration (UDI).

Lengthy clarification processes can create challenges for companies that want to set up industrial projects promptly and meet their specific needs in this regard, in competition with players elsewhere. Expeditionness must be balanced against the need for a solid knowledge base, good environmental assessments, acceptance and involvement of affected interests. The local population and interest groups must be involved and consulted in the planning and licensing process, and they must be given the opportunity to provide feedback and input in the various phases of the project. Faster clarification must therefore be achieved within the constraints of the planning system pursuant to the Planning and Building Act.

Measures

- ✨ The Government will prepare a guide specially aimed at the actors in the industry and the relevant authorities that shows the requirements for location, area assessments and studies in connection with the establishment of green industrial projects.



”Rapid processing of applications will also increase predictability for the industry.”

ACTION 9

Support pilot municipalities during the growth phase

Major industrial establishments are under way in the battery value chain in Norway, particularly within the production of battery materials, battery cells and recycling. These projects set new records for mainland industrial projects in Norway in terms of level of investment and employment. The projects are also very labour-intensive in the development phase and in operation.

If the industrial initiatives are realised in full, significant population growth is expected in the municipalities of Arendal and Rana over the next 4-5 years. Similar developments can also be expected in the municipality of Tysvær, which is hosting Beyonder. These municipalities will experience positively a "shock" as a result of significant growth.

The situation puts additional (positive) pressure on some host municipalities in respect of increased needs for new housing, roads and schools, other forms of concrete and coordinated adaptations. Furthermore, the municipalities must provide for a good range of services for businesses that establish themselves and for workers and their families who want to move to the municipality as a result of the battery business. For the municipal authorities, such a development will require both good planning and

implementation capacity, and presupposes good coordination between the various public bodies and private enterprises involved, locally, regionally and nationally.

However, the scale and nature of the battery establishments will lead to that host municipalities may face a number of new and unfamiliar challenges. Planning, facilitation and investment on the part of the host municipality will often have to be started several years before an industrial project can be expected to be profitable, and most municipal authorities do not have sufficient resources to be able to deal with such sudden growth in activity. Moreover, battery production is a new growth area in Norway and in Europe, and there is no established best practice for how a host municipality can best handle this kind of situation. In other words, the municipalities face many of the challenges described earlier in the battery strategy related to speed, size, and risk. The host municipality must therefore partly "pilot" its facilitation activities.

Sharing of experiences with other municipalities in a similar situation can help reduce the uncertainty for the individual host municipality and contribute to good solutions. Some Norwegian municipalities



We want the host municipalities to experience the State as a valuable partner.



have been in similar situations in the past, for example Gardermoen in connection with the construction of Oslo Airport and Melkøya in connection with development of the Snøhvit field, and experiences from these projects may be relevant for municipalities preparing to host new battery plants. Useful experience-based knowledge can also be gained from host municipalities for the battery industry in neighbouring countries, such as Skellefteå in Sweden, which hosts the battery cell manufacturer Northvolt. It may also be useful for the “pilot municipalities” for the Norwegian battery industry to collaborate and share their experiences with each other.

A collaborative forum has been initiated by the Norwegian municipalities that are going to host battery industry players, and there is collaboration between several of the Nordic battery industry host municipalities. The topic is also on the agenda for the cooperation between InvestIN (part of Innovation Norway), Business Sweden and Business Finland.

Menon Economics has carried out social impact analyses of the establishment of Freyr in Mo i Rana and Morrow in Arendal. The analyses highlight several areas that are essential for these establishments to succeed: recruitment, housing and social planning,

education, competence and R&D, land, infrastructure and transport, and the power system. Not least, the analyses underline the need for greater coordination and better joint projects across sectors and administrative levels.

Many of these challenges are addressed in the battery strategy's 10 actions for sustainable industrialisation, for example by facilitating suitable industrial sites efficient processing, access to renewable power and competence building.

Measures

- ✧ Through the measures presented in this strategy, the Government will support “pilot municipalities” that are hosting large establishments in the battery value chain. We will invite the municipalities involved to engage in further dialogue, and we will facilitate sharing of experiences among the host municipalities, in Norway and in the Nordic region as a whole. The work may involve the ministries, county authorities, the county governor and relevant parts of the policy apparatus including InvestIN.

ACTION 10

Become a leader in tomorrow's battery solutions and leveraging the opportunities afforded by digital technologies



Norwegian industry will further develop leading environments through research, development and innovation. This entails close collaboration between different centres of expertise, research institutes, the authorities and industry itself.

Europe's decision to build up a battery value chain, when the production of batteries and associated raw materials has to date mainly taken place in Asia, must initially be based on utilisation of existing technology. Norwegian and other European players will have to become competitive by producing batteries efficiently and profitably on a large scale, based on existing technology, and ensure they remain competitive over time by simultaneously working to improve battery properties and production technologies, and significantly improving batteries' environmental footprint assessed on the basis of the entire battery value chain. Technology, employee competencies and market understanding must be built up, in addition to supply chains and development environments.

The EU's approach to building a robust European battery value chain can be regarded as a cluster approach, whereby actors in different European countries will complement each other through collaboration and distribution of roles, in order to realise their growth ambitions. The European Battery Alliance acts as a coordinator in this European "battery cluster", focusing on, among other things, making sure that the different players have different roles and that gaps are identified at an early stage

”The battery industry is developing at a very rapid pace, and Norwegian centres of expertise are leading the way.”



to prevent them from causing bottlenecks. From this angle, it is essential that Norwegian investments in the battery value chain are aligned with the pan-European initiative.

The Norwegian centres of expertise already possess and are further developing their research infrastructure for the development, production and testing of battery cells, modules and systems. These form an important foundation for advancing knowledge and the associated education of future candidates. Measures that promote collaboration, such as clusters, centres for research-based innovation (SFI)⁴⁵ and catapults, help spread research findings. For Norway, it will also be important to develop national expertise, proprietary technology, and solutions with intellectual property (IP) parallel to industrial developments in order to contribute to long-term, sustainable value creation. At the same time as closer collaboration appears to be necessary for us and other European countries to realise our ambitions in the battery sector, Norwegian companies will also be in competition with businesses in other European countries. In achieving our ambitions for

the Green Industrial Initiative in such a context, it is necessary to balance the public policy apparatus with regard to collaborating with both the EU and individual countries on the one hand and promoting Norway’s own ambitions for the battery value chain on the other.

Batteries and battery production often interact with digital autonomous technologies, enabling “smart” solutions in a range of fields. There is considerable potential in using automated/autonomous production technology with control/digitalisation, robots, unmanned autonomous vehicles (UAV) and track systems in connection with battery production. It is estimated that battery cell production can provide 7,000 direct jobs in Norway. Utilisation of digital technology in low-staffed, highly automated production facilities may reduce this number significantly. These are areas that have been successfully exploited by several Norwegian companies, and much can be learned from companies in the manufacturing industry.

The battery market is developing dynamically and at great speed. Close, constructive collaboration

45 SFI – Centres for Research-based Innovation



The Government wants Norwegian industry to be a leader in Industry 4.0.

between academia and industry will be essential for rapid, targeted innovation and development that reflects the demands and needs of the markets in a life-cycle perspective.

Battery manufacturers with development plans in Norway have varying degrees of intellectual property ownership to their battery technology and solutions. Some players license in the technology, while others develop technology themselves or in partnership with overseas players. Developing proprietary technology will be necessary to create lasting value and ripple effects in the value chain and also to exploit the head start we already have by virtue of our position as a world-class knowledge nation in both research and industry in materials technology, applied chemistry and advanced production. Norwegian research communities are already international leaders in these areas.

Measures

- ☀ The Government will build strong centres of education, research and expertise throughout Norway of adequate dimensions and in parallel with the industrial initiatives. The Government wishes to focus on ripple effects and the impact of the industry-oriented research. The Government aims to further develop the battery value chain to ensure the export of battery cells, products, applications and services, with high quality requirements and a high degree of automation.
- ☀ The Government wants Norwegian industry to be a leader in Industry 4.0, and we will therefore consider our public schemes to advance promising projects within automation and digitisation of industry, including the possible creation of a national Industry 4.0 programme.

LEARN FROM THE BEST: How do the best companies gain a competitive edge through digitalisation?

The executive forum for digitalisation in industry, chaired by the Minister of Trade and Industry, which was initiated in connection with the White Paper on Industry (Report no. 27 to the Storting (2016–2017) *A greener, smarter and more innovative industry*) has explored the hypothesis that the Norwegian working model, combined with our industry expertise, provides us with an advantage in connection with the current global digitalisation of industry. In this context, SINTEF has conducted in-depth interviews of 175 key personnel at different levels in the business in a sample of 33 of our leading companies from different industries, in order to gain insight into how these companies work to ensure digital tools yield added value.⁴⁶ One objective of the survey was to share this kind of experience-based knowledge with companies that are in earlier stages of their digital journey.

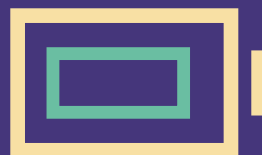
The study confirms the hypothesis that the Norwegian working life model provides us with a unique advantage in connection with digitalisation, partly because employees are given

the freedom to play and test ideas through trial and error in small-scale projects at the factory. Through this, experiences are gained that build expertise and reduce the risk associated with scaling up digital technology. The short distance and close collaboration between the management and skilled workers in the industry are also highlighted as an advantage. The study points out that the competence needs in the industry are changing, and with it the way the work is organised. Employees will increasingly work with, understand and operate ever more advanced and autonomous machines. Manual, experience-based competencies in a particular industry must increasingly be linked to expertise in generic digital technologies, and contact with customers and other players in the value chain is likely to become more direct. In other words, tomorrow's industrial employees will spend less time performing traditional, routine operations, and lifelong learning will become increasingly important.

⁴⁶ <https://www.norskindustri.no/kampanjesider/industrifuturum/artikler/ny-studie-hvordan-skaaffer-de-beste-bedriftene-seg-konkurransekraft-igjennom-digitalisering/>



”Tomorrow’s Norway will be built on a foundation of green industry, with batteries playing a key role. Green industry is the way ahead - Norway are charging up collectively!”



Norwegian Bokmål

Published by:
Ministry of Trade, Industry and Fisheries

Ordering of publications:
Norwegian Government Security and Service Organisation

publikasjoner.dep.no
Telephone: (+47) 22 24 00 00

Publications are also available at:
www.regjeringen.no

Publication code: W-0042 E

Design and layout:
Anagram Design

Printed by:
Norwegian Government Security and Service Organisation
09/2022 – print run 20

