A study on Asian electromobility investments in the EU

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Executive Summary

The European has decided to transition quickly towards electric vehicles, for which battery is the most valued item, but lacks battery production plants – or gigafactories - on its territory to close the gap with the expected demand. European players (Northvolt, ACC) have started production, and Asian players with more experience on this technology also set up factories in the European Union or make partnerships with European car manufacturers. **While these gigafactories are welcomed and will help the EU to reach its ambitious climate targets, it is important that they respect the environmental and social regulations** (as for European players), to make sure that the curse is not worse than the disease. And as batteries are a key-technology for the energy transition, it raises the question of **the expertise transmission between Asian and European actors**, as it was performed in China a few years ago when European car manufacturers created JV with Chinese ones.

The **main environmental challenges of battery gigafactories** are the **high energy requirements** as many of the processes needed for the manufacturing of battery cells are energy intensive. Some of these **processes also involve hazardous substances**: the battery chemistry elements (specially for the Nickel-Manganese-Cobalt (NMC) chemistries), solvents in cathode manufacturing (the production process employs N-Methyl-2-pyrrolidone (NMP) as a solvent) and other toxic gases produced during the manufacturing process such as hydrogen fluoride (HF). Therefore, **gigafactories and authorities must be especially vigilant on treating and handling waste and other effluents that can be rejected into air or wastewater effluents.** Meanwhile, the **EU has been establishing and reenforcing its comprehensive regulatory framework governing battery manufacturing** among other industrial activities with the Industrial Emissions Directive, the Water Directive, the Waste Directive, the REACH regulation, the Environmental Impact Assessment Directive, and the Battery regulation, for which most of the implementation has yet to come.

Focusing on two representative cases, the LG Energy Solution plant in Wroclaw, Poland, and the **CATL gigafactory project in Debrecen**, Hungary, and based on public documents, the compliance of the environmental regulations has been reviewed. It comes out that for both plants a **breach has been identified in air emissions, where NMP levels exceed the EU Industrial Emissions Directive limit, and a breach in water emissions, with the presence of NMP in effluent water, which contradicts best environmental practices.** The LG environmental impact assessment for Phase III provides figures for energy or land use which appear to be inaccurately low compared to other gigafactories. **Other aspects, including waste management, land occupation, and social implications, while they don't constitute direct breaches, raise concerns**. Especially about the NMP treatment in wastewater, as the capacity of external recycling actors in the area seems to be limited, and regarding land-use, with the conversion of the previously agricultural lands in the CATL project. More broadly, these projects highlight the environmental **challenges involved in a rapid industrial development.** This is exacerbated in Hungary, which wants to attract 300 GWh of battery capacity production by 2030 on its territory: **this battery industry strategy will raise challenges such as energy security and energy mix decarbonization** as it will create a significant additional demand, **and hazardous waste management**. And **it therefore questions the value for Hungarians**: social acceptability is low because of environmental concerns, additional jobs surge in an already tense market, and so far, few partnerships have been set with local universities and no R&D facilities set up for knowledge transmission.

While these 2 cases illustrate the socio-environmental breaches and concerns which needs to be corrected or improved, **the analyses should be extended to other battery manufacturers, including the European ones**, to make sure they abide by EU regulations, and to **highlight the best practices to ensure a cleaner transition towards electromobility.**

When it comes to partnerships between European car manufacturers and Chinese battery producers, **it is important to note that 'know-how' is not necessarily the key factor, if it plays any role at all**.

European carmakers are under pressure to meet the European Union's (EU) roadmap milestones for car electrification, (with the next one in 2025), as well as those of their Chinese competitors, like BYD, who have developed quality electric vehicles (EV) capable of competing with, or even supplanting, brands already established in the zero-emission segment.

China has overcapacity in both battery and electric car production, and some sources say that China's domestic plants in the EV sector are currently operating at only 40% of their maximum capacity.

While the European Commission has recently imposed trade tariffs on imported EVs from China due to Chinese subsidies, it has avoided imposing customs duties on battery vehicles, even though Chinese battery manufacturers have also been heavily subsidised. This is because, there is currently no alternative to Chinese LFP (lithium iron phosphate) batteries, and European car manufacturers are mandated to sell 100% zero-emission cars by 2035.

Establishing joint ventures (JV) with European carmakers allows Chinese companies to share CAPEX expenditures and get help from their local partner to handle EU norms and local stakeholders (authorities, trade unions, employees, etc.). This solution is also positive for European carmakers as it helps them secure battery supplies in the short to medium term. They can also work on improving the integration of batteries produced by the JV, into their vehicles, through the co-development of battery settings - i.e. the battery management system (BMS), which is typically developed by the car manufacturer and needs to be properly integrated into the battery pack.

In this context, **each European carmaker and Chinese battery producer looks for the optimum strategy, depending on its DNA, market position and future vision**. We will focus on two examples: the Volkswagen-Gotion and the Stellantis-CATL partnerships.

In 2020, Volkswagen decided to take a 26% stake in Gotion, becoming the Chinese battery maker's majority shareholder. Industry experts consider that Gotion had the upper hand in the discussions as Volkswagen was not the sole candidate for the 'partnership'. The underlying elements of this strategic alliance have not been made public. However, it seems that the presence of Volkswagen as a shareholder in Gotion facilitates access to the international market for the Chinese group. In exchange, **Volkswagen gains exclusive supply agreements on the production of Gotion battery factories established in Europe** (such as the GIB plant in Slovakia, belonging to Gotion InoBat JV). Gotion also agreed to provide support to Volkswagen's battery plant PowerCo in Salzgitter, Germany. This suggests that in time, **Volkswagen may want to develop an internal capacity to produce its own batteries**, which is consistent with the group's DNA of vertical integration.
Gotion, for their part, has set-up **a JV called GIB, with InoBat, a battery manufacturer in Slovakia. This project includes possible technology transfer as this seems to have been a condition from the local authorities to subsidise the JV**. In addition, Gotion vowed to work with local universities to train students in the skills needed to work in the electric battery field. Gotion is, however, the decision maker in the JV with an 80% controlling stake. While the two partners in the JV say they will retain their intellectual property assets, they may develop common projects in the future. Gotion will also send Chinese specialists to Slovakia to train the local employees, with the aim of having a 100% Slovak workforce at GIB in time. This suggests some form of transfer of technologies, or at least of know-how.

Stellantis appears to have a different approach. The group doesn't seem interested in developing its own capacity in battery production for the time being. **Its main objective is to secure supplies of affordable batteries** to meet the EU targets in car electrification. As the ramp-up of European battery producers is still below expectations as well as European carmakers needs, Stellantis decided to turn to Chinese battery producers. The group even took a share in a Chinese competitor, the EV carmaker Leapmotor, presumably to meet EU intermediate targets in EV production and avoid heavy fines.

For Stellantis, batteries are considered a raw material that should be purchased in optimum conditions (price, quality, delivery times), considering the group's position as a "major customer". **The group's strategy seems more influenced by procurement logic than by industrial considerations**. The Stellantis-CATL JV project in Spain is to secure supplies in batteries for a local production unit of EVs. **Therefore, the option of technology transfer within the Stellantis-CATL JV doesn't appear to be a priority**. Stellantis negotiated subsidies with the Spanish government and local administration mostly to help the group finance the production shift of the local factory from thermic vehicles towards EV. The Spanish authorities were apparently not in a position to impose technology transfer clauses on CATL, as they needed to prioritise protecting local employment. Up to now, **the EU has not imposed any technology transfer requirements on foreign investors creating a joint venture**.

While these case studies serve as examples, **they highlight that technology transfer is easier and more logical in horizontal partnerships between battery manufacturers** (like Gotion and InoBat), especially if Europe wants to catch up in battery production, rather than through joint ventures between carmakers and battery producers.

Part 1: Analysis of the socio-environmental impact of gigafactories

The EU has set a target of transitioning to 100% "zero-emission" vehicles sales by 2035[1], paving the way for electric cars (and hydrogen cars, though at a more expensive price) which relies heavily on lithium-ion batteries, that is the most valuable item of the car. **Lithium-ion batteries production is currently mostly based in Asia** (especially in China, but also Japan and Korea) and, facing **a gap between expected demand for electric cars and European battery production, the European Union has attracted Asian battery manufacturers** to set up gigafactories on its territory, in parallel with the development of European players. However, battery manufacturing relies on high technology as it requires great accuracy and a strong control of the environment in some production stages, which are energy-intensive and involve the use of hazardous substances. **Managing to set up factories in a small timescale and to produce batteries at such a large scale is challenging, and it implies equally a challenge to manage the environmental impacts along the social impacts on the local economy, to respect EU and local regulations**.

Based on public documents available, we review in this first part the main environmental and social impacts specific to battery gigafactories, with its application on **two case studies of major Asian battery manufacturers**: the **CATL gigafactory project in Debrecen**, which is the second European plant of the world's largest battery producer, and the **LG Energy Solution gigafactory in Wroclaw** which has currently the highest producing output of batteries in Europe (86 GWh/year in 2025 for a total cell capacity production of 115 GWh/year).

The rapid establishment of these gigafactories and the ability to scale production effectively pose significant challenges, necessitating careful management of both environmental impacts and local socio-economic effects. Meanwhile, the **EU has been establishing and reenforcing its comprehensive regulatory framework governing battery manufacturing** among other industrial activities. The **Industrial Emissions Directive** mandates integrated permits for large industrial installations, including those involved in battery production. The **Water Framework Directive** imposes strict quality objectives for water resource use and wastewater management. Additionally, the **Waste Framework Directive** enforces recycling targets and requires proper classification of hazardous waste. The **REACH** regulation aims to protect human health and the environment from chemical risks associated with battery production. It mandates registration of chemical substances used in manufacturing processes and ensures that hazardous substances are replaced with safer alternatives when possible. The **Environmental Impact Assessment Directive** requires projects likely to have significant environmental effects to undergo thorough assessments prior to construction.

[1] Regulation (EU) 2023/851 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2019/631 as regards strengthening the CO_2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition.

Battery gigafactories environmental challenges

Hazardous substances

The vast majority of current battery manufacturing in Europe is based on NMC battery chemistry. This type of batteries uses **Nickel, Manganese and Cobalt** as cathode materials, which have all been classified as hazardous in the EU's Classification[2]. In addition, other hazardous substances are involved in **electrolytes**, and in cathode manufacturing with the solvent the N-Methyl-2-pyrrolidone (NMP).

While for the anode manufacturing, water is used as a solvent to lay the graphite on the copper sheet, **for the cathode production, NMP is an essential solvent**. The NMP solvent, thanks to its polar and aprotic characteristics, enables the NMC mix to be applied and deposited on the metal collector while protecting it from water (when the NMC mix comes into contact with water, it will react, raising the pH and creating carbonates, which will affect the battery's durability). **NMP has a harmonised classification as toxic to / for reproduction and is also a respiratory, skin and eye irritant.** This organic solvent can harm organisms when entering soil or water bodies and water quality. Restriction requirements under the REACH Regulation[3] apply to any processing, consumption, storage, transfer and mixing in order to protect anyone that could be exposed to it. **Alternatives are being tested based on elastomers, but further research is needed**.

The electrolyte injection process, which typically involves a solution containing lithium hexafluorophosphate (LiPF6) salt, **can lead to the formation of hydrogen fluoride (HF)**. This occurs when the electrolyte decomposes under elevated temperatures or when it reacts with moisture present in the cell. Both conditions can trigger the release of HF as a byproduct. HF is highly corrosive and a powerful contact poison.

Energy

The **production of lithium-ion batteries is an energy-intensive process** that requires significant amounts of electricity and heat, mainly produced through natural gas fired boilers. Several battery manufacturing processes are made in **high temperature environments**. Other highly energy-intensive hotspots **are clean and dry rooms** used to prevent moisture from interfering with the sensitive materials during core processes in battery manufacturing such as electrode manufacturing and battery cell assembly.

The additional energy requirements for new battery gigafactories add pressure to power grids and may raise concerns on the energy supply. In addition, in the context of the energy transition towards renewable sources, it can also slow down the energy mix decarbonization or request higher renewable targets. To address these challenges, many manufacturers pursue energy efficiency measures to decrease their energy needs.

[2] Information on chemicals. European Chemicals Agency

[3] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

Water

Water consumption is mainly driven by the cooling systems and other industrial processes such as the **slurry mixing and distillation of pollutants**, that are water intensive. Most of the water is evaporated but some effluents are discharged to the local sewage systems. **Water consumption from battery gigafactories varies widely between facilities** and is lower than other water-intensive industries such as steel and aluminium smelters. However, **the multiplication of such investments and the concentration in a same region can increase water needs to non-sustainable levels**, especially in certain areas that can be at the same time more often impacted by droughts. Water is a subject widely addressed during the planning and operation phases of a factory.

Scrap and waste

Battery manufacturing scrap is too dangerous to be directly treated or stored in its current form as the cathode and the anode are susceptible to spontaneous combustion. Therefore, **the storage and transfer of this waste poses a safety risk**. Scrap goes through a pre-treatment process involving mechanical processes to break down packs, modules or cells through shredding and sorting stages. A second thermal process is applied to the main components of the cathode and anode. **A water-induced spontaneous combustion is carried out under controlled conditions** in a special chamber designed for this purpose. This process allows the recovery of the primary battery material feedstock called "black mass" – a powder containing the active materials present in the cathode and the anode and thus the more valuable battery metals (nickel, cobalt, lithium and graphite). Black mass will be then treated by hydrometallurgy which involves chemical leaching and purification processes to precipitate out individual metal products[4].

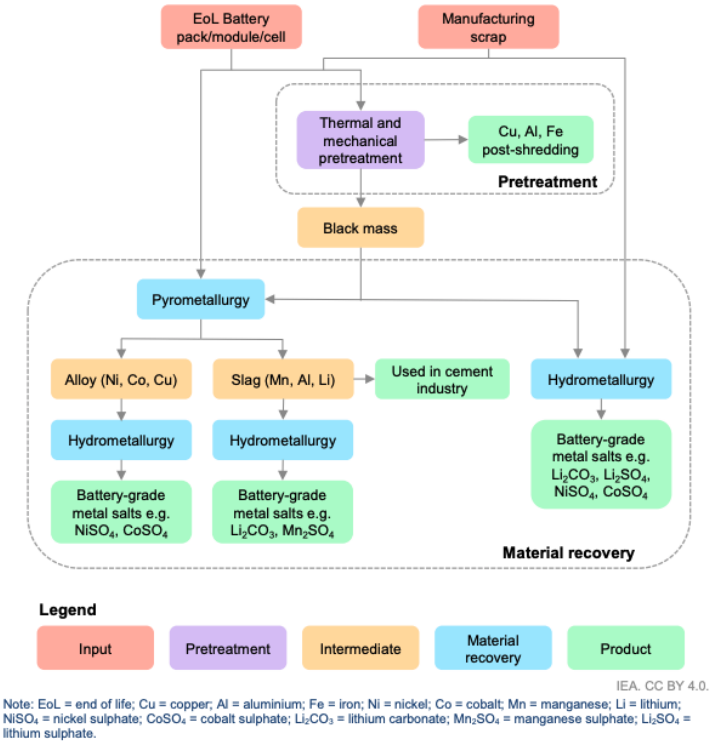

Figure 1. Battery recycling processes and pathways. Source: International Energy Agency. (2024): Recycling of Critical Minerals

[4] International Energy Agency. (2024): Recycling of Critical Minerals. Strategies to scale up recycling and urban mining

The battery manufacturing process also generates waste all along the process. **Some of the waste contains dangerous substances** and needs to be classified as hazardous waste in order to treat it correctly and to minimise the risks related to the transport and handling. The lack of classification makes services associated with the safe transport of undischarged batteries and the **collection of statistical data more complicated**. It is not possible to calculate or demonstrate their recycling efficiency, since processing is only documented administratively for non-hazardous batteries. Currently, the European list of Waste is undergoing modifications to properly take account of new battery chemistries (see Waste in the Main European regulations section).

Land occupation

As a result of the significant production output of battery gigafactories and their scale, **these facilities require considerable surface areas**, which needs to be considered and evaluated during the first phases of the projects. **Many of the new European battery gigafactories were created in the form of greenfield or a mix of greenfield and brownfield sites** investments, thereby requiring the use of new land. Soil artificialization for gigafactory construction can lead to environmental impacts in terms of biodiversity loss, water flowing issues and reduced carbon sequestration, among others.

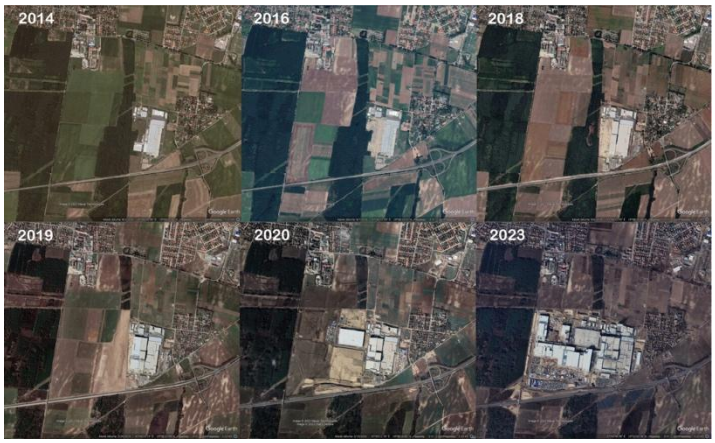

Figure 2. Expansion of the battery factory in Göd (Hungary) between 2014-2023. Source: Szalámiba csomagolt akkumulátorgyárak

Main European regulations

Table 1. Main European Regulations regarding battery manufacturing

Regulation/Directive	Description	Compliance requirement
Industrial Emissions Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial and livestock rearing emissions	• Aims to **prevent and reduce pollution from industrial production** by requiring integrated permits for emissions into air, water, and soil. • **Covers installations in several sectors** such as energy, metal processing (incl. manufacturing of batteries), minerals, chemicals,	For emissions of the volatile organic compounds where the mass flow of the sum of the compounds is greater than, or equal to, 10 g/h, an emission limit value of 2 mg/Nm^3 shall be complied with. The emission limit value refers to the mass

	waste management, livestock rearing, etc. • Operators must obtain **integrated permits based on Best Available Techniques (BAT)** conclusions adopted by the European Commission.	sum of the individual compounds.
Water **Directive 2000/60/EC** of the European Parliament and of the council of 23 October 2000 establishing a framework for Community action in the field of water policy	• Establishes a **framework for protecting inland surface waters, transitional waters, coastal waters, and groundwater**, focusing on preventing deterioration, promoting sustainable water use, improving aquatic ecosystems, reducing groundwater pollution, and mitigating flood and drought effects.	**Member States must identify and manage river basins**, designating areas requiring special protection. **Specific measures will be adopted to address pollution from harmful substance**s, including those affecting drinking water sources.
Waste **Directive 2008/98/EC** of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives	• Implements the **waste hierarchy** (prevention, reuse, recycling, and disposal) and **establishes recycling targets**. **Waste classification has been harmonized across the EU** using the European List of Waste (LoW).	**Companies must adhere to the waste hierarchy and handle hazardous waste according to specific rules. Manufacturers** are **accountable** for their **products'** entire **lifecycle**, including post-consumer waste management. **Waste must be classified and documented** in compliance with the LoW.
Hazardous Substances **Regulation (EC) No 1907/2006** of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)	• Ensures the reporting and safe use of chemicals products to protect the environment and human health.	Requires **manufacturers, importers and downstream users** to identify and **manage risks** associated with chemical products: **1. Registration** **2. Evaluation** **3. Authorization** **4. Restriction**
Environmental Assessment **Directive 2011/92/EU** of the European Parliament and of the	• Defines the environmental impact assessment (EIA) process which ensures that projects likely to have significant effects on the environment are made subject to	The project developer may request scoping guidance from the competent authority, provide an EIA report as per Annex IV of the directive, ensure

Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment	an assessment, prior to their authorization.	consultation with environmental authorities, the public, and affected entities, await the authority's decision (which includes a reasoned conclusion on significant effects), and allow the public to challenge the decision before the courts.
Batteries Regulation **Regulation (EU) 2023/1542** of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries	• This regulation aimed at the EU internal battery market promotes a circular economy and reduces environmental and social impacts across the battery lifecycle.	Producers must gradually ensure collection and recycling and introduce recycled content in batteries for certain materials. Other features include the creation of a "battery passport" among other declarations to ensure correct labeling and safety dispositions.

Industrial emissions

Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on **industrial emissions (integrated pollution prevention and control)**[5] requires companies to prevent and reduce pollution in all aspects of their industrial production, with integrated permits to manage emissions into air, water, and soil. Operators of industrial facilities engaged in activities listed in Annex I of the Industrial Emissions Directive (IED) must obtain an integrated permit from the relevant authorities in EU member states. **Over 50 000 large industrial installations are covered by the IED**. Regarding the battery sector, it applies to the manufacture of batteries, other than exclusively assembling, with a production capacity of 15 000 tonnes of battery cells or more per year. These installations can only operate if in possession of a permit, whose conditions are based on the best available techniques (BAT) conclusions adopted by the European Commission. "BAT conclusions" refer to a document summarizing BATs and emerging techniques, including their descriptions, applicability, associated emissions and environmental performance measures among others.

The Directive is founded on several key principles:

- **Integrated Approach**: Authorities must consider the overall environmental performance of a plant throughout its lifetime during the permitting process.
- **Emission Limits**: Emission limit values must be set at a level that ensures pollutant emissions do not exceed the levels associated with the use of BATs established at the EU level, with EU-wide limits for certain activities. This is the case for volatile organic compounds (VOCs) and emissions from waste incineration plants. In specific cases, member state authorities may set less strict limits if justified.
- **Environmental Inspections**: Mandatory inspections occur every 1 to 3 years, based on risk criteria.
- **Public Participation**: The public has the right to be involved in permitting decisions and access information on emissions monitoring results.

The permit for the installation includes details of the deep industrial transformation, the emission levels, the resource efficiency goals and the implementation timeline with key milestones. The operator is required to submit an annual progress report to the competent authority on the transformation's implementation.

[5] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)

Throughout this period, the competent authority ensures that no significant pollution occurs and that a high level of environmental protection is maintained.

Water

The **Water Framework Directive** (2000/60/EC)[6] sets quality objectives and imposes restrictions on water resource use and wastewater management to manage and protect water bodies, including rivers, lakes, groundwater, and coastal waters. The legislation assigns clear responsibilities to national authorities, requiring them to:

- Identify individual river basins within their territory, including the surrounding land areas that drain into specific river systems.
- Designate authorities to manage these basins in accordance with EU regulations.
- Analyse the characteristics of each river basin and establish reference conditions for each water body type to assess its status.
- Assess the impact of human activity and conduct an economic evaluation of water use.
- Monitor the water status in each basin.
- Register protected areas, such as those used for drinking water, which require special attention.
- Develop and implement 'river basin management plans' to prevent surface water deterioration, protect and improve groundwater, and preserve protected areas.
- Ensure that the cost of water services is recovered to promote efficient resource use and ensure polluters are held accountable.
- Provide the public with information and opportunities for consultation on river basin management plans.

Waste

The **Waste Framework Directive** (2008/98/EC)[7] enforces the waste hierarchy (prevention, reuse, recycling, disposal) and sets recycling targets for companies. Waste classification has been standardized across the EU through the European 'List of Waste' (LoW) according to the Commission Decision of 3 May 2000 (2000/532/EC)[8], which offers a unified coding system for waste in the EU.

Nonetheless, there is **no specific code for lithium-based waste batteries yet**. **Additional updates to the LoW concerning waste batteries are expected in 2025** to classify such batteries appropriately as hazardous waste and facilitate accurate sorting and reporting. The amendment of Commission Decision of 3 May 2000 will **modify the classification of lithium-ion (Li-ion) batteries, reclassifying them as hazardous waste** under the EWC code 16 02 15* (hazardous components removed from discarded equipment) or new codes specific for Lithium-ion batteries waste. This change reflects the recognition of the potential environmental risks associated with the disposal of Li-ion batteries, as they contain substances that may be harmful to both human health and the environment. This amendment is designed to take into account of the rise of new battery chemistries, especially those based on lithium and nickel. **The amendment aims to improve sorting, recycling, and reporting of waste batteries under the new Batteries Regulation** (See below). Feedback period was

[6] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

[7] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives

[8] Decision 2000/532 - 2000/532/EC: Commission Decision of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous w

closed in November 2024 and Commission adoption should follow, although adoption was planned for the third quarter 2024[9].

Hazardous substances

REACH[10] (Registration, Evaluation, Authorization, and Restriction of Chemicals) is a regulation adopted by the EU to improve the protection of human health and the environment from the risks posed by chemicals. REACH applies to all chemical substances and concerns all companies involved in the substance value chain from the produced to the end-user:

- **Registration**: Companies handling chemical substances exceeding 1 ton per year must register them with the European Chemicals Agency (ECHA). Registration requires companies to identify associated risks and explain how they are managed, applying to both individual substances and mixtures.
- **Evaluation**: ECHA and Member States assess the submitted data to determine if the substance poses risks to human health or the environment.
- **Authorization**: Ensures that Substances of Very High Concern (SVHCs) are replaced with safer alternatives when feasible, both technically and economically.
- **Restriction**: Restriction processes apply to SVHCs posing unacceptable risks, potentially limiting or banning their use.

Users of the NMP solvent must take steps to **comply with DNELs**[11] under REACH Annex XVII restriction 71 and European Union OELs[12] adopted in implementation of Directive 98/24/EC[13] on risks related to chemical agents as well as with national limit values.

Environmental Impact Assessment

The **Environmental Impact Assessment (EIA) Directive** (2011/92/EU)[14] applies to any project likely to have a significant environmental impact. It requires projects to **undergo an environmental assessment before construction** considering direct and indirect significant effects on the following factors: population and human health, biodiversity, land, soil, water, air, climate, material assets as well as the cultural heritage and the landscape.

The project developer may request scoping guidance from the competent authority, provide an EIA report as per Annex IV of the directive, ensure consultation with environmental authorities, the public, and affected entities, **await the authority's decision (which includes a reasoned conclusion on significant effects), and allow the public to challenge the decision before the courts**.

[9] See more detail in Waste treatment – Amendment to the European List of Waste to address waste batteries and wastes from treating them

[10] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

[11] Direct no-effect levels

[12] Occupational exposure limits

[13] Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work

[14] Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment

Battery Regulation

The EU New **Battery Regulation** (2023/1542)[15], published by the EU Commission on July 28, 2023, and effective from August 17, 2023, aims to enhance the EU internal battery market (including products, processes, waste batteries and recycling), promote a circular economy, and reduce environmental and social impacts across the battery life cycle.

The Regulation aims to **ensure that batteries will have a low carbon footprint, use fewer harmful substances and reduce dependence on raw materials from non-EU countries** by promoting a circular economy through the collection and recycling of used batteries. The regulation applies to all types of batteries, including:

- Portable batteries.
- Electric vehicle (EV) batteries.
- Industrial batteries.
- Starting, lighting and ignition batteries (used mostly for vehicles and machinery) (SLI).
- Batteries for light means of transport (LMT) such as electric bikes, e-mopeds and e-scooters.

The Regulation also requires companies to identify, prevent and address social and environmental risks linked to the sourcing, processing and trading of raw materials contained in their batteries. It also includes performance, durability and safety criteria which cover restrictions on hazardous substances. In terms of labelling, the Regulation imposes a digital information system in the form of a QR code and for LMT, industrial and EV a "battery passport".

Regarding EV batteries, the timeline of the main EU Battery Regulation implementations is:

- **August 18, 2024**: Mandatory enforcement of performance and durability requirements, conformity assessment procedures, and economic operator obligations.
- **2025**:
  - Mandatory enforcement of carbon footprint requirements for EV batteries.
  - Mandatory enforcement of supply chain due diligence / Mandatory enforcement of waste battery management.
  - Recycling efficiency targets of 65% for lithium-based batteries.
- **2027**:
  - Mandatory enforcement of battery passports for EV batteries.
  - Target for lithium recovery from waste batteries of 50%.
  - Targets for the recovery of cobalt, copper, lead and nickel of 90%.
- **2028:**
  - Mandatory enforcement of requirements for recycled materials in EV batteries, conformity assessment procedures, and economic operator obligations.
- **2031:**
  - Target for lithium recovery from waste batteries of 80%.
  - Targets for the recovery of cobalt, copper, lead and nickel of 95%.
  - Minimum levels of recycled content for EV batteries of 16% for cobalt, 85% for lead, 6% for lithium and 6% for nickel.

[15] Regulation (EU) 2023/1542 of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries

Case study: CATL in Debrecen

With the objective to take advantage of the energy transition in the automotive sector which is key to Hungary (20% of its national GDP in 2023), **the Hungarian government has set the goal to become one of the main battery producer's countries in Europe** and has attracted many leading EV battery manufacturers for their new manufacturing plants. CATL's gigafactory is located in Debrecen, the second most populous city of Hungary. It will be the company's **second battery manufacturing base outside China**, after commissioning the first unit in Erfurt, Thuringia, Germany. The project is the **largest greenfield investment in Hungary up to date** and receives strong support from the Hungarian government[16]. The CATL plant in Debrecen plans to start production in 2025 with a strong first phase of 40 GWh per year in order to **reach 100 GWh per year** in the near future. Main elements and figures are retrieved from the last modification of the single environmental permit[17].

Energy Demand and Availability

Battery production energy requirements align with those of similar projects. Th**ere are no direct breaches related to CATL's energy consumption for its battery gigafactory** in Debrecen. However, the **broader context of Hungary's ambitions** to become a battery production superpower **raises concerns about energy security and decarbonization of the mix**. Expanding battery production to 200-300 GWh by 2030 increases significantly the energy demand and would tension the transition towards renewable energy sources, thus **potentially increasing dependence on fossil fuels** like natural gas, primarily imported from Russia, which conflicts with EU energy independence objectives.

Battery manufacturing requires great amounts of energy derived from all the processes that are carried out at high temperature such as drying, sintering and aging as well as dehumidification and temperature control processes in dry rooms. CATL energy consumption is estimated in the Single Environmental Permit to reach a total of **1 640 GWh during the first phase (for production capacity of 40 GWh).** The total energy demand is composed of 1 000 GWh of natural gas and 640 GWh of electricity. **From an energy intensity perspective, the energy required per kWh of battery cell produced is similar to projects from French competitors ACC and Verkor (see table 1).**

Comparison of CATL energy needs with similar gigafactory projects shows that energy requirements are aligned to other gigafactories.

Table 2. Battery gigafactories energy consumption

Gigafactory	kWh/kWh of battery cell capacity
CATL	41
LG ENERGY SOLUTION	7
ACC	62
Verkor	41

Following a proportional ramp-up, the factory at full-capacity would need a total of 4 100 GWh of energy (2 500 GWh of natural gas and 1 600 GWh of electricity). In order to put these figures into perspective, in 2020

[16] Intellinews (2024). Hungary gave €800mn grant to lure Chinese gigafactory, according to Chinese media

[17] ENVIPROG GROUP. AKKUMULÁTOR GYÁRTÓ ÜZEM DEBRECEN, DÉLI IPARI PARK. TELJES KÖRŰ KÖRNYEZETVÉDELMI FELÜLVIZSGÁLAT. EGYSÉGES KÖRNYEZETHASZNÁLATI ENGEDÉLY MÓDOSÍTÁSA. 2024. Retrieved from: https://www.debrecen.hu/assets/media/file/hu/50615/05_catl_ippc_2mod_kozertheto_24_0617.pdf

levels, the energy consumption at full capacity would be equivalent to **3% of all natural gas imports and 10% of Paks nuclear power plant production**.

And it is important to highlight that **CATL factory part of a much bigger nationwide battery strategy with other gigafactorie**s that aims to reach 300 GWh of battery production capacity in 2030[18] (to date, publicly announced battery production projects represent only 215 GWh, according to T&E[19]), which **would translate into an estimated 12 500 GWh of energy consumption.**

In June 2020, the Hungarian parliament passed the Law on Climate Protection which sets a climate neutrality goal for 2050[20]. The National Clean Development Strategy presents the pathways toward climate neutrality which integrates different scenarios[21]. The Early action (EA) climate neutrality scenario envisages achieving climate neutrality by 2050. The **12 500 GWh of energy consumption required in 2030 to supply the battery industry** (under the hypothesis that the cell production capacity will reach 300 GWh), **would equal 20% of all industry energy requirements under this scenario, which is really significant and may not have been planned in the energy demand estimated in 2020, as many battery factories projects were not yet planned or confirmed.** If additional electricity consumption were to be supplied with fossil energies (e.g. natural gas), the equivalent emissions would reach 1 $MtCO_2e$.

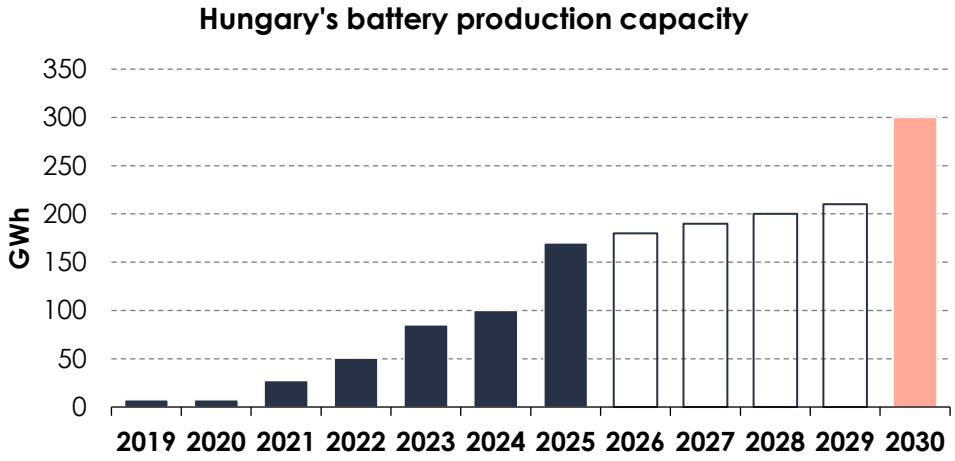

Figure 3. Hungarian battery production capacities 2019-2030 (GWh). Various sources

The **National Battery Industry Strategy[22]** (NBIS) **addresses the subject of the energy requirements** of the future production capacities and especially its carbon content, **as it aims to entirely supply the battery plants with solar capacities**. However, **apart from the fact that solar energy is a non-dispatchable energy** and would need to be combined with gas-fired, nuclear power plants, or energy storage plants, there is an **evident mismatch between energy needs and renewable energy production**.

From a projection based solely on the production capacity evolution of SK Innovation and Samsung SDI gigafactories, which could reach 87,3 GWh by 2030, the NBIS already forecasted an increase in energy demand that would reach 3600 GWh in 2030 for both gas and electricity. This energy demand estimation seems correct as it is proportionally in line with the energy consumption reported by CATL. SK Innovation and Samsung SDI gigafactories alone would then require half of the total capacity of solar power plants scheduled for

[18] Nemzeti Befektetési Ügynökség (HIPA), Akkumulátor
[19] Transport&Environment (2024). An industrial blueprint for batteries in Europe.
[20] 2020. évi XLIV. Törvény
[21] National Clean Development Strategy 2020-2050
[22] National Battery Industry Strategy 2030

commissioning in Hungary by 2030. Taking into account the total **battery production projected at 300 GWh of capacity by the NBIS, the objective of a 100% energy supply with solar capacities becomes unfeasible**. Last but not least, although Hungary has achieved remarkable growth in solar power generation, **the target of 90% clean electricity by 2030 remains very ambitious**, to which must be added an early phase-out of coal use in electricity generation by 2030.

In conclusion, a single battery gigafactory does not pose significant concerns regarding energy demand, but it is part of a nationwide industrial strategy aimed at a large-scale expansion of the battery manufacturing sector in the same region. **And while battery gigafactories cannot rely entirely on renewable sources by 2030, a realistic alternative could be a fossil fuel demand increase such as natural gas,** already representing than half gigafactories total energy consumption. Apart from environment issues, it may **increase the vulnerability of the European Union in terms of energy security** as the vast majority of natural gas in Hungary is imported from Russia, from which the EU wants to reduce its dependence[23].

Water

CATL plant in Debrecen will require significant quantities of water, primarily for cooling towers. While **comparable to other European battery gigafactories, there is a significant room for improvement** with best practices available. Although there is **no direct breach concerning the water resources**, on the water pollution side, **potential contamination from NMP is effluent water is a significant concern and creates a clear breach**. Current permits lack clear limits for NMP, which contradicts best practices in environment preservation like precautionary and zero-emission approaches.

Water demand and availability

CATL battery manufacturing in Debrecen requires water for the process itself, for the boilers feeding and for the cooling towers when they exist, in addition to the drinking water. The **demand for the cooling towers represents most of the water consumption, around 85% for the Debrecen plant**. CATL plant will require a total of 1 048 229 m^3/year[24] or 26 206 m^3/GWh during the first phase.

Locals fear that the factory may exacerbate water demands in a **zone that already suffered from severe droughts**.[25] Groundwater supply limits in the area are also a cause for concern, as there are no rivers nearby, as is the case for other smaller battery production facilities which are located near the Danube (SK in Komáron and Samsung SDI in Göd). Moreover, **a study carried out before the announcements of battery investments in the Debrecen area concluded that recharge and infiltration in Debrecen aquifers are slowing down** and therefore groundwater demand could approach its limits very soon.
Water consumption estimated is significant, as it is comparable in magnitude to the water demand of other water-intensive industries, such steel foundries and smelters (yet less than for aluminium).

[23] Where does the EU's gas come from? Council of the European Union.

[24] ENVIPROG GROUP. AKKUMULÁTOR GYÁRTÓ ÜZEM DEBRECEN, DÉLI IPARI PARK. TELJES KÖRŰ KÖRNYEZETVÉDELMI FELÜLVIZSGÁLAT. EGYSÉGES KÖRNYEZETHASZNÁLATI ENGEDÉLY MÓDOSÍTÁSA. 2024. Retrieved from: https://www.debrecen.hu/assets/media/file/hu/50615/05_catl_ippc_2mod_kozertheto_24_0617.pdf

[25] Euronews (2023). As electric cars boom, locals fear Chinese battery plant will harm land in drought-stricken Hungary

Table 3. Water consumption for metallurgical industries (industrial and drinking water)

Industry	Name	Water consumption (m^3/year)
Battery manufacturing	CATL	1 048 229
Battery manufacturing	LG ENERGY SOLUTION	1 487 642
Aluminium smelter	CONSTELLIUM Neuf-Briasch	25 000 000[26]
Steel smelter	ARCELOR MITTAL Basse-Indre	850 000[27]

Regarding the water consumption intensity in relation to the plant production capacity, **the water needs are aligned to other battery gigafactories such as ACC, although water demand can be significantly reduced**, as demonstrated in Verkor gigafactory project (air cooling in dry mode without water misting, in substitution of cooling towers). It could be an inspiration to improve CATL project, as Debrecen area may approach its groundwater limits. CATL has said recently to work on making its cooling towers more efficient, without providing more details or expected consumption reduction so far[28].

Table 4. Battery gigafactories water consumption

Gigafactory	Water consumption (m^3) per GWh
CATL	26 206
LG ENERGY SOLUTION	17 500
ACC	40 000[29]
Verkor	31 250 reduced to 6625[30]

Water pollution

Examining the NMP concentrations in pre-treated effluent water as laid down in the single environmental permit[31] (Table 47, p.164), NMP emission concentration is defined as "the first concentration measured at the start of the activity, accepted by the authority as the baseline" (see Table below). Attention must be drawn to two points: firstly, traces of NMP are expected to be found in effluent water and secondly, no clear limit is set for NMP.

[26] Demande d'Autorisation Environnementale. Constellium – projet FD6. APAVE (2021)

[27] Présentation des sites du secteur Mines et Métallurgie engagés dans la démarche d'accompagnement. Plan Eau – Bilan des actions menés par l'industrie. (2024).

[28] Balázs Szilágyi, senior public affairs manager, CATL, CE Energy News, november 2024

[29] Dossier de demande d'autorisation environnementale. Automotive Cells Company SE.

[30] Autorité environnementale. N°Ae : 2022-115. Avis délibéré de l'Autorité environnementale sur le projet Verkor de fabrication de cellules et de modules de batteries électriques sur les communes de Bourbourg et Craywick (59). (2022)

[31] ENVIPROG GROUP. AKKUMULÁTOR GYÁRTÓ ÜZEM DEBRECEN, DÉLI IPARI PARK. TELJES KÖRŰ KÖRNYEZETVÉDELMI FELÜLVIZSGÁLAT. EGYSÉGES KÖRNYEZETHASZNÁLATI ENGEDÉLY MÓDOSÍTÁSA. 2024. Retrieved from: https://www.debrecen.hu/assets/media/file/hu/50615/05_catl_ippc_2mod_kozertheto_24_0617.pdf

Table 5. Table 47 of the Modification of the Single Environmental Permit (June 2024) summarizing the characteristics of wastewater discharged to public sewers (translated)

Pollutants	Treated effluent (mg/l)	Limit value* (mg/l)
KOI_{Cr}	≤ 150mg/l	1000
BOI_5	≤ 2,0mg/l	500
Ammonium Nitrogen	≤ 30 mg/l	100
Total nitrogen	≤ 40mg/l	150
Air content	≤ 140mg/l	200
Total cobalt	≤ 0,1 mg/l	1
Total nickel	≤ 0,5 mg/l	1
Total manganese	≤ 1,5 mg/l	5
pH	6,5 - 9	6,5 - 10
Total cadmium	≤ 0.15 mg/l	0,15
Total copper	≤ 2 mg/l	2,0
Total aluminium	≤ 3 mg/l	3
Total mercury	≤ 0.04 mg/l	0,04
Total lead	≤ 0.2 mg/l	0,2
Total zinc	≤ 5 mg/l	5
Lithium	will be determined within 30 days of the start of operations	first concentration measured at the start of the activity
NMP		

** Threshold values for the pollutant content of wastewater discharged into public sewers established in accordance with Decree No 28/2004 (XII.25.) of the Ministry of Public Works and Water Management - in the case of indirect discharge to other receptors*

To address the first point, an interview with an environmental engineer specialized in battery manufacturing explained that **no NMP should be present in wastewater**. Water containing NMP, possibly from the NMP-recovery process should be treated separately and not reinjected in the effluent flow. For example, **according to the environmental permits of other battery gigafactories such as ACC or Verkor, no NMP is expected in the wastewater effluent**. This proves the existence of processes and methods already applicable, which guarantee the absence of NMP in the discharged water. **These processes could be also implemented in the Debrecen plant in order to avoid any possible contamination of NMP in the wastewater.**

In relation to the limit value for NMP, if we set aside the complex issue of determining the limit value, the authority's decision is based on the fact that the Decree No.28/2004 (XII. 25.) KvVM of the Ministry of Environmental Protection and Water Management[32] which sets limit values for water pollutant emissions and certain related rules, does not specify a limit for NMP. Since NMP is not listed in the regulation's tables, the Authority may have assumed that no limit for NMP concentration in water should be set for the discharged effluent. However, **several relevant legal provisions provide clear guidance as described in a document for setting NMP concentration limit values produced by the Hungarian Chamber of Engineers**[33], making this decision not entirely justifiable. Some of the main arguments presented in the guidance are:

- **NMP should be limited** as it can be declared as a matter of principle that is not an element naturally occurring not degradable, and is in itself a hazardous substance, presenting an environmental and health risk at the time of release.
- **Precautionary Principle and Pollution Prevention:** In the absence of specific regulatory limits, the precautionary principle and pollution prevention must guide decision-making, ensuring that NMP concentrations do not harm human health or the environment.
- **Zero Emissions Principle for Hazardous Substances**: Given NMP's hazardous properties (e.g., recognized as a reproductive toxicant), the "zero emissions" principle should apply to NMP discharges. Effluents containing NMP should be treated on-site to prevent contamination of public water systems, in line with Best Available Techniques (BAT) and the polluter-pays principle.

[32] Decree No. 28 of 2004 (XII. 25.) KvVM of the Ministry of Environmental Protection and Water Management concerning emission standards of water-pollutant substances and laying down rules of application.

[33] A Li-ion alapú akkumulátor gyártással összefüggő engedélyezési eljárásokban a kibocsátott szennyvíz NMP koncentrációjára vonatkozó határérték megállapítása során figyelembeveendő szempontok

Air emissions

CATL gigafactory will employ an NMP recovery system to minimize solvent use, but **small amounts of NMP will be still released into the air**. Hungarian regulations establish different emission limits for NMP, and **authorities have applied the less strict** VM Decree 4/2011 **instead of the stricter VM Decree 26/2014, which sets a VOC emission limit of 2 mg/Nm^3 for substances with reproductive toxicity in line with the EU Industrial Emission Directive**. This indicates a **breach of EU regulations and Hungarian law if the stricter limit is not met for NMP**.
No breaches have been identified for other emissions of dangerous gases such as hydrogen fluoride and electrolyte.

Solvent containing NMP is dried from the cathodes and a regeneration system allows the recovery of most parts of the NMP solvent. NMP vapours are separated by condensation and then water content is removed by distillation. Exhaust gases from the NMP recovery process where significant volatile organic compound (VOC) emissions are possible are directed to an adsorption unit and a scrubber to minimize emissions although small amounts of NMP are emitted. The regulation of NMP air emissions is governed by two pieces of legislation in Hungary:

1. VM Decree 4/2011 (14.I.)[34]: For combined emissions of substances from different classes with a mass flow rate of 3 kg/h or more, the total emission limit value is set at **150 mg/Nm^3**.
2. VM Decree 26/2014 (25.III.2014)[35]: For substances with carcinogenic, mutagenic, or reproductive toxicity, when the total mass flow rate is 10 g/h or higher, the VOC emission limit is **2 mg/Nm^3**. It is **in line with the European Directive 2010/75/EU[36] on industrial and livestock rearing emission** Part 4, which sets an emission limit value of 2 mg/Nm^3 that shall be complied with for emissions of VOCs with specific risk phrases.

These decrees establish different limits for NMP emissions. In practice, authorities have primarily applied VM Decree 4/2011, disregarding the stricter limits of VM Decree 26/2014. CATL's Debrecen plant set 3 different limits for three different point sources: 1, 10 and 25 mg/Nm^3. In a similar way as wastewater containing NMP, **it may be argued that under the precautionary principle and pollution prevention of a substance not-naturally occurring the operation should comply with the stricter limit**. In addition, **CATL factory**, which is concerned by the Industrial Emissions EU Directive, **must comply with the 2 mg/Nm^3 VOC emission limit.**

Regarding other critical air emissions concern hydrogen fluoride and electrolyte (Dimethyl carbonate and methyl ethyl carbonate), no breaches of the current legislation have been identified.

[34] 4/2011. (I. 14.) VM rendelet a levegőterheltségi szint határértékeiről és a helyhez kötött légszennyező pontforrások kibocsátási határértékeiről

[35] 26/2014. (III. 25.) VM rendelet az egyes tevékenységek illékony szerves vegyület kibocsátásának korlátozásáról

[36] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial and livestock rearing emissions (integrated pollution prevention and control)

Scrap and Waste Management

Hungary's ambition to become a battery manufacturing superpower will lead to a **significant increase in hazardous waste, including large volumes of water containing NMP**. While intern waste treatment plants involve outsourcing to specialized companies, **capacity limitations and lack of operational transparency raise concerns without posing a clear breach.**

As explained before, the massive investments in the battery industry made today expect to make Hungary a battery superpower with several hundreds of GWh manufacturing capacities. As waste is proportional to the production, large quantities of battery manufacturing waste and scrap will certainly be generated, even more during the first years of ramp-up. An article published by Heinrich Böll Stiftung foundation[37] shows the huge increment of hazardous waste produced in Hungary in the recent years and how it is currently treated.

In the case of the CATL Debrecen plant, **a question rises concerning the treatment of aqueous mixtures containing NMP as the NMP regeneration plant is expected to be commissioned at the end of 2025, one year after the beginning of the production.** The single environmental permit states that "**the collection of about 5 400 tons of NMP water mixture during this period will be treated by an external specialized company**. At present, two such companies have waste recovery licenses in Hungary. The preparation of a contract with a waste treatment company is under way".

The country's largest and only operational NMP recycling plant is authorized to process up to 55 000 tons of waste annually. In 2023, JWH processed nearly 48 000 tons of waste (EWC 06 03 15* and 16 10 01*) in addition to other waste types in 2023 as indicated in the article of the Heinrich Böll Stiftung foundation. The plant plans to expand its capacity to 105 000 tons per year although no timeline has been provided. When the waste treatment is outsourced, there is less insight into the operation of waste recycling and disposal companies.

Concerning scrap, any battery factory produces significant amounts of waste containing important quantities of Nickel and Lithium such as "black mass", the result of the primary battery corposants after incineration to reduce danger while its treated. As stated before (See Waste section), **there is a lack of clear identification for this hazardous type of waste although an amendment of the European will be adopted soon in line with the Battery Regulation.** Codes for lithium- and nickel-based battery wastes will make easier the handling, sorting and treatment of this wastes.

Land Occupation

Battery gigafactories such as CATL's plant have a significant physical footprint. In the case of Debrecen, the main part of the **new facilities take place in the Southern Industrial Par**k, which was already prepared to receive these types of investments. **The other facilities are being implemented on land which was previously agricultural land. Although the important impacts that this land occupation have in terms of biodiversity or carbon capture among others raise concerns, there is no direct breach.**

As previously said, **CATL gigafactory is the biggest greenfield investment in Hungary**. In comparison, CATL's first European plant in Erfurt, Thuringia, was implemented on the site of a former solar cell factory as a brownfield investment[38]. This second plant will **cover 221 hectares of land in the Southern Industrial Park of**

[37] Hidden hazards: Disinformation and waste in Hungary's battery boom

[38] CATL starts construction of its first overseas factory in Germany

Debrecen. As denounced by the NGO WWF [39], **salami tactics are being used as the authorization project was divided into phases**. For example, phase I, which is currently in progress, only covers 64,6 hectares. The zoning classification of the owned part of the site is General Economic Area, which was previously agricultural land, while the zoning classification of the leased part of the site is General Agricultural Area.

The Hungarian Chamber of Engineers issued a technical guide for environmental experts and public authorities for Li-ion battery production[40]. In this guide, **the land occupation is underlined as a primary concern, particularly in relation to soil and land quality**. It states that for such projects, it is crucial to assess the potential soil loss and determine whether high-quality arable land will be affected. It adds that planning documentation should prioritize the designation of land with lower ecological value with the minimum possible use of land. If the investment involves land of above-average quality, but the proposed activity, installation, or land use could, under similar conditions, be carried out on land of average or below-average quality, this must be clearly noted in the environmental documentation. Finally, it mentions that socio-economic impacts should be presented if arable land is lost.

Social implications

The **Hungarian authorities are providing significant support to the battery investments** including grants, tax incentives and battery investments, so far in line with EU rules. However, there are co**ncerns over the lack of industrial R&D and limited collaboration with local research institutions**. The industry's rapid expansion is expected to create **significant employment**, **though labor shortages** and reliance on foreign workers may cause social integration issues, and **public acceptance of battery factories is low**, with concerns about environmental and industrial safety risks.
There are no direct breaches.

State aid and institutional support

The Hungarian government actively supports the development of the domestic battery industry using similar strategies as in other sectors. **State aid is similar in proportion to other Eastern European countries such as Poland.** Investments, such as battery gigafactories receive state aid ranging from €100-200 million, including grants, tax incentives to reduce corporate income tax, soft loans and public infrastructure investments. Financial support for the battery industry has paid one eight of investments[41].
Most state aid granted through individual government decisions aligns with EU internal market rules. Certain large-scale battery value chain investments required authorization from the European Commission due to their magnitude. This was the case for the investment aids to Samsung SDI's[42] (€89 million) and SK On Hungary's[43] (€209 million) battery plants. For both projects the EU Commission assessed that without the public funding, the project would not have been carried out in Hungary or any other EU country, since it would have been more profitable for the companies. **The institutional support that CATL has received is significantly more substantial compared to earlier battery investments**, particularly when considering the scale of their

[39] Szalámiba csomagolt akkumulátorgyárak. WWF Magyarország
[40] A Li-ion alapú akkumulátor, illetve akkumulátor részegység gyártás környezetvédelmi hatósági engedélyezésének környezetvédelmi alapkövetelményei. Magyar Mérnöki Kamara Kiadványsorozata
[41] Czirfusz, Márton. (2023): The battery boom in Hungary: companies of the value chain, outlook for workers and trade unions. Friedrich Ebert Stiftung, Budapest.
[42] See the detail in the European Commission press release
[43] See the detail in the European Commission press release

financial commitment. Hungary provided €800 million in grants, tax incentives, and infrastructure investments to support the €7.34 billion project[44].

The government allocates also more resources indirectly through infrastructure developments for the battery industry than the direct subsidies. These may include the preparation of industrial sites as well as the construction or extension of network infrastructures (electricity, gas, water, sewage). This is the case for the Debrecen Industrial Park where the CATL plant is located, for which the government has invested €1.8 billion to prepare the site and modernize the roads and the water and sewage supply networks.

Table 6. State aid for the CATL gigafactory

Aid granting authority	Forms of aid	Date	Investment aid	Total investment
Hungarian Investment Promotion Agency	Reduced corporate tax	2023	800 M€	7340 M€

Technological transfer

The Hungarian National Battery Industry Strategy for 2030 acknowledges that to sustain and enhance the leading position that the country is taking on the battery industry, a significant qualitative leap is required: **it is necessary to switch from the product "manufactured in Hungary" to the products "developed in Hungary"**[45]. The same commitment has been communicated by the Hungarian Investment Promotion Agency (Hipa)[46].

To achieve this, close collaboration between industry and research is necessary with close geographical proximity. **Good practices include the creation of research centres close to the manufacturing plants** in addition to the development **of technological transfer through the collaboration with research institutions and universities**. The 2023 workshop report of the Hungarian Battery Association on Facts and recommendation for the development of an environmentally and socially sustainable domestic battery industry value chain signals the fact that **although companies often install high-tech and modern production capacities, there is virtually no industrial R&D activity in Hungary. In addition, there is a mismatch between academic research and industrial R&D.**

Today CATL has six R&D centres: one in Germany and five in China[47]. So far, **no plan or announcement has been made concerning the creation of a research centre in Hungary**. Nonetheless **CATL has come to an agreement with University of Debrecen to train skill professionals for the Debrecen plant**. The partnership focuses on strengthening engineering education, research and curriculum development in battery technology and industry[48].

Labour

CATL claims that the Debrecen plant will create 9 000 jobs[49]. Access to skilled labour is currently one of the main risks in the battery value chain. Meeting the high labour demand requires both a significant development and strengthening of undergraduate education and professional training.

Hungary has been experiencing a labour shortage during the last decade, the number of job vacancies is substantial among the occupational groups of professionals, machine operators, assembly workers, drivers of

[44] Csonka, Tamas. (2024): Hungary says it has attracted €24bn in battery-related investments since 2016

[45] National Battery Industry Strategy 2030. INTELLINEWS

[46] Budapest Business Journal. (2024): Hungary commits to becoming R&D centre for battery tech

[47] On details see CATL Company Profile

[48] HUNGARY today (2024) Cooperation between the University of Debrecen and CATL for skilled workforce

[49] CATL creates 9,000 jobs in Debrecen

vehicles and elementary occupations not requiring qualifications[50]. **If the battery industry is to play the role that the Battery industry strategy expects, this will certainly add tension to the labour market, and CATL and the battery industry may increase the reliance on foreign workers**. The company announced Debrecen plant will rely on local manpower as well as Chinese workers[51].

Other well-established battery factories brought in experienced professionals and engineers to transfer expertise and oversee the critical processes of starting and scaling up production. For example, Northvolt, a Swedish battery manufacturer, collaborates with various international partners including South Korean firms[52]. The Korean firm Samsung SDI has also sent support staff from its headquarters in Korea to the plant in Göd[53].

However, this dependency to foreign workers has raised concerns about social integration[54]. Hungarian labours framework allows contracts for two years for guest workers through temporary agencies. An exception is made to the so-called **Strategic Partners of the Hungarian government who can import labour directly from third countries without the involvement of a temporary agency**. Last entry of the Strategic Partners list[55] was CATL.

Social acceptability

Hungarian industrial policy has showed little effort to foster trust or achieve compromises with the civil society. As presented in the article *Hidden hazards: Disinformation and waste in Hungary's battery boom*[37], **the rapid expansion of the battery industry revealed a significant rise in hazardous waste**. The article criticises the lack of transparency and disinformation around these issues, with limited public awareness. Similarly, the article *Industrial safety risks in the Hungarian battery industry and related communication*[56] summarizes the recurrent incidents in South Korean-owned factories like Samsung SDI and SK Battery, suggesting that industrial safety risks are not adequately apprehended. At the same time, the government's communication on these risks is criticized for lacking transparency. Among other reasons, **the public has lost trust in the battery industry and acceptability of the new plans is more difficult to achieve**. Several surveys illustrate this decline of the public's acceptance:

- Survey by 21 Kutatóközpont (2023)[57]: according to this independent pollster, **62% of Debrecen's 200 000 residents were opposed to the CATL factory.**
- Nationwide Survey (February 2023)[58]: according to this public survey, **50% of the Hungarian population supported a nationwide ban on the construction of new battery factories.**

Western Hungary Survey (April-July 2023)[59]
A quantitative study with 305 respondents from Western Hungary found:

- Respondents wanted to live at an "unrealistically large distance" (150 km) from battery factories.
- 32,1% supported completely shutting down existing battery factories.
- 66,9% thought permission should not be granted to establish new battery factories.
- Less than 25% of respondents were willing to obtain information from literature about environmental hazards related to battery production

[50] 20.1.1.64. Number of job vacancies and the job vacancies rate by major occupational group
[51] Employee Care and Engagement Coordinator
[52] Dongjin breaking new ground in Skellefteå – looking for multiple skills
[53] Korean battery makers focus on maintaining overseas workforce
[54] Reindustrialisation, battery factories and Hungary's workforce gamble
[55] Stratégiai partnerségi megállapodások
[56] Industrial safety risks in the Hungarian battery industry and related communication
[57] https://21kutatokozpont.hu/wp-content/uploads/2021/11/debrecen.pdf
[58] Medián: Minden második ember szerint be kellene tiltani az újabb akkumulátorgyárak építését
[59] Hungarian Battery Production – Public Opinion on Sustainability, Labor Market and Environmental Protection

Summary for CATL

Table 7. Summary of the analysis carried out on the CATL's battery gigafactory in Debrecen

	Description	Breach
Energy demand and availability	• The energy needs of CATL's Debrecen gigafactory align with similar projects, indicating no direct breach. However, Hungary's broader goal of expanding battery production by 2030 raises concerns about energy security, as it may increase reliance on natural gas, and conflict with EU energy independence goals.	×
Water Water demand and availability	• The CATL plant in Debrecen will consume significant amounts of water, in line with other battery gigafactories, but with room for improvement.	×
Water emissions	• The lack of clear limits for NMP in effluent water poses a significant environmental concern and constitutes a breach. This omission contradicts best practices, such as precautionary and zero-emission principles, essential for environmental protection.	✓
Air emissions	• Direct breach of legislation concerns NMP emissions to air from the NMP recovery system. Hungarian authorities have applied the less stringent VM Decree 4/2011 rather than the stricter VM Decree 26/2014, which aligns with the EU Industrial Emissions Directive and sets a 2 mg/Nm³ limit for VOCs with reproductive toxicity.	✓
Scrap and Waste management	• Hungary's goal to become a battery manufacturing leader will generate substantial hazardous waste. Although waste treatment is outsourced to specialized companies, capacity constraints and limited transparency raise concerns but do not pose a clear breach.	×
Land occupation	• Battery gigafactories like CATL's in Debrecen occupy substantial land, with most facilities in an industrial park and some on former agricultural land. While this impacts biodiversity and carbon capture, no direct breach has been identified.	×
Social implications	• Hungary is supporting battery investments through grants, tax incentives and infrastructure investments aiming to quickly become a major player for battery production. • Rapid expansion faces challenges including limited local R&D, potential labor shortages and significant public opposition, but no direct breach has been identified.	×

Case study: LG Energy Solution in Wroclaw

LG Energy Solution (formerly LG Chem until 2020) plant near Wroclaw in Poland started production in 2017. LG Energy Solution (LG ENERGY SOLUTION) is now operating two stages of battery production with an annual production capacity of 85 GWh, making it the largest battery plant in Europe. The gigafactory is currently being expanded to increase the production capacity to 90 GWh in 2025[60] (third phase). Main elements and figures are retrieved from the Environmental Impact Report.[61]

Energy Demand and Availability

The **reported energy consumption** figures for Phase III of the project **raise concerns about their accuracy for both natural gas and electricity**, indicating possible omissions in energy accounting. Although **these figures require careful review for accuracy of the scope**, **there is no breach with current legislation.**

The energy consumption figures reported for Phase III of the project raise **significant questions regarding their accuracy or the perimeter taken into account.** The natural gas consumption is stated to be 60 Mm^3/year, equivalent to 633 000 MWh annually. **This figure is notably low—approximately four times lower—when compared to values reported by CATL for their factory in Debrecen, Hungary, which has a comparable production capacity**. The substantial discrepancy between these figures suggests either **an underestimation or miscalculation of the natural gas requirements** for Phase III, which should be carefully reviewed to ensure consistency and reliability.

Furthermore, **the report describes natural gas as an "environmentally friendly" or "ecological fuel"** due to its lower CO_2 emissions when compared to oil or coal. Even if natural gas generates fewer CO_2 emissions per unit of energy**, it remains a fossil fuel with a significant higher climate impact than renewable energy sources**, and nations at COP28 agreed to “transition away” from all fossil fuels in 2023.

T**he electricity consumption figures reported for the factory also appear to be underestimated**. The total consumption at full capacity is stated to be 90 MWh/year, a figure far lower than the 1 600 000 MWh/year reported for CATL’s factory in Debrecen, which operates at a similar scale. This stark difference suggests either **a possible error in the reported units or an incomplete accounting** of the facility’s total electricity consumption. Such discrepancies necessitate a thorough review to ensure that all energy demands are accurately captured and reported, reflecting the true scale of the factory’s operational needs.

[60] On details see the LG Energy Solution Wroclaw site

[61] LEMITOR Ochrona Środowiska. Raport o oddziaływaniu przedsięwzięcia na środowisko. Wroclaw: s.n., 2019. Retrieved from: https://www.eib.org/attachments/registers/129331028.pdf

Water

The **LG Energy Solution battery factory will have a significant water consumption** due to the expansion of the plant, in line with the consumption of other battery factories. The plant will produce significant amounts of wastewater, and while small amounts of **NMP** may be discharged, it **is not classified as a harmful substance, with no specific discharge limits.** NMP use increases significantly after expansion, raising concerns over environmental impacts. In conclusion, **there is a direct breach of the applicable legislation as NMP is not considered as a hazardous substance**.

Water demand and availability

Total water consumption after plant extension will be approximately 1 487 000 m^3 per year, mainly driven by the cooling systems water consumption. The water use is equivalent to 17 500 m^3 of water per GWh of batteries produced, a consumption below the average water use of other gigafactories reviewed earlier (See Water demand and availability section of the first case study), yet above the improved water consumption claimed by Verkor with its new cooling process. Thus, LG plant could align with best practices on water consumption.

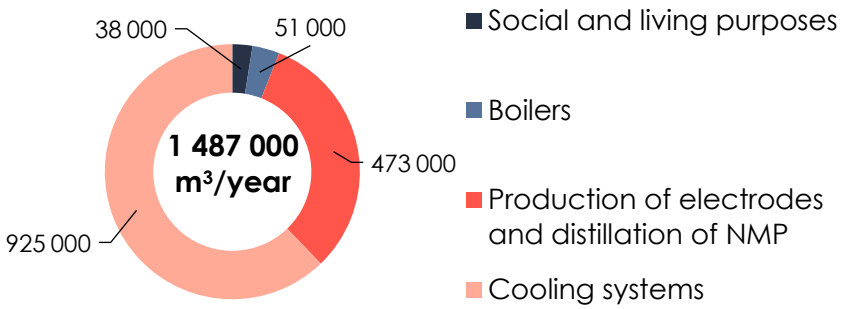

Figure 4. Total water consumption after expansion. Source: LEMITOR Ochrona Środowiska. Raport o oddziaływaniu przedsięwzięcia na środowisko. Wroclaw: s.n., 2019. Retrieved from: https://www.eib.org/attachments/registers/129331028.pdf

Water pollution

The amount of 674 300 m^3 of technological sewage is expected to be produced per year. More than 77% of the sewage comes from the cooling towers and the boilers. The remaining sewage comes from the production of electrodes and distillation and purification of the NMP at the SRP station (Solvent Recovery Plant). This last flow, which accounts for approximately 151 000 m^3/year is the most critical.

The environmental impact assessment for the third phase indicates that **wastewater from the NMP treatment process from the SRP station may contain insignificant amounts of NMP**. Nonetheless the impact assessment report does not precise NMP limits of discharge water effluents. The justification is made through the Regulation of the Minister of the Environment on substances particularly harmful to the aquatic environment, the introduction of which in industrial wastewater into sewage systems requires a water permit[62]: as this substance is not listed in this regulation, **NMP is not considered as a particularly harmful substance**. Similarly, it is not listed in the Regulation of the Minister of Construction of 14 July 2006[63], which outlines the obligations of industrial sewage suppliers and specifies permissible pollution levels for substances introduced into sewage systems. In conclusion, **while small quantities of NMP will be discharged into the sewage system, LG ENERGY SOLUTION justifies that its control and limitation are not required**, as NMP is not currently classified as a

[62] (Dz. U. poz. 1220)

[63] (Rozporządzeniu Ministra Budownictwa z dnia 14 lipca 2006)

harmful substance under the applicable regulations. However, NMP is widely recognized as a hazardous substance, as classified under REACH. This inconsistency represents a clear breach.

NMP emissions on the environment will depend greatly on the overall quantity of substance used**. Yearly mass balance indicated in the environmental impact assessment defined a yearly NMP solvent consumption of 92 tons in the existing situation and 323 tons after expansion. These figures are particularly low, even more compared to CATL Debrecen plant NMP consumption which reaches more than 50 000 tons per year** with a similar battery production output.

Air emissions

The LG Energy Solution battery factory **air emissions limits for NMP exceed the European Directive 2010/75/EU** limit of 2 mg/m^3 for VOCs with specific risk phrases, indicating a **non-compliance with EU air emissions regulations.**

SRP stations in charge of the distillation and recuperation of the NMP contain absorbers with water circulating under pressure**. Each of the absorbers has a maximum emissions of 3 ppm NMP in 1 m^3 of ejected air, which is equivalent to 13,25 mg/m^3.** Again, as explained in the Air Emissions section of the first case study, **the European Directive 2010/75/EU[64] on industrial and livestock rearing emission Part 4** emission limit value of 2 mg/Nm^3 that shall be complied with for emissions of VOCs with specific risk phrases **is not respected**.

Scrap and Waste Management

The third stage of LG Energy Solution's gigafactory expansion is expected to increase waste generation. **Battery scrap is classified as non-hazardous waste** under EWC 16 06 06, despite the associated risks requiring special treatment. The Environmental Impact Report does not address battery waste under EWC 16 02 15*, overlooking upcoming regulatory changes. **Although there is no breach of current legislation, there is a risk of non-compliance if the planned amendments are implemented in the coming months.**

As the plant undergoes its third stage of expansion, the volume of waste produced during the manufacturing process is expected to rise. Projections estimate that the investment will lead to the additional generation of approximately 38 400 t/year of non-hazardous waste and 2 800 t/year of hazardous waste. Following the expansion, **the total waste output is anticipated to reach around 77 800 t/year for non-hazardous waste and approximately 4 300 t/year for hazardous waste**.

The environmental impact assessment reports that **the battery scrap** generated after the expansion will be about 10 250 tons per year (6 000 tons from the current operation and 4 250 tons due to the plant's third phase expansion). This waste is classified under the EWC 16 06 06 (Other batteries and accumulators), and it **is accounted in the environmental impact assessment as non-hazardous waste.**

[64] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial and livestock rearing emissions (integrated pollution prevention and control)

Table 8. Battery waste codes

EWC	Name	Quantity (t/year)	Description of the waste
16 06 05	Other batteries and accumulators	6 000 + 4 250 = 10 250	Batches of non-conforming products arising from the various stages of production, including, but not limited to damaged cells, charged or uncharged cells in an Al. Pouch, charged or discharged modules, whole charged batteries (trowels) not conforming to requirements. Composition: plastics (e.g. polyethylene, polypropylene, etc.), metals (e.g. copper, aluminium, etc.).

This classification is allowed by the EU legal framework as within the European Waste Catalogue, there is no specific code assigned to lithium-ion batteries. **However as described in the Scrap and waste section, battery scrap is dangerous and should be treated as hazardous waste**. Consequently, Li-ion battery waste will require special handling, treatment, and disposal procedures to mitigate these risks. The current Environmental Impact Report does not account for any waste classified under EWC 16 02 15*, suggesting that all battery waste is currently being managed—and is intended to continue being managed—as non-hazardous waste. **This approach does not appear to anticipate the implementation of the Battery Regulation nor the amendment of Commission Decision of 3 May 2000** (2000/532/EC).

Other hazardous waste is accounted under EWC 16 10 01* (Hydrated liquid wastes containing dangerous substances). A total of 2 600 tons of water containing dangerous substances (mainly water containing NMP) will be generated each year. The Environmental Impact Report states that wastewater will be sent to an external facility for processing. LG ENERGY SOLUTION is considering BASF in Ludwigshafen and Jae Won Hungary, among others. **The choice of the Hungarian treatment facility would exacerbate the critical situation exposed previously** (See Scrap and Waste Management section).

Land Occupation

The LG Energy Solution plant will expand to approximately 81.3 hectares within a designated economic activity zone, but **its size remains smaller than comparable battery gigafactories like CATL**, **highlighting a potential discrepancy in development** scope. **There is no breach of current legislation.**

The plant covers an area of about 76 hectares. The new development will occupy an area of approximately 5,7 hectares. **The target area of the entire plant development will take approximately 81,3 hectares**. **This surface is much lower compared to CATL and other battery gigafactories, signalling again a possible discrepancy in the scope that has been taken into account.**
The investment plot is situated in an area designated as an economic activity zone in the current Local Spatial Development Plan. **This area is primarily intended for the development of production facilities, warehouses, and storerooms, as outlined in the plan**.

Table 9. Battery gigafactories land occupation

Gigafactory	Land occupation per GWh (ha/GWh)
LG Energy Solution	0,7
CATL	2,2
ACC	3,7[65]
Verkor	5[66]

Social implications

LG Energy Solution **has received several state aids and EU funding**. The company intends to **establish technological transfer** by the creation of the Electromobility Research Center at Politechnika Wroclawska and launching several internship programs. Although challenges remain in retaining talent the company is a major employer in the region.

State aid and support

In the same way as with the state aid for the Hungarian battery factories, **LG Energy Solution also received €36 million[67] and €95 million[68] state aid which has been approved by the EU Commission.** The investigation by the Commission revealed that without the €95 millions of Polish support, LG Energy Solution would have chosen to invest outside the EEA due to the subsidies provided by the third country, as the investment would have been more economically feasible there. **LG Energy Solution also received financing for an amount of €250 million for a total project cost of €1 billion from the European Bank for Reconstruction and Development (EBRD)[69].**

Table 10. State aid for the LG Energy Solution gigafactory

Aid granting authority	Forms of aid	Date	Investment aid	Total investment
• Ministry of Economic Development and Finance • Agencja Rozwoju Przemysłu	• Non-refundable cash grant	2017	36 M€	315 M€
	• Sale of land and related infrastructure at preferential price • Corporate Income Tax exemption • Real Estate Tax exemption	2019	95 M€	1040 M€

[65] Dossier de demande d'autorisation environnementale. Automotive Cells Company SE.

[66] Autorité environnementale. N°Ae : 2022-115. Avis délibéré de l'Autorité environnementale sur le projet Verkor de fabrication de cellules et de modules de batteries électriques sur les communes de Bourbourg et Craywick (59). (2022)

[67] See the detail in the European Commission press release

[68] See the detail in the European Commission press release

[69] See the detail in the Project Summary Documents

Technological transfer

LG Energy Solution has worked to enhance exchange of knowledge and to integrate the region's academic and research fabric. Firstly, LG Energy Solution has invested in the **development of the Electromobility Research Center at Politechnika Wroclawska[70] dedicated to electromobility**. **However, no R&D centres have been established in Poland.** In 2023 **the internship program "Charge the Future" was launched for Polish university students**. As part of this 3-month paid internship, students can take their first steps on the job market under the supervision of an experienced LG Energy Solution Wrocław employee and thus validate their student internship[71].

This year marks the graduation of the first class of electromobility engineers (undergraduate level) from Politechnika Wrocławska. During an interview with a member of the Electromobility Research Center, it was noted that **the institution is struggling to motivate students to pursue master's studies**. This is because the undergraduate engineering degree alone is highly sought after in today's job market, where there is a **strong demand for engineers in Poland.** In the region, **several recruiters compete for talent**, including Polish companies as well as global players such as Mitsubishi, Siemens, and LG Energy Solution. These companies often offer **salaries that are sometimes more competitive than those of LG Energy Solution**. Furthermore, the electromobility engineering program includes training in programming, which leads **many graduates to transition into the IT sector**, where salaries tend to be even higher. This situation has created significant salary competition in the region. Thus, **the implementation of foreign companies in Poland contribute positively to employment and technological transfer, although this does not benefit exclusively the electromobility sector** nor LG Energy Solution.

Labour

Kobierzyce, where LG Energy Solution plant is located, is one of the wealthiest municipalities in Poland[72]. It owes much of its prosperity to the significant investments by LG Energy Solution as **the company has become one of the largest employers in the region, providing jobs for over 9 500 people**[73] and fostering strong partnerships with the local authorities.

The rapid implementation of the first plant in Biskupice Podgórne which took only 5 years was made possible by experienced engineers from South Korea but also through Polish engineers, who then played an important role in the expansion of LG Energy Solution production plants in the United States[74].

Social acceptability

In the case of LG Energy Solution, **the company seems to be enjoying a certain degree of social acceptability among the community**, at least without a strong opposition[72]. Its better social acceptability than in Hungary may be linked to the fact that LG is the only significant battery manufacturing in Poland, whereas in Hungary five plants projects are already undergoing, with potentially others to be added.

[70] See more in LG Energy Solution Wrocław wspiera studentów. Koreańczycy fundują profesjonalne Laboratorium Elektromobilności

[71] LG Energy Solution (2023). Innowacyjne Laboratorium Elektromobilności na Politechnice Wrocławskiej

[72] Gross domestic product (GDP) at current market prices by metropolitan region

[73] Elektromobilnosc kluczem do rozwoju gospodarczego Polski, 2023

[74] Jak wygląda praca w LG pod Wrocławiem? Zajerzeliśmy do gigafabryki

Summary for LG Energy Solution

Table 11. Summary of the analysis carried out on the LG Energy Solution's battery gigafactory in Wroclaw

	Description	Breach
Energy demand and availability	• The energy consumption figures for Phase III appear inaccurate, with natural gas and electricity usage reported as much lower than similar factories, suggesting possible underestimation. • Describing natural gas as "environmentally friendly" oversimplifies its impact.	×
Water Water demand and availability	• Expansion of the factory will result in significant water usage and wastewater generation, in line with other gigafactories consumption.	×
Water emissions	• While small amounts of NMP may be released, this solvent is not considered as a harmful substance, which raises environmental concerns. Despite these issues, the wastewater handling does not violate current regulations.	✓
Air emissions	• The LG Energy Solution battery factory's air emissions for NMP exceed the EU Directive 2010/75/EU limit of 2 mg/m³ for certain VOCs, indicating non-compliance with EU air emissions regulations.	✓
Scrap and Waste management	• Increase in waste generation, with battery scrap classified as non-hazardous waste despite requiring special handling, poses a risk of non-compliance in the light of forthcoming regulatory changes.	×
Land occupation	• Although the size of the installations (81,3 ha) remains smaller than other similar gigafactories, suggesting potential underestimation, the development complies with current legislation.	×
Social implications	• LG Energy Solution, supported by state aid and EU funding, is fostering technological transfer through the Electromobility Research Center and internships, while serving as a major regional employer despite talent retention challenges.	×

Part 2: Chinese European alliances in battery production

Development of Electric Vehicles in Europe - Overall Context

To reach its climate neutrality goal by 2050, the European Union is taking action to reduce emissions from cars, as road transport accounts for one fifth of the EU's CO_2 emissions. This will include reducing emissions from new cars by 55% and from new vans by 50% by 2030, compared to 2021. The EU also aims to reach the goal of zero emissions from new cars and vans by 2035, meaning vehicles cannot emit any carbon dioxide (CO_2). This is to ensure that by 2050, the transport sector can become carbon neutral.[75]

To comply with the above schedule, European carmakers need to shift their production - currently mainly focused on vehicles equipped with a thermal engine, towards electric vehicles, as this is the only mature technology that guarantees zero CO_2 emissions from combustion.

The shift to 100% electric car production by 2035 requires carmakers to find an adequate supply of electric batteries, in both volume and price.

Challenges Europe faces in developing a battery industry

According to a report published in 2023 by the European Court of Audit (ECA)[76], "In 2018 (…) the Commission designated batteries as a strategic imperative for the EU's clean energy transition and launched an action plan aimed at making Europe a global leader in sustainable battery production and use". In its report, the ECA "assessed the relevance of that plan, its implementation, and the results achieved [to] date", focusing in particular, on the significant funding planned to help develop the sector, such as the Horizon programme: EUR 80 billion between 2014 and 2020, and EUR 100 billion from 2021 to 2027, or the Innovation Fund which has financed eight mature projects in the field of electric batteries, to the tune of EUR 161 million.

In its conclusions, the ECA praised the EU for understanding the importance of developing a strong battery manufacturing industry in Europe, integrating as much as possible of the value chain. However, it voiced some concerns on how the Commission monitors EU production of battery cells: "Eurostat [in 2023] gives figures on quantities (units) of batteries produced regardless of their energy capacity in watt-hours (Wh), which is the essential market indicator. In the absence of actual data from manufacturers, the Joint Research Centre could only estimate the 2021 production of lithium-ion battery cells (16 GWh (gigawatt hours)), based on assumptions and related variables. The EU's production capacity, cited in each of the Commission's Clean Energy progress reports and commonly shown in several other sectorial publications, is based on manufacturers' announcements, which are often withdrawn and are not independently verified".

[75] European Pariament (2022). EU ban on the sale of new petrol and diesel cars from 2035 explained

[76] European Court of Auditors (2023). Special report 15/2023: The EU's industrial policy on batteries – New strategic impetus needed

As a result, the European Court of Auditors considers that "the lack of up-to-date and comprehensive data limits the Commission's ability to monitor the competitiveness of the European value chain". Based on this assumption, the ECA fears two things: firstly "a possible inability of the European battery industry to reach the planned production capacity, and to offer a cost-competitive alternative to internal combustion engines. This could lead to a prolongation of emissions from internal combustion engine vehicles, which would be a failure to achieve the carbon neutrality objectives of the Green Deal", and secondly that "the transition to a zero-emission vehicle fleet [could] largely rely on imported batteries and electric vehicles, to the detriment of the European automotive industry".

European battery manufacturers have, in fact, invested massively in R&D to produce car batteries, with the support of the EU and other stakeholders like the carmakers. However, they have chosen to focus on a technology based on *Lithium nickel manganese cobalt oxide batteries* (NMC), that provide greater autonomy than the *Lithium iron phosphate batteries* (LFP) but remain expensive. To date, these European players are experiencing industrial and financial difficulties, like Northvolt (which went bankrupt), or ACC, which halted two of its three gigafactory projects.

Faced with the need for actionable solutions to equip their electric vehicle fleet with batteries, European carmakers had to turn toward Asian producers: Koreans, Japanese and Chinese. According to a note from the Direction Générale des Entreprises (DGE) - a French government department under the Minister of Economy and Finance[77], "Demand for batteries in Europe has fuelled a sharp increase in imports. Driven by the needs of the automotive industry, European battery imports will reach nearly EUR 27 billion in 2023, a sharp increase since 2021. Given the highly concentrated nature of battery production, around 90% of battery imports come from just three Asian trading partners, including China, which alone accounts for 87% of European imports."

While the DGE reckons that "European battery production has increased significantly in recent years, [it is] partly due to the establishment of non-European players in Europe. This increase in production is partly explained by the establishment of large non-European companies: LG in Poland, CATL, Samsung and SK Innovation in Hungary, Tesla in Germany (…). Ultimately, 75% of existing European production capacity comes from Korean companies, with LG's plant in Poland alone accounting for half of this capacity (International Energy Agency (IEA, 2024))".

"The EU's battery production covers around half of its needs (55% in 2023). According to the IEA, in terms of installed production capacity, the EU would currently be able to equip 80% of the electric vehicles produced in Europe (…) However, the battery industry's dependence is growing with the demand for electric vehicles. In particular, the majority of the active materials needed to produce these batteries come from China."

China - the leader in battery production

China adopted a policy of developing electric vehicles as early as 2011. It has thus accumulated a considerable lead in terms of R&D and control of industrial production. A recent study released by the IEA[78] indicates that "battery production in China is also more integrated than in the United States or Europe, given China's leading role in upstream stages of the supply chain".

IEA further states that "China represents nearly 90% of global installed cathode active material manufacturing capacity and over 97% of anode active material manufacturing capacity today", meaning that China currently dominates the production of key components for lithium-ion batteries (negative and positive terminals). China's closest

[77] Madlie Ericher, Florian Gache, Valérie Petat (2024). Déploiement de l'électromobilité : comment développer l'offre européene de batteries ?

78 International Energy Agency (2024). Global EV Outlook. 2024. Trends in electric vehicle batteries

competitors for cathode active material manufacturing were Korea (9%) and Japan (3%). China represents "almost 100% of the LFP production capacity and more than three-quarters of the installed lithium nickel manganese cobalt oxide (NMC) production capacity".

According to the European Parliamentary Research Service (EPRS)[79], Chinese EV firms "owe their competitive edge to government support and incentive policies that began two decades ago when the EU car industry was still focused on internal combustion engine vehicles:

- Chinese R&D investment objectives into battery electric vehicles (BEV) were integrated into the 10th 5-year plan (2001-2005) and the 11th 5-year plan (2007-2010),
- Speeding up BEV development became one of the priorities of the 12th 5-year plan (2011-2015) and the EV industry was identified as one of the seven strategic emerging industries,
- The 2015 "Made in China 2025" strategy includes BEVs as one of 10 strategic industries in which China seeks global leadership by 2049, with 80% of BEV to be made in China by 2025.

Since 2009, China has used a variety of subsidies to scale up BEV production, boost market penetration, build a BEV charging station infrastructure and achieve global leadership. China's early 2000s 'going out policy' to acquire overseas mining assets (…), and its 2013 flagship Belt and Road Initiative helped China reach a dominant position in cobalt and lithium refining that it can now leverage."

According to a publication from June 20, 2024, by the Centre for Strategic and International Studies (CSIS)[80], China's current position on the electric batteries sector is largely due to high subsidies in different forms which lasted over a decade: i.e., buyer's rebates, sales tax exemptions, infrastructure financing, R&D funding and government procurement.

The level of subsidies granted by Chinese authorities to its EV sector is uncertain, as there is a lack of consistency in the official figures. "If one used the [Chinese] State Tax Administration (STA) reported figure for 2023, total state support combining the five [above mentioned] categories would be $22.9 billion, just over half the [CSIS] estimate of $45.3 billion. For 2022 the respective totals would be $28.6 billion instead of $45.8 billion. The best way to resolve questions of data accuracy would be for Chinese authorities to provide a more comprehensive reporting on data for the various elements on an annual basis dating back to 2014".

Even considering the lower end of the subsidies range (STA's figures), the amounts would still be conservative as they do not account for other means of help granted to the Chinese EV producers:

- Local rebate programmes (despite the recent decision to stop the national buyers' rebates, Shanghai, Shenzhen and others have created their own incentive programmes),
- Low cost of land, electricity, and credit,
- Direct investments by local / provincial governments in EV companies to bolster a local champion (like the acquisition of a 17% stake in NIO by the Hefei municipal government in 2020, in exchange for RMB 5 billion (~EUR 668 million),
- Subsidies to other players in the value chain like mining companies.

CSIS considers that "the cumulative effect of 15 years of state support, combined with the likelihood that available data does not account for other elements of industrial policy aid, would result in a higher subsidy rate as a proportion of overall sales and per vehicle, as acknowledged by the Chinese authorities. Furthermore, after all this time, there are 200 EV producers in China, who have collectively created far more capacity than

[79] EU anti-subsidy probe into electric vehicle imports from China. Epthinkthank. European Parliament.
[80] The center for strategic and international studies/CSIS is a bipartisan, nonprofit policy research organization dedicated to advancing practical ideas to address the world's greatest challenges

the domestic market can bear. Production has expanded rapidly leading to growing inventories. As a result, firms have engaged in a bitter price war at home and expanded efforts to promote exports".

According to IEA, "In 2023, excluding portable electronics, China used less than 40% of its maximum cell output. Installed manufacturing capacity for cathode and anode active materials was almost 4 and 9 times greater than global EV cell demand this same year".

CSIS reckons that "despite the extensive government support and expansion of sales, very few Chinese EV producers and battery makers are profitable. In a well-functioning market economy, firms would more carefully gauge their investment in new capacity, and the emergence of such a sharp gap between supply and demand would likely result in industry consolidation, with some mergers and acquisitions, and other poorly performing companies leaving the market entirely".

The article's author, Scott Kennedy, Senior Adviser and Trustee Chair in Chinese Business and Economics, considers that "the endurance of these subsidies is unlikely part of an intentional plot for global domination of this industry [by China] but instead a by-product of China's inefficient industrial policy system in which support typically extends too long and is spread overly widely".

At any rate, "in this context, given Chinese EV makers' scale and reach, it is difficult for other countries' producers who face tighter budget constraints, to effectively compete" concludes CSIS.

In the face of strong Chinese competition, the EU is taking steps to protect its market

In the context described above, China has become the biggest exporter of EV cells, cathodes and anodes globally. The same situation applies to EV sector, which is also experiencing an overproduction as China tries to export to Europe posing a real risk to European (and American) carmakers.

Against this backdrop, on 4 October 2023, the European Commission published "a notice of initiation of an anti-subsidy proceeding, concerning imports of new battery electric vehicles designed for the transport of persons originating in China. This investigation sought to determine whether BEV value chains in the country benefit from illegal subsidisation and whether this subsidisation causes or threatens to cause economic injury to BEV producers in the European Union"[81].

"On 4 July 2024 the Commission imposed provisional countervailing duties on BEV imports from China. The investigation found that the BEV value chain in China benefitted from unfair subsidisation, which was causing a threat of economic injury to EU BEV producers. Member States endorsed the proposal on 4 October, which was formally adopted by the Commission on 29 October 2024"[82].

Tariffs on imports of Chinese EVs came into force on 30 October 2024. They are less punitive than those from the United States or Canada (which are 100% on EVs and electric batteries). "EU tariffs are levied according to the company, and cover EVs only. For example, EVs produced by China's Shanghai Automotive Industry Corporation will face the highest rate, 35.3%, and those made by the firms Geely and BYD face tariffs of 18.8% and 17%, respectively. These are in addition to the 10% tariff the EU already imposes on all car imports"[83].

[81] EC's anti-subsidy investigation into imports of battery electric vehicles (BEV) from China – European Sources Online
[82] Ibid.
[83] The EU's approach to tariffs on Chinese electric vehicles (International Institute for Strategic Studies)

The decision to impose tariffs to Chinese EVs has not been unanimous in the EU. Ten countries voted in favour (Italy, France, Poland, the Netherlands, Ireland, Latvia, Lithuania, Estonia, Bulgaria and Denmark), five voted against (Germany, Hungary, Slovenia, Slovakia and Malta), the rest abstained.

We note that the countries opposed to customs tariffs are also those which have the strongest links with China (either because they export there, like Germany, or because they have developed a policy of co-development with the Chinese).

It is also worth noting that, unlike North America, the tariffs were placed on electric vehicles, not batteries. That's because the EU wants to protect its carmakers but needs Chinese battery technology to reach its goal of 100% zero-emission cars by 2050.

However, the EU implemented a new regulation to impose new norms on batteries of all types, including EV batteries. The new Batteries Regulation[84] was enacted on 28 July 2023. According to King & Spalding law firm[85], "this was a long-awaited text, presented for the first time by the EU Commission in late 2020 and subject to negotiations since then. It contains a comprehensive legal framework addressing the entire life cycle of batteries, from their manufacturing to end-of-life disposal (…). The new regulation contains specific provisions for each type of battery. Notably, the EV batteries category is being enshrined for the first time in EU law, reflecting Brussels' desire to tailor a regime for this specific automotive category".

King & Spalding depicts the Batteries Regulation as particularly long and complex as it covers many aspects and addresses a wide range of stakeholders. In a nutshell, the composition of a battery placed on the EU market is subject to stricter requirements:

- Restriction of the use of hazardous substances in batteries is strengthened,
- Recycled content must be incorporated in batteries,
- Electrochemical performance and durability parameters are set out,
- Improve the collection and recycling of batteries,
- Greater transparency and communication requirements for manufacturers or importers.

All these requirements make it more complicated to directly import battery packs from China, as they need to comply with the EU Batteries Regulation.

The market for battery packs is a local one…

The market for electric vehicles and battery packs is anyway largely a local one. According to CEPII[86], the average distance between the producer of the battery pack and the producer of the electric vehicle is just 683 km. Germany, for example, is the biggest importer of batteries in the EU, worth EUR 21 billion, but 62% of its imports come from producers based in Europe, particularly Poland and Hungary. This proximity between battery pack assembly and vehicle assembly is partly explained by the high costs and risks involved in transporting battery packs, which means that most imports from outside the EU are cells that are then assembled on the continent. It can also be explained by the fact that battery design is highly dependent on the car model (Thémas DGE[87]).

[84] Regulation (EU) 2023/1542 of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries

[85] King & Spalding. New European batteries regulation has been adopted

[86] CEPII stands for Centre d'Etudes Prospectives et d'Informations Internationales. This is a leading French centre for research and expertise on the world economy. Website: CEPII - Mission

[87] Les Thémas de la DGE N°23, October 2024 released by the French Ministry of Economy, Finance and Industry, see Thémas de la DGE N°23 - Déploiement de l'électromobilité : comment développer l'offre européenne de batteries ?

IEA still expects battery production to remain close to EV demand centres through 2030, although this was based on early 2024 figures, before a series of announcements about postponed or cancelled projects for European battery producers and carmakers, as well as difficulties registered by others (such as Northvolt).

…so, to enter new markets, Chinese battery producers must establish local production.

The presence of China's battery manufacturers beyond Chinese borders is only just beginning. Their initial reluctance to locate production capacity in Europe or the US may be due to the authorities' initial desire to maintain China's technological lead in battery manufacturing over other major players, by keeping the IP and expertise outside the competitors' reach.

For a while, Beijing was able to consider conquering the European and American EV markets with exports of finished vehicles, through companies like BYD, but it has been faced with barriers to entry, for example, the EU tariff increase and the US Inflation Reduction Act that promotes home built EV over imported ones, and thus blocked from selling its overproduction of cars.

With a saturated domestic market and no, or limited perspective, of selling via exports of finished vehicles, China's battery producers seem to be contemplating the possibility of locating part of their productions abroad, and notably in the EU. The three largest producers – CATL, BYD and Gotion, which account for nearly 50% of the Chinese domestic capacity, are now developing their own alliances and strategy to invest near their clients' factories.

There are several options open to Chinese battery producers wanting to invest in the EU:

- Creation of a local subsidiary in a European country,
- Acquisition of a local battery manufacturer,
- Signing a licensing agreement with a local battery manufacturer,
- Establishing a joint venture with a local battery manufacturer or carmaker,
- Forming an alliance with a European partner, either by investing in their company or inviting them to invest in theirs (that of the Chinese battery producer).

The choice depends on the policy and guidelines determined by the Chinese government as well as operational factors.

The Chinese government's reluctance to allow money to leave China

According to a strategy manager working for a European battery producer, "The Chinese government is putting strong pressure on domestic companies to keep capital within China. Authorities are urging firms to slow down foreign investments, encouraging foreign companies to invest in China instead, and bring cash into the country". On the other hand, setting up subsidiaries abroad requires capital expenditure (capex). "There is an element of control over funds leaving the country through the overseas direct investment department. Even CATL, the oldest and largest Chinese company in the electric battery sector requires authorisation before using its war chest to invest in Europe".

This is consistent with the opinion of a regulatory expert for a car manufacturer who noted that, "The Chinese government is trying to limit foreign investments in battery producers in the EU (opening plants), because it

would rather have Europeans buying Chinese cars or battery packs produced in China, instead of helping them to equip their vehicles with Chinese LFP batteries, and then compete with Chinese carmakers."

Establishing a joint venture helps reduce capital outflow, as the local European partner can cover capex, while the Chinese firm contributes technology and their know-how.

The Chinese authorities' desire to protect the technological edge of domestic battery producers

According to Bloomberg (13 September 2024), "The Chinese ministry of Commerce held a meeting with more than a dozen automakers. [During this meeting, it] strongly advised carmakers to make sure advanced electric vehicle technology remains in the country, even as they build factories around the world to escape punitive tariffs on Chinese exports (…). Beijing is expected to encourage Chinese automakers to export knock-down kits to their foreign plants, meaning key parts of a vehicle would be produced domestically and then sent for final assembly in their destination market."

This appears to be a tightening of the Chinese authorities' stance following the introduction of customs tariffs on imports of electric vehicles (in Europe), and even electric batteries (in North America). No laws or regulation has been enacted to restrict overseas investments by Chinese electric battery or electric vehicle producers.

Conversely, a former Peugeot executive notes that, "In China, the New Energy Vehicle (NEV) regulations dating to the 2000s required that a Chinese partner hold a controlling majority stake of at least 51% in joint ventures, while foreign investors were limited to a minority stake of no more than 49%. Additionally, Chinese companies were encouraged to leverage the intellectual property of their European partners."

Challenges faced by Chinese companies in achieving the same productivity levels in Europe as in China

According to a strategy manager working for a European battery producer, "Reports indicate that Chinese battery producers are struggling to replicate the performance of their Chinese factories in their wholly owned European subsidiaries. Operating a factory in Europe differs significantly from China, particularly in terms of workforce management and HSE (Health and Safety Executive) standards. Chinese companies must comply with EU regulations and standards, which is not always the case, posing legal risks in the event of inspections."

Requirements for technology transfer when investing in Europe

There has long been a disparity between the investment conditions for Europeans in China and for Chinese investors in Europe. Due to the EU's commitment to fair treatment, Chinese companies investing in the EU have never been restricted to minority stakes in joint ventures, while the opposite was true for European firms investing in China. As a result, Chinese companies have almost exclusively held majority stakes in their EU joint ventures and have even been able to acquire European companies entirely, along with their patents.

To date, while some regulations have been in place to protect the intellectual property of foreign investors In China, the reality has been very different. Local bureaucracies or state-owned companies often explicitly or

implicitly, imposed informal requirements for technology transfers when establishing a joint venture or partnership with a European investor.

Conversely, so far, Europe has not imposed technology transfer requirements on Chinese companies investing in the EU.

According to an article from the Financial Times dated 19 November 2024[88], this may change as Brussels is "planning to force Chinese companies to transfer intellectual property to European businesses in return for EU subsidies, as part of a tougher trade regime for clean technologies. New criteria requiring Chinese businesses to have factories in Europe and share technological know-how, will be introduced in December when Brussels invites bids for a EUR 1 billion grant programme to develop batteries, according to two senior EU officials (…) The requirements, while on a much smaller scale, echo China's own regime, which pressures foreign companies into sharing their intellectual property in exchange for access to the Chinese market. The criteria could be subject to change ahead of the tender, officials said."

If confirmed, this shift in the EU's position, would mark a departure from its previous policy of urging China to ease restrictions on foreign investment. These negotiations have gradually led Beijing to allow the establishment of companies in China that are majority, or even entirely, foreign owned.

General framework of current EU-Chinese cooperation

According to the China Europe International Business School, the Chinese-EU JVs appear to be aimed at driving the electrical transformation of established European carmakers and expanding the global footprint of emerging Chinese battery manufacturers. They seek to do so by combining the funds, brands, and distribution channels of the former with the technology of the latter.[89]

Illustrative of this point is a study commissioned by the Association of German Mechanical and Plant Engineering in 2014,[90] in which Chinese machinery manufacturers reported that their primary motivations for cross-border acquisitions or investment are:

- Gain technology and R&D capabilities,
- Acquire qualified and experienced staff,
- Use established brands to improve global reputation,
- Widen product portfolio,
- Enter new markets.

In addition to these global trends, Chinese battery producers as well as European car manufacturers have specific strategies that meet their own needs and consider their market situation and constraints.

According to a 2022 report published by the European Trade Union Institute, "different strategies are being pursued by European original equipment manufacturers (OEMs) to capture and control shares of the battery value chain. At one end of the spectrum, a company may control the entire value chain from raw material extraction to pack integration. At the other end of the spectrum, a company might outsource all previous steps

[88] Financial Times (2024). EU to demand technology transfers from Chinese companies
[89] How can China and Europe cooperate in the auto industry? | CEIBS
[90] Impuls Stiftung. Implications of Chinese competitor strategies for German machinery manufacturers

and focus only on vehicle integration. In between, partial control of the value chain is achieved by entering into partnerships and joint ventures."[91]

The report cites BYD, Tesla and Volkswagen as examples of companies seeking full control over the value chain by manufacturing cells, modules and packs. While Stellantis and Daimler seek partial control by creating JVs with battery producers or outsourcing the manufacturing of modules and packs, and BMW or Volvo are also willing to have less control over the value chain by creating JVs with battery producers or outsourcing the manufacturing of packs.

[91] Wolfgang Schade, Ines Haug, Daniel Berthold. European Trade Union Institute (2022). The future of the automotive sector. Emerging battery value chains in Europe.

Case study Volkswagen - Gotion - InoBat

Gotion and Volkswagen – Legal framework

A strategic collaboration between Gotion and Volkswagen

The Volkswagen group and Gotion High-Tech Co., Ltd. entered a strategic cooperation framework, based on a substantial shareholding agreement: in May 2020, Volkswagen invested around EUR 1.1 billion and became the majority shareholder in the Chinese battery cell manufacturer, holding 26.47% shares.[92] According to Gotion's first semester 2024 Report, Volkswagen (China) Investment Co., Ltd. (Volkswagen China) directly holds 440,630,983 shares of Gotion High-tech Co., Ltd (Gotion High Tech), accounting for 24.60% of the total shares of Gotion High-tech.

The shareholder agreement was signed in 2020 between Volkswagen China, Zuhai Gotion Trading Co. (Gotion holding), Li Zhen and Li Chen[9393] (the main founder of the Gotion group and his son respectively). This document states that for 36 months, Volkswagen China will irrevocably relinquish the voting rights of some of its shares, ensuring that the German group's voting power remains at least 5% lower than the total voting rights held by the founding shareholders (Gotion holding, Li Zhen and Li Chen). This limitation on voting rights was due to expire on 28 May 2023. We have not identified information on the current status of Volkswagen's voting rights in Gotion High-Tech (it is likely they have returned to normal). This agreement on voting rights goes along with the comments of an engineer and trade unionist from IG Metall (Germany's largest union): "Volkswagen was somewhat at the mercy of Gotion during negotiations on its investment, as the Chinese group had other potential partners, giving it a stronger negotiating position. This likely limited Gotion's commitments to technology transfers. On the other hand, the benefits for Gotion of having Volkswagen as a reference shareholder are clear".

Operationally, the partnership between Volkswagen and Gotion includes securing priority supply of Gotion batteries for European Volkswagen factories, produced in the gigafactories currently being built in the EU. One of these factories is under Gotion's full control in Göttingen, and another is in a JV with InoBat in Slovakia (see below). Gotion will also assist Volkswagen in developing a battery cell factory in Salzgitter, set to begin production in 2025, and will be fully controlled by the German group.

According to a German economist, "Volkswagen's investment in Gotion and the technology transfers were likely two sides of the same coin in the agreement between the firms. The issue is that there is no single opinion on how broad the scope of expertise and technology transfer will be. Neither the European Commission nor the German government enforces technology transfers from the Chinese side 'as a rule', and this does not operate in the same way in Europe as it did in China in the past. In the context of the suspension of government subsidies intended to help citizens acquire electric cars, and the resulting decline in interest in EVs, the shrinking market in China and the threat of factory closures, some sources in the automotive industry remain sceptical about what Gotion has committed to in Germany. However, the fact that Volkswagen has become a significant co-owner of Gotion changes its perspective and the scale of potential cooperation".

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[92] Volkswagen Group (2021). Volkswagen Group and Gotion High-Tech team up to industrialize battery cell production
Teslamag (2023). Chinesische Elektroauto-Akkus aus Göttingen: VW-Partner Gotion meldet Start von Produktion
Teslamag (2022) Entwicklungshilfe aus China: VW-Partner Gotion will in Göttingen Batterien produzieren
Elecdrive (2021). VW is now majority owner of Gotion High-Tech

[93] 2024 H1 Report, page 114, https://static.cninfo.com.cn/finalpage/2024-08-29/1221032673.PDF

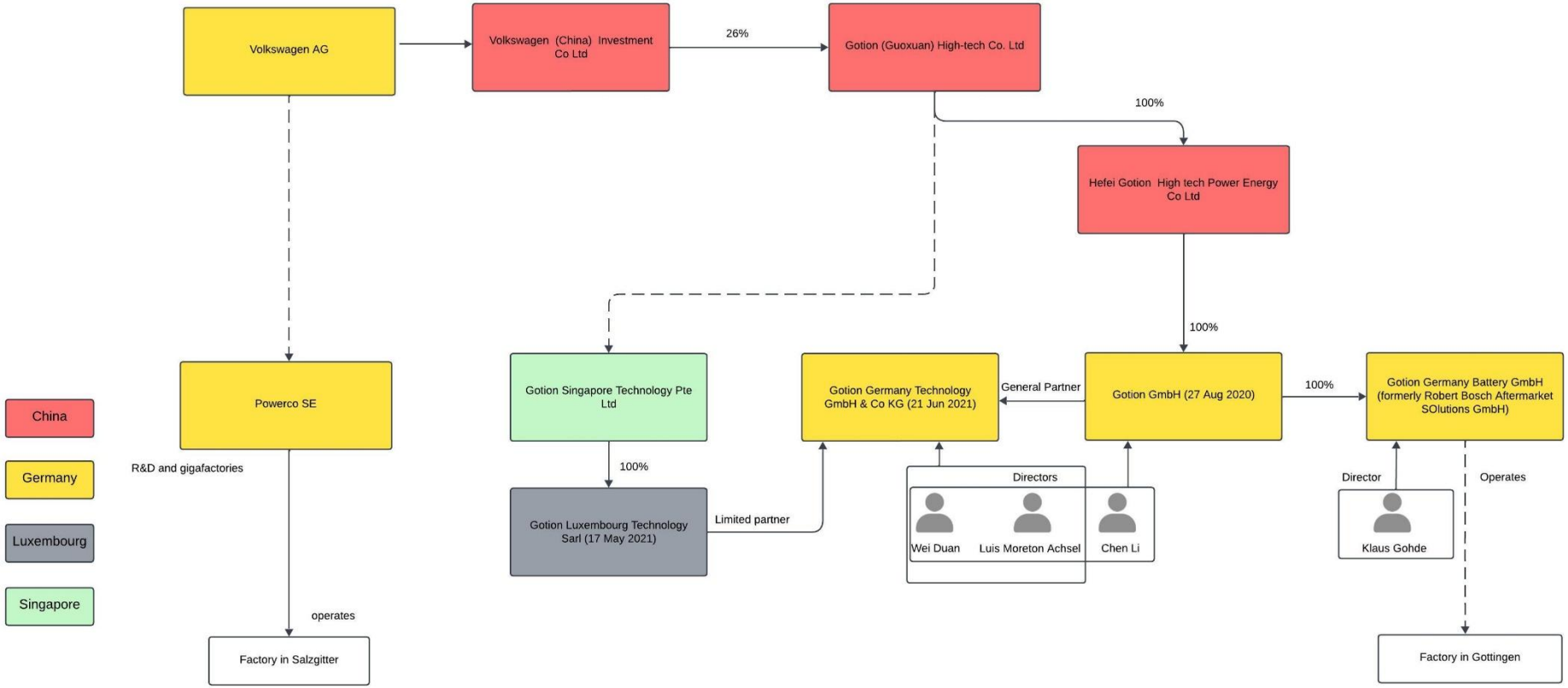

Figure 5. Ownership structures between Volkswagen and Gotion

Non-JV cooperation avenues between Gotion and Volkswagen

The Salzgitter plant (PowerCo/Volkswagen-Gotion)

According to a 2021 press release by the Volkswagen (VW) Group, VW and Gotion High-Tech are collaborating to "industrialize battery cell production in Germany". Gotion High-Tech is described as the "technology partner" for a planned battery cell factory at the Volkswagen Group component plant in Salzgitter, where it will design and manage the cell factory layout, machinery, and production processes.[94] In addition, it will support the pilot production lines for new battery cells and the establishment of recycling capabilities at the Salzgitter plant.[95] The production is scheduled to start in 2025.

Gotion High Tech had to leverage its patents to support the Volkswagen Group's electrification strategy and entered into an exclusive agreement with Volkswagen to supply EV batteries outside of China.

According to a German analyst who had contacts with former Volkswagen managers, "one cannot be certain that the deal with Gotion in Salzgitter guarantees full technology transfers. Partial for sure, but to what extent it is not yet known. In this factory, the decision-making advantage appears to lie with Volkswagen, but one of the contacts considers this to be an illusion. In the past, some manufacturers seemed to have the advantage in decision-making, but when the Chinese side chose to temporarily disrupt the supply chain, the European manufacturer was left helpless. No one can guarantee that the same will not happen in Salzgitter until Volkswagen and other European manufacturers catch-up with the more technologically advanced Chinese car manufacturers".

The Salzgitter gigafactory is part of PowerCo, the entity through which the Volkswagen Group consolidates its global battery activities. PowerCo aims to produce around 80% of the battery cells needed by the Volkswagen Group. The targeted was an annual production capacity of 40 GWh, enough to power half a million electric vehicles.

There was room, in the Salzgitter plant, for two production lines, and only one is currently under construction[96], with a capacity of 20 GWh. Volkswagen stated that it aims to adapt to the slowdown in demand for electric vehicles.

According to an article in the German regional publication *Peiner Allgemeine Zeitung,* the teams responsible for operating the site at the start of production have been, and continue to be, trained by Gotion.[97]

The engineer and trade unionist at IG Metall (formerly referred to), maintains that while "training for employees has been promised by Gotion, there are no specifics details on this topic at the moment. In a context where talks of plant closures in Germany are still ongoing, unionists from Salzgitter have expressed

[94] Volkswagen group (2021). Volkswagen Group and Gotion High-Tech team up to industrialize battery cell production in Germany

[95] Automotive World (2021). Volkswagen Group and Gotion High-Tech team up to industrialize battery cell production in Germany

[96] Valentin Cimino. Automobile Propre (2024). En Allemagne, la future usine de batteries Volkswagen ne tournera pas à plein régime

[97] "Batterieproduktion: Drei Gigafabriken für die elektrische Zukunft ", Peiner Allgemeine Zeitung, 23 October 2024; accessed via a third-party database.

concern about the potential impact of a conflict between Volkswagen and Gotion, should it arise. A withdrawal of the Chinese could have a severe impact on the factory and if that happens, Volkswagen's situation may be much worse than the battery manufacturer Varta, which was recently saved from bankruptcy through Volkswagen's intervention. Indeed, the size of the carmaker would make such a situation highly volatile".

Press releases mentioning Volkswagen's cooperation with another Chinese group shows that the German carmaker works in close coordination with Chinese battery producers or technical providers.

On 22 June 2022, the manufacturer of new energy equipment Wuxi Lead Intelligent Equipment Co., Ltd. (LEAD) announced that it has signed a cooperation agreement with Volkswagen AG (Germany) to provide solutions for its Salzgitter 20 GWh lithium battery equipment, accounting for more than 65% of the parts[98].
At a time when Volkswagen announced investments of EUR 30 billion for six large battery factories in Europe, LEAD was said to "provide 20 GWh lithium battery equipment services for Volkswagen's Salzgitter factory in Germany, including front rolling, pole piece baking, middle assembly line, liquid injection, battery cell baking, formation equipment, and complete line integration general contracting". The company had to "become the core supplier of Volkswagen's 240 GWh Gigafactory by 2030". LEAD also supplies ACC (Automotive Cells Company) and Northvolt, and in 2022[99] employed a local European team of "more than 100 people" as well as 1 100 engineers who provided "long-term fixed service for overseas customers".

At the beginning of 2023, Gotion was granted the Volkswagen Cell Test Lab qualification certificate, acknowledging its test capabilities, and formally permitting its entry into the globally leading technological management system of Volkswagen. This confirms Gotion's status as the Volkswagen Group's battery supplier in China, including supplies for "local MEB vehicles" (modular electric drive matrix).[100] Furthermore, according to the press release reporting on the above, "In May, Gotion's wholly-owned subsidiary, Hefei Gotion High-tech Power Energy Co., Ltd., received a procurement letter from Volkswagen making the company the designated supplier of lithium iron phosphate (LFP) unified cell products for the automaker's international markets".[101]

According to an April 2024 article published in the Chinese publication *People's Daily Online* by Ralf Brandstätter, board member of Volkswagen Group China, the Volkswagen Group is cooperating with Chinese technology firms, including Gotion, on sectors like autonomous driving, infotainment systems, and energy batteries.[102] In his opinion, China has become the most developed global market for intelligent, connected vehicles (ICVs).
This all occurs against the backdrop of Volkswagen's establishment of the Volkswagen (China) Science and Technology Co., Ltd., the company's biggest R&D centre outside of the German HQ, that represents an interface between the joint ventures and Volkswagen's local partners and focuses on the R&D and procurement for intelligent, connected electric vehicles.[103]
Gotion intends to establish its own local R&D centre, however, it remains to be seen whether this will involve collaboration with Volkswagen.

[98] Green Car Congress (2022). Volkswagen selects China-based LEAD for European gigafactory battery manufacturing equipment
[99] Pandaily (2022). Wuxi LEAD Strikes Agreement With Volkswagen on 20GWh Lithium Battery Equipment
[100] Automotive World (2021). Volkswagen Group and Gotion High-Tech team up to industrialize battery cell production in Germany
[101] PR Newswire (2023). Von VW unterstütztes High-Tech-Unternehmen Gotion verdreifacht Umsatz in Übersee im ersten Halbjahr (H1)
[102] Von Ralf Brandstätter. German people (2024). Zusammenarbeit bringt Chinas Entwicklung von intelligenten Elektrofahrzeugen auf ein neues Niveau
[103] Ibid.

Gotion proprietary project in Gottingen

Aside from the partnership between Gotion and Volkswagen/PowerCo in Salzgitter and the Gotion-InoBat JV in Slovakia, Gotion has also set up a series of subsidiaries in Germany aimed at owning and operating a proprietary project in Göttingen.

In July 2021, Gotion High-Tech Co. Ltd. purchased Robert Bosch Aftermarket Solutions GmbH from Robert Bosch GmbH in Göttingen, and in 2022, renamed it Gotion Germany Battery GmbH. Gotion Germany is wholly owned by Gotion GmbH,[104] itself a subsidiary of Hefei Gotion High-Tech Power Energy Co. Ltd. in China.

The agreement between Gotion and Bosch was made public in July 2021,[105] and depending on press articles, the aim was to build two production facilities in Göttingen to reach an annual production capacity of 6 to 20 GWh.

According to a press release from Gotion High-Tech from September 2023, the site produces LFP battery packs for buses, automobiles, stationary energy storage devices, mobile devices, and other product categories.[106] In addition, it will also supply starters, generators, ignition distributors, air flow and air mass meters for the automotive industry. Ray Chen, Vice President of Gotion Global, is quoted as saying “Göttingen factory's production line is highly automated, with an overall automation level of nearly 70%, and close to 80% in the module assembly stage”.[107]

Gotion particularly emphasises the alliance between Chinese battery technology and German quality control, along with advanced process engineering, in this factory.

The former head of Gotion's Göttingen site and Gotion Germany Battery GmbH, Ahmet Toptas, mentioned that the Göttingen-based branch of Gotion would establish its own local product R&D team in Europe. Given that Volkswagen has a procurement agreement in place with Gotion, the German carmaker will likely benefit from Gotion’s domestic R&D efforts.

Gotion’s website announced on 10 June 2023 that the first battery pack product from Gotion’s German base has officially rolled off the production line. Han Jun, Party Secretary of the Anhui Provincial Committee, Stephan Weil, Minister President of Lower Saxony and other Chinese and German government officials witnessed the event.

On 16 September 2023, Gotion High-tech signed cooperation agreements with five internationally renowned companies, covering various aspects such as battery materials, product development and the supply of automotive and energy storage products. Specifically, Gotion will further collaborate on projects related to battery materials with BASF China. Gotion and ABB of Switzerland will work together on battery product offerings and technology R&D to support Gotion's new factories in Europe and the US. Cooperation with Ebusco will focus on the development and production of battery energy storage systems, and wind and solar energy storage projects. In addition, Gotion will collaborate with Ficosa and Idneo, in the areas of intelligent mobile energy storage and vehicle charging power, battery bundling, battery recycling, battery management systems and massive data engineering.

It is noted that since late 2023, Gotion Germany Battery GmbH has been managed by Klaus Gohde, who had worked for Bosch since the late 80s. He replaced Ahmet Toptas (at Gotion), who joined Bosch in early 2024.

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[104] Per the German corporate registry.
[105] Phate Zhang. CNEVPOST (2021). Power battery maker Gotion secures its first plant in Europe through acquisition
[106] Gotion (2023). Gotion High-tech's Battery Achieves "Made In Germany"
[107] Stern (2021). Volkswagen setzt in der Elektromobilität auf China und Spanien

Gotion and InoBat's formation of GIB: a joint venture to build a battery gigafactory in Slovakia

The Slovak joint venture entity between Gotion and the Slovak group InoBat is GIB EnergyX Slovakia s.r.o. ("GIB"), a Slovak limited liability company established in November 2023. It is the result of Gotion's engagement with InoBat after the companies signed a memorandum of understanding (MoU) on 7 February 2023. GIB is 80% owned by the Germany-based Gotion GmbH and 20% owned by the Slovakia-based InoBat Auto j.s.a. Its managing director/CEO is Pavol Krokoš, a Slovak, who also serves as managing director at InoBat. The JV's supervisory board members are Steven Cai, Tobias Schmieg, Xie Xiaoxin, and Tahereh Lindstedt.

According to Slovakia's Public Sector Partners Register, Gotion GmbH is 100% owned by Hefei Gotion High-Tech Power Energy Co., Ltd., which is, in turn, 100% owned by Gotion High-Tech Co., Ltd. Gotion High-Tech Co., Ltd.'s largest shareholder, with a 24.69% stake, is Volkswagen (China) Investment Co., Ltd. Gotion GmbH also controls the group's 100% owned gigafactory in Göttingen.

The ownership structure of InoBat Auto j.s.a. – as recorded in Slovakia's Public Sector Partners Register – involves multiple entities; its largest shareholders being two Slovak investment holding companies:

- InfraPartners Management s.r.o. (IPM), with a 45.41% stake
- Cielo Capital II s.r.o. (Cielo), with a 33.33% stake

Both IPM and Cielo have complex ownership structures, but their primary ultimate beneficial owner is Marián Boček. Boček is named in Slovakia's Public Sector Partners Register as indirectly holding over 25% of InoBat shares, although his precise ownership percentage is not disclosed.

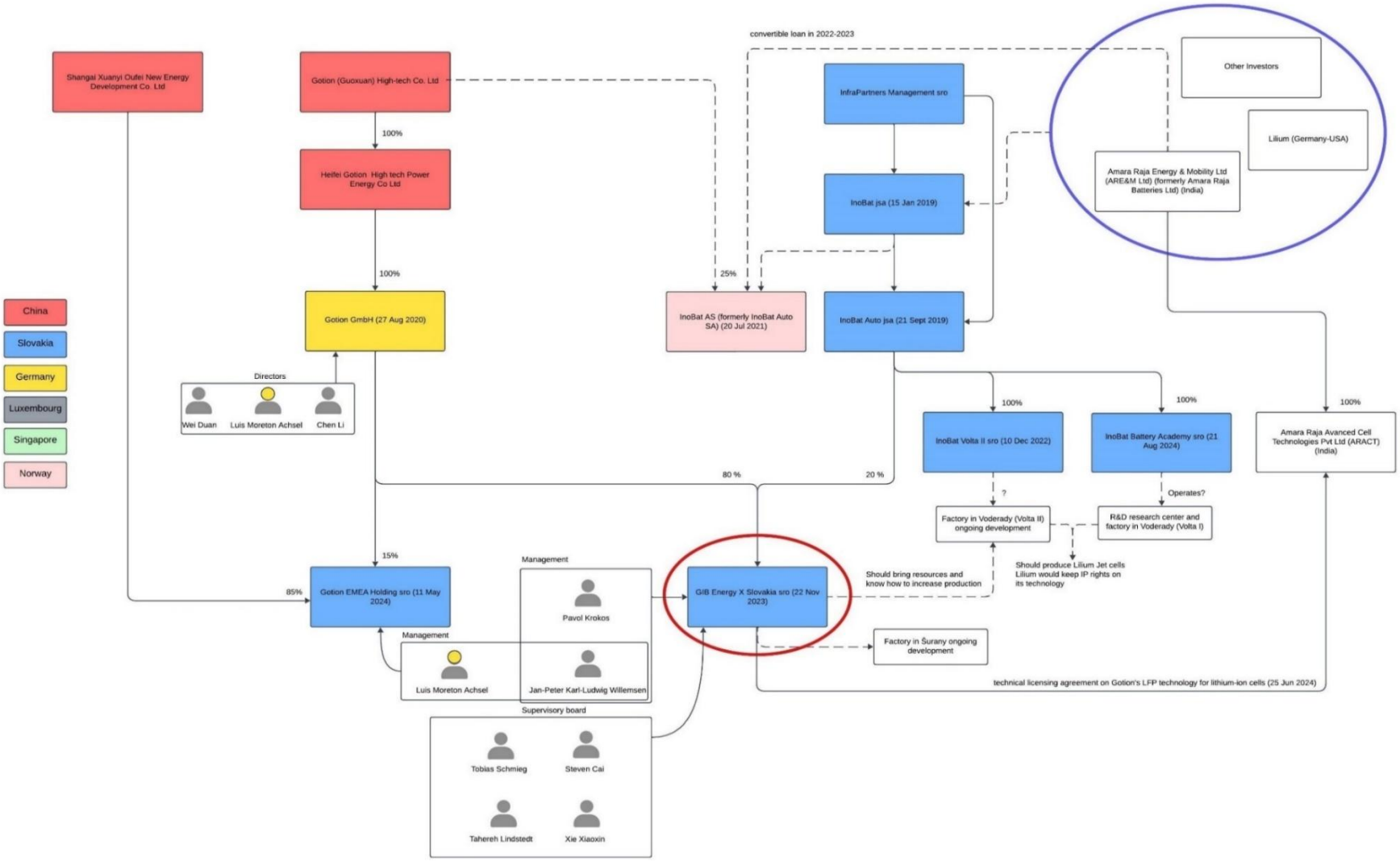

Figure 6. Description of InoBat and Gotion's association in GIB

The Gotion-InoBat JV: GIB

The GIB project

GIB's press release stated in December 2023,[108] that the production line "consists of 35 machines, covering the entire production process from preparing anode and cathode mixtures to final formation and aging, utilising the latest high-speed layering technology". The line was transferred from China and "the process [installation and commissioning] was successfully carried out by the InoBat team, along with 60 experts and engineers from Wuxi Lead. In the current first phase, the line will be operated by 41 operators from InoBat, with 20 of them working in shifts to ensure 24/7 operation of the battery formation and aging process.[109]

According to InoBat stakeholders and local officials, "The new InoBat and Gotion factory will not serve as an assembly plant for finished components, but a production plant for lithium iron phosphate batteries built from scratch".

No definitive information was found in open sources about who has the final say in critical business decisions in GIB. However, in a recent media interview, Krokoš talked about GIB receiving "an order" from Gotion's headquarters concerning recruitment. The use of this word may be indicative of the balance of power.

Gotion's strategy in relation to GIB?

GAINING BARRIER-FREE ACCESS TO EUROPEAN MARKETS

While Gotion could set up its own factories in the EU to avoid duties, the benefit of joint ventures is that "joining forces with a local producer reduces costs and provides faster access to the single market."

LEVERAGING INOBAT'S FACILITIES, EXPERTISE, AND STRENGTHS

A press release from InoBat in February 2023 – concerning the company's JV MoU with Gotion – mentions the following benefits:[110]

- Gotion will benefit from InoBat's manufacturing sites and expansive market connections in Europe,
- Technical cooperation to leverage the respective strengths of the companies in LFP and NMC batteries,
- Access to InoBat's three laboratories equipped with the latest technology.

In an interview published by *Denník N* in October 2024,[111] GIB's CEO, Pavol Krokoš explained that "Gotion was looking for a European partner with experience in battery production, able to assist with project development, recruitment, ensuring compliance with European standards, and building a positive reputation for the project in the region."

[108] InoBat (2023). The first battery line in Slovakia is launched
[109] Ibid.
[110] InoBat (2023). Inobat and Gotion sign MOU to develop joint venture EV battery cells and packs in CEE
[111] Daniela Krajanová. DennikN (2024). Nedovezieme ľudí z Indie, prilákame naspäť našich z Maďarska, tvrdí manažér šurianskej baterkárne

FULFILLING GOTION'S BUSINESS PLAN

In a February 2023 press release from InoBat,[112] Gotion's Steven Cai said of the JV: "It will be part of Gotion High-Tech's business plan of establishing 100 GWh of battery production capacity in the overseas market by 2025 and help to advance the international development of the company in Europe."

MEETING THE LOCALISATION DEMANDS OF CUSTOMERS

In a September 2023 press release from InoBat, Gotion's Steven Cai said that the gigafactory would help the group "to meet the localisation demand from European customers currently being supplied by China".[113] The following paragraph noted that "Gotion High-Tech has an exclusive contract with Volkswagen to supply EV batteries outside of China," which may suggest that VW was the source of the demand. According to the release "Localising battery production and reducing the need for long-distance transport will contribute to reducing CO2 emissions and strengthen the region's competitiveness."

LEVERAGING STATE SUPPORT AND INCENTIVES

Gotion will benefit from EUR 214 million in Slovak state aid to GIB, which includes subsidies and tax relief.[114] In an October 2024 interview with *Denník N*, GIB's CEO, Pavol Krokoš, indicated that Gotion might not have received this if it weren't part of a JV: "I assume that the fact that GIB is not a purely Chinese investor played a role… The Slovak government was more confident in a JV where the European partner would pay attention to legislation, and uphold security, human rights and other European standards."[115]

Also, according to InoBat stakeholders and local officials, "the joint investment of InoBat and Gotion is treated partly as an EU (German) investment thanks to Volkswagen's 26% stake in Gotion. However, the Germans do not seem to have any input into decision-making, notably on the location of the factory (otherwise it would have been located in Germany, not Slovakia)".

ACCESSING GLOBAL PARTNERSHIPS

The JV might be perceived as an effective conduit to facilitate partnerships with other companies, like the Indian group Amara Raja.[116]

What is the framework and the set of conditions governing the sharing of knowledge, expertise and intellectual property in GIB?

No specific detail was found in public sources on knowledge, expertise and IP sharing with regards to the InoBat-Gotion partnership, however some technology and expertise transfer is expected.

According to InoBat stakeholders and local officials: "Official sources confirm that the agreements only include production with technology transfers. Additionally, there will be some educational partnerships with some

[112] InoBat (2023). Inobat and Gotion sign MOU to develop joint venture EV battery cells and packs in CEE
[113] InoBat (2023). The GIB gigafactory is one step closer, Gotion high-tech and Inobat will build it together
[114] Ta3 (2024). Investičná pomoc štátu. Slovensko podporí baterkáreň v Šuranoch stámiliónovým stimulom Novy CAS (2024). Obrovská investícia! Závod v Šuranoch dostane od štátu pomoc vo výške 214 miliónov eur
[115] Daniela Krajanová. DennikN (2024). Nedovezieme ľudí z Indie, prilákame naspäť našich z Maďarska, tvrdí manažér šurianskej baterkárne
[116] A Ksheerasagar (2024). Amara Raja shares hit 20% upper circuit after subsidiary signs licensing deal with GIB

schools and universities in Slovakia (see below). The main concern lies in how this will be implemented in practice".

A former employee who worked at InoBat, confirms that "There will be technological transfers; this was secured at an early stage, during the initial negotiations. Marian Boček (InoBat's founder) agreed on this even before the announcement of a new factory. This was supposedly agreed upon during the negotiations for Gotion's purchase of a 25% stake in InoBat. However, the scope of the technology transfer, and the depth of the relationship have not been disclosed. It is widely agreed that Boček would not have entered the deal without securing some form of transfer. The first mention of this was in 2021, so there was ample time to finalise the details".

In November 2023, the Slovak government signed an MoU with GIB regarding the construction of a battery gigafactory in Šurany. Following this, the country's prime minister, Robert Fico, reportedly stated that the project would involve technology transfer. Likewise, GIB's CEO, Pavol Krokoš, has said that initially "engineers and supervisors" would come from China for the purpose of "technological and knowledge transfer". InoBat's CEO, Marián Boček, has also talked about "bolstering knowledge share."

However, there have also been indications in the media that InoBat and Gotion could remain quite separated, using GIB to work "together in mutually beneficial areas" and "devise new and exciting technologies," while maintaining "their independent businesses and chemistries". Krokoš has mentioned that none of InoBat's existing technologies or products will be used in the factory in Šurany, possibly suggesting a desire to retain control over certain proprietary technologies.

What are the short and mid-term deliverables around expertise, technology and production?

In the short term

InoBat's CEO, Pavol Krokoš, claimed that GIB's workforce will be predominantly sourced locally; 95% of the JV's employees are expected to be local "at the start of production", with the remaining 5% initially being "sourced externally" due to "engineers and supervisors coming from China". However, the goal is to reportedly employ 100% local personnel by 2029. GIB reportedly plans to recruit 1,300 people by 2027.

Initially, supplies are destined for two European VW plants outside of Slovakia but, according to Krokoš, "It's possible that in the future, batteries may also be produced [in Šurany] for the local VW plant."[117] The Šurany factory's location, close to VW's factory in Bratislava, could prove beneficial in the future. It apparently benefits from good infrastructure and ready access to energy from a nuclear power plant at Mochovce.[118]

In the middle term

In April 2024, *Pravda* reported that InoBat had expanded its workforce in recent months, adding dozens of Slovak operators and maintenance technicians to its production team. Given the advanced technologies and

[117] Daniela Krajanová. Dennikn (2024). Takú extrémnu atmosféru sme nečakali, hovorí manažér šurianskej baterkárne — Denník E

[118] Slovenské Elektrárne. Mochovoce Nuclear Power Plant
Volkswagen stopol gigafactory v Šuranoch. Prečo uprednostnil Američanov?

complex processes involved, the company provided retraining for these employees. At the time of the article, InoBat had employed an international team of experts from 18 countries. The integration of hands-on battery technology experience with local talent had led to the development of Slovakia's first retraining course, paving the way for a new profession as a battery cell production operator.

InoBat's CEO, Marián Boček, highlighted the company's goal to train experts and provide opportunities to those who have worked in related fields. InoBat initially requalified its workers within the existing R&D centre in Voderady in Slovakia, where a pilot battery production line is located.[119] The requalification process itself was divided into three key stages: theoretical training, technical training, and on-the-job training. The educational programme has been developed in-house and tailored to the company's needs, combining the expertise of InoBat employees with engineers from the Chinese company, Wuxi Lead - the supplier of the production line.[120] InoBat's plan is reportedly to extend these training processes to its gigafactory in Šurany.[121]

What is InoBat's involvement in the research & manufacturing part of the project. How will the firm acquire skills, technology and manufacturing expertise?

The engineer, a former InoBat employee, considers that, "regarding the arrangement in this particular joint venture, the transfer of technology assumes very far-reaching concessions from InoBat regarding its voting and decision-making power in the JV. In business terms, it will be completely under Gotion's control. But in return, the technological gains – long-term benefits from knowledge acquisition, and access to Gotion's network of contacts and sales – will outweigh the advantages InoBat would gain from having greater influence over the joint investment".

Is there any foreseen longer term value retention?

Krokoš reported that he sees "great potential in retraining the workforce in the region", and InoBat reportedly plans to extend its existing training processes to the Šurany factory.

In October 2024, *Štandard* reported that GIB plans to involve students in a comprehensive educational programme, collaborating with the Technical Secondary School in Šurany. GIB representative, Peter Papánek, said: "Our goal is to build a research and development centre in Šurany, which will offer new opportunities for qualified professionals... We also plan to closely collaborate with primary and secondary schools, as well as universities, to prepare the younger generation for work in modern industry. We are ready to offer educational and retraining programmes for future employees, enabling them to acquire the skills needed for new technological challenges."[122] Adding that it would "ensure the transfer of the latest knowledge into industrial practice in Slovakia."

[119] Pravda (2024). Slovenská firma "šije" baterky na mieru. Z jej továrne vyšli prvé kusy, zaradili sme sa medzi lídrov v EÚ
[120] InoBat (2024). Inobat announces first Slovak batteries for e-mobility and introduced a completely new profession to Slovakia
[121] Pravda (2024). Slovenská firma "šije" baterky na mieru. Z jej továrne vyšli prvé kusy, zaradili sme sa medzi lídrov v EÚ
[122] Jozef Uhlárik. Standard (2024). Štát už vyvlastnil prvé pozemky pod megabaterkárňou, ich majitelia sa ešte môžu odvolať

Regarding the research and development centre, Krokoš has said that it will be a 'brain centre,' not just an assembly line. The source understands that InoBat has already engaged with staff at the University of Nitra (Slovak University of Agriculture in Nitra) and the Technical University in Bratislava (Slovak University of Technology), with a view to "educating students for the future needs of the company".

InoBat seems to be stepping up its own efforts in education. According to the Slovak business register, InoBat Battery Academy s.r.o. was registered on 21 August 2024, and is solely owned by InoBat Auto j.s.a. Boček and Victoria Vernarecová are the academy's managing directors. According to its website, the academy represents an educational campaign aimed at increasing awareness of the battery ecosystem among students and young professionals. Over the course of the academy's 12-month programme, leading experts in batteries and e-mobility reportedly cover various aspects of battery research and development, and production, through monthly videos, podcasts, and lectures.[123][125] It is not known whether this entity will have a direct role in the JV's educational activities.

[123] Nauč sa o budúcnosti MOBILITY v našej. BATTERY Academy

Case study Stellantis - CATL

Legal framework of Stellantis - CATL cooperation

Initial announcements

The automotive group Stellantis announced in a press release on 21 November 2023[124] the signature of a MoU (non-binding agreement) with the Chinese company CATL, to build a gigafactory aimed at producing batteries using lithium iron phosphate (LFP) technology. This cooperation would take place in the form of a 50-50 JV.

This gigafactory project, announced by Stellantis' Director of Purchasing and Supply, Maxime Picat, was due to be the fourth European gigafactory project of the group. However, two of the three initial projects that were to be developed with ACC in Germany and Italy have been "paused" as of June 2024.

The JV with CATL was aimed at "accelerating the deployment of cheaper electric vehicles" to counter the offers of Chinese models sold at attractive prices. For CATL, it was one of its new European projects alongside those announced in Hungary, and the production capacity expansion of an existing plant in Erfurt, Thuringia, Germany.

The MoU between Stellantis and CATL outlined a long-term collaboration focused on two strategic axes:

- Development of a technological roadmap,
- Identification of new opportunities to strengthen the battery value chain.

Signature of Agreement on 10 December 2024

In a statement on 10 December 2024, Stellantis and CATL announced a joint investment of up to EUR 4.1 billion for a Large-Scale LFP Battery Plant in Spain.

“Stellantis and CATL today announced they have reached an agreement to invest up to EUR 4.1 billion to form a joint venture that will build a large-scale European lithium iron phosphate (LFP) battery plant in Zaragoza, Spain. The battery plant, designed to be fully carbon neutral, will be implemented in multiple phases and with corresponding investment plans.

Targeted to start production by end of 2026 at Stellantis’ Zaragoza, Spain site, the facility could reach up to 50 GWh capacity, subject to the evolution of the electrical market in Europe and continued support from the authorities in Spain and the European Union. The 50-50 JV between CATL and Stellantis will boost Stellantis’ best-in-class LFP offer in Europe, enabling the automaker to offer more high-quality, durable and affordable battery-electric passenger cars, crossovers and SUVs in the B and C segments with intermediate ranges.”

(…)

[124] Stellantis signe un accord stratégique (MoU) avec CATL pour l’approvisionnement local en batteries LFP sur le marché européen
Stellantis et CATL envisagent une gigafactory européenne de batteries LFP abordables
Automobile : Stellantis s'allie au Chinois CATL pour la production des batteries de voitures électriques

The transaction is expected to close in the course of 2025 and is subject to customary regulatory conditions.

(…)

“CATL is bringing state-of-the-art battery manufacturing technology to Europe through its two plants in Germany and Hungary, which are already operational. The Spanish facility will enhance its capabilities to support the climate goals of its customers, further underscoring its commitment to advancing e-mobility and energy transition efforts in Europe and the global market.

Stellantis is employing a dual-chemistry approach – lithium-ion nickel manganese cobalt (NMC) and lithium iron phosphate (LFP) – to serve all customers and explore innovative battery cell and pack technologies. Stellantis is on track to becoming a carbon net zero corporation by 2038, all scopes included, with single-digit percentage compensation of remaining emissions.”

Before the agreement was signed, discussions between both parties and Spanish stakeholders were tense, particularly regarding subsidies and custom tariffs

The JV project with CATL, identified as the "Antares project", was initially estimated to cost around EUR 2.5 billion, and could lead to the creation of 3,000 jobs.

The host country of the project is Spain, specifically in Figueruelas, near Zaragoza (Aragon), where Stellantis already has a presence.[125] The gigafactory project is part of Stellantis' broader industrial initiatives including an estimated EUR 1 billion investment to adapt existing factories for the production of the STLA Small platform, dedicated to small electric cars.

The negotiations have lasted about a year since the end of 2023, because Stellantis considered the amounts of subsidies proposed by the Spanish government in the "PERTE VEC"[126] plan, insufficient. Throughout spring 2024, discussions on subsidies took place between stakeholders, including the President of the Government of Aragon and Stellantis management in Spain (José Luis Alonso, Plant Manager in Zaragoza, Ana Capistros, Director of Industrial Strategy in Zaragoza and Carlos Iglesias, Human Resources Manager of the Opel plant in Zaragoza), as well as representatives of CATL.

In May 2024, the government had committed around EUR 55 million under PERTE VEC II for the gigafactory project, which was still considered insufficient by Stellantis.[127] In October 2024, the PERTE VEC III plan (which began in May 2024), offered a total of EUR 210 million in aid - an amount that includes all subsidies provided for Stellantis' projects in the region from 2022. However, the figures and their breakdowns vary depending on the source.

In October 2024, a Stellantis' spokesperson announced that despite these latest developments, the gigafactory project was still, “subject to the completion of all regulatory approvals (…) and that a further announcement would be made in due course”. A Spanish consultant who approached several contacts among Spanish officials

[125] Stellantis facilities are also near Madrid and Vigo (Galicia)
[126] Proyectos Estratégicos para la recuperación y Transformación Economice (PERTE) del Vehículo Eléctrico y Conectado (VEC)
[127] Stellantis felt that it had received less aid than Volkswagen at Sagunto (Valencia) or the Chinese group Envision at Navalmoral de la Mata (Cáceres).

was able to confirm that “everyone in Spain was in favour of the JV project between Stellantis and CATL. After agreeing on subsidies, the obstacles shifted to the Chinese side, as their government was focused on securing a larger stake with the EU, rather than prioritising this particular deal, even though this agreement would be favourable to CATL”.

In June 2024, the Chinese government had tried to put pressure on the Spanish government to advocate against the tariffs before the European Commission, while in September 2024, on a visit to China, Pedro Sanchez had again been reminded by Xi Jinping to play a "constructive role" in improving strained ties between Beijing and the European Union.[128] Spain did not vote against the tariffs but abstained.

The implementation of tariffs did not stop China from applying pressure, using the Stellantis-CATL project as leverage. On 15 October 2024, *La Razón*, a national newspaper, published an article titled “Zaragoza Factory and the agreement with CATL pending CATL approval”. The article referred to the tension between China and the EU as the major issue for the deal, with the Chinese reportedly threatening to pursue alternative battery factory projects in Morocco, Algeria, or Egypt, instead of Zaragoza.[129]

More recently, on 25th November, while negotiations aimed at finding alternatives to EU customs seemed stalled, Carlos Tavares – then CEO of Stellantis – met with the Spanish Prime Minister. He emphasised the importance of “understanding China” and reaching a mutually beneficial agreement on EV tariffs.[130] He remarked, “Either you play with China or against it, and playing against it is not the best idea”. He mentioned Morocco as an example of an emerging electric industry powerhouse that intends to attract EV investments.[131]

In this tense context, CATL appears to have continued to move on discreetly, waiting for the global situation to be resolved. An unconfirmed online source[132] indicated that in early October 2024, CATL was “already working incognito” in Zaragoza, while another online source indicated slightly earlier (in September), that CATL had launched a recruitment process in June/July[133].

These weak signals are consistent with a well-informed European parliamentarian on the JV project. According to him, “China and CATL will, of course, negotiate in their best interests but while they may be hesitant on topics such as technology transfers, their desire to enter the EU market is probably higher. China knows that technologies can be copied in time, so denying technology transfers will only have a short-term effect”.

Stellantis strategy: why create a JV with CATL?

According to an executive working for ACC’s public relations department, “ACC's roadmap initially planned to produce NMC battery packs to power Stellantis' Peugeot 3008 and 5008. However, ACC is experiencing difficulties with this technology. Current projects have been suspended, and the company must diversify its technological offering. ACC is considering shifting to LFP or LMFP technologies”.

This is confirmed by a TV report from 25 September 2024,[134] which mentions quality problems on ACC’s NMC battery packs. Only 50% of the production would be certified.

[128] Joe Cash. Reuters (2024). China's Xi, Spain's Sanchez seek to ease EU-China trade disputes
[129] Carlos De Miguel. La Razón (2024). La factoría de baterías de Zaragoza, pendiente del acuerdo con la china CATL
[130] Pablo M. Ballesteros, Ignacio Anasagasti. La Tribuna de Automoción (2024). Tavares (Stellantis) transmite a Sánchez que los 357,8 millones en ayudas es «un nivel de apoyo satisfactorio» para adjudicar proyectos a España
[131] Heraldo (2024). Carlos Tavares achaca el retraso de la fábrica de baterías de Zaragoza a los aranceles
[132] Stellantis suma ayudas de 230 millones tras el Perte de descarbonización, Expansion, 8 October 2024
[133] Alejandro Pérez. (2024). EXCLUSIVA: ¡CATL FABRICARÁ BATERÍAS EN ESPAÑA!
[134] France info. Batteries électriques : la première usine française peine à décoller

Given this, Stellantis faces an issue with its battery supply chain.

A former Peugeot executive, now consultant, explains that “The interest of the JV for Stellantis resides in the possibility of sourcing battery packs in Europe, negotiating volumes and purchase prices in good conditions and sharing the risks. For CATL, the main advantage would be the car manufacturer’s purchase commitments as well as a guarantee of negotiated prices”. He adds that “while the JV will allow Stellantis to regain control on its electric battery future, this is more about supply chain than acquisition of the technology”.

This is concurred by other sources. A consultant working in a consulting firm specialised in macro-economic analysis considers that “there will be no preset provisions on technology or IP transfers in such partnerships as the Stellantis-CATL JV. The carmaker is purchasing an off-the-shelf technology to meet its immediate needs. This is also Tesla’s approach, which consists of using what already exists while working on the next generation of batteries in its R&D department.” He reckons however that “The European partners in the JVs will be in a position to ‘capture’ information on the design of the cell and the associated expertise”.

This is further confirmed by a strategy manager working for a European battery producer: “The main reasons for creating a JV with a Chinese group in the electric battery sector is to have access to the LFP battery technology in which the Chinese are leaders, while the Europeans followed other avenues. For Stellantis, the agreement with CATL guarantees its access to LFP technology to equip a large number of cars before the 2035 deadline. While Stellantis can buy batteries directly on the market from any Chinese producer, forming a JV is a way to secure the supply chain”.

He adds that, “In the context of a Stellantis-CATL JV, not only does Stellantis secure its supply chain, but in the long run, it can covet a vertical integration of this battery production technology, after having absorbed the licensing and the know-how. Indeed, as a majority co-shareholder of the JV, Stellantis can envisage an industrial Meccano in the future. This is a way to acquire skills, whereas if Stellantis bought directly from CATL, it would have to pay a margin and would not be any further ahead after a few years: it would have neither a factory, nor intellectual property.”

While it is better to have factories controlled by Stellantis in Europe than to buy batteries directly from China, the source considers that, “This is not such good news, as Stellantis is a carmaker, not a battery manufacturer. The technology transfers will likely be limited, as Stellantis’ team isn’t the most qualified to learn from their Chinese partners – unless Stellantis decides to make batteries, which is unlikely. Horizontal JVs between European battery manufacturers and Chinese ones would be preferrable, according to the source. Stellantis and other carmakers could be facilitators of such deals by guaranteeing orders for their production. Such a JV would be more efficient in terms of technology transfer.” We note that this is the case in the Gotion-InoBat JV mentioned above.

“In the envisioned JV, Stellantis will be a financial shareholder and the know-how will remain in CATL’s hands, even if the factory is in Europe”. The source did not know what Stellantis’ current R&D policy is but, as far as he knows, there is no repatriation of R&D to Europe by CATL. This will clearly not help European battery manufacturers to acquire the LFP technology.

CATL’s interest in creating a JV with Stellantis is to access the European market and secure financing outside of China. Chinese players in the battery sector understand that Europeans carmakers want to secure their supply chain by having local providers. They have two options: creating wholly owned subsidiaries in Europe and facing possible setbacks as they may not fully master all parameters, (such as work laws, working habits, etc.), or finding JV partners. If they do not take a market share now, when they are strong, the Europeans will eventually succeed in organising themselves and will no longer need them.”

While Stellantis may have projects to develop its own batteries in the future, it seems that the group has no intention of ramping-up the current LFP technology. A regulatory expert for a car manufacturer explains that “Stellantis JV with CATL is all about securing supplies. This is the same in the Stellantis-Leap Motors partnership (Leap Motors is a Chinese EV manufacturer, a competitor to Stellantis). In this deal Stellantis only seeks to increase its volume of electric cars rapidly, in order to avoid EU fines for failure to meet pre-2035 intermediate thresholds for electric vehicle production. There appears to be no provision for Stellantis to receive any technology transfers from the Chinese side”.

Other significant developments of Stellantis in the EV and electric batteries industry

In October 2023, Stellantis signed a strategic partnership with Chinese electric car manufacturer Leapmotor. According to Stellantis, the group could "benefit from Leapmotor's ecosystem of high-tech electric vehicles in China, to achieve its Dare Forward 2030 electrification goals while remaining open to exploring future synergies with its partner".

This agreement notably resulted in Stellantis acquiring a 21% stake in the Chinese manufacturer for EUR 1.5 billion, followed by the creation of a Stellantis - Leapmotor (51% - 49%) joint venture named "Leapmotor International" and registered in the Netherlands.

This joint venture aims to import Leapmotor vehicles (model T03 and C10 equipped with LFP batteries), with the first identified arrival dating from June 2024. In addition, the T03 model has been produced through semi-assembled units at the Stellantis plant in Tychy, Poland, since June, with a ramp-up until September. This replaces the production of the Fiat 500 hybrid and allows Leapmotor to circumvent increased customs taxes on electric vehicles imported from China to the EU. These vehicles are distributed in 9 European countries, including Germany.

In September 2024, while the Italian government withdrew EUR 200 million in funding for ACC's project in Termoli following a “project pause”, Stellantis announced a EUR 40 million investment in a ‘Battery Technology Center’ in Mirafiori, to “test and develop the battery packs for its future products”. A press release highlighted that “the vertical integration of battery pack development, testing and manufacturing, as well as software management, is a key element of Stellantis’ strategy to produce electric vehicles at lower cost”.

Another technology centre was also under construction in Windsor, Ontario, Canada. It was highlighted on this occasion that “Stellantis’ electrification strategy is based on two different battery chemistries”, presumably NMC and LFP. In this context, the JV with CATL for LFP batteries appears to be relevant.

Carlos Tavares has been quoted as saying that he preferred to be part of the Chinese push in the electric vehicle sector rather than become a victim of it, believing that he could not compete with Chinese vehicles, only with technologies developed internally.

This is a turnaround after his earlier statements in 2022, where he said, "We should ask the European Union to impose the same conditions on Chinese manufacturers as we, the Western companies, have in China. There is no reason why we should make it easier in Europe for the Chinese manufacturer, than what we face when we enter their market".

The early departure of Carlos Tavares from Stellantis, decided by John Elkann, could lead to a change in the carmaker's strategy depending on the new leader appointed to head the group.

CATL proprietary projects in the EU

CATL's project with Stellantis in Spain is not the first one in Europe. The group has already laid out two other battery factories projects, one in Germany and the other In Hungary. Hungary's factory Is not yet producing; the EUR 7.34 billion investment is expected to yield a production capacity of 100 GWh, with production scheduled to begin in 2025.

As far the German factory is concerned, CATL started the construction of a battery cell gigafactory in Erfurt, Thuringia, in 2019[135], having invested EUR 240 million. The plant would be operated by CATT and has delivered its first batteries in December 2022. Its capacity is estimated to 14 GWh.

According to an article published in *Automotorsport,* by establishing a production site in Germany, CATL intended not only to improve its image with German consumers, but also to avoid the long and costly overseas transport of their battery cells. This move was also intended to mitigate bottlenecks and excessively long delivery times.

In addition to the production of batteries, CATT was also due to undertake research and development, as evidenced by its participation in the BattLife project in 2020, launched by the Battery Innovation and Technology Center (BITC) at Erfurter Kreuz.[136] CATT joined the project, which set out to develop new approaches to the life cycle and reliability of batteries. As an industry partner, CATT would work closely with researchers at BITC, receiving funding from the state of Thuringia.[137]

BITC is a branch of the Fraunhofer IKTS (Institute for Ceramic Technologies and Systems), said to be one of the largest battery research institutes in Germany. As reported in a press release by CATL, the research results will be directly applied to the production of CATT batteries, which in turn will promote battery technology innovation, thereby helping the German state of Thuringia become a European and global battery hub.[138]

CATT's production is not intended for Stellantis but for other car manufacturers, notably BMW and Volkswagen. According to its first semester 2024 financial report, released on 27 July 2024, CATT has obtained dual certifications from the Volkswagen group's module test laboratory and battery cell test laboratory. It has become the world's first battery manufacturer to obtain these Volkswagen group's certifications.[139]

CATT's first batch of batteries was successfully delivered on 21 December 2022. However, things were not all smooth sailing. In November 2023, there was no large-scale supply delivered from the factory. People familiar with the matter revealed that the factory's "costs [were] too expensive and its output not high enough", adding that the plant was still operating at a loss. "CATL wanted to assign Chinese workers to the factory to ramp up production capacity, but visas were not delivered [by the German government]. Using local workers results in lower productivity [than in China], and production capacity could not be increased sufficiently", said the source. Even with the manufacturing level and expansion capabilities of CATL, it has not succeeded in

[135] MOOVE (2019). CATL investiert mehr in deutsches Batteriewerk
[136] CATL (2020). CATL Subsidiary Joins "BattLife" Project in Germany to Explore Novel Battery Technology
[137] Fraunhofer Institute for Ceramic Technologies and Systems IKTS (2020). Making batteries live longer – "BattLife", initial project of the BITC, is launched at the Erfurter Kreuz
[138] CATL (2020). CATL Subsidiary Joins "BattLife" Project in Germany to Explore Novel Battery Technology
[139] CATL (2024). 宁德时代新能源科技股份有限公司

achieving mass production of battery cells in Europe after four years[140] [141]. This information could not be crosschecked.

A July 2024 article from People.cn[142], a mainstream government-owned media website, reported that at the 15th World Economic Forum New Champions Annual Meeting in Dalian, China, CATL chairman Zeng Yuqun, said that that his group would provide technology licensing services to European and American automobile manufacturers and battery manufacturers, to help them start battery production so as to address climate change and promote industrial transformation. CATL's chairman had already mentioned his intentions in January 2024.[143] [144]

It is interesting to highlight a difference between EU and USA policies with regards to Chinese companies.

An article published in September 2024 explains that in America, under this cooperation model, CATL is responsible for building battery production lines, supply chains, debugging production line equipment and managing manufacturing processes. All factory capital expenditures are borne by car companies. CATL does not hold shares in the factory, but collects patents and license fees, as well as service fees. The reason why CATL adopt technology licensing rather than building its own factories in the United States is to avoid potential risks associated with some provisions of the Inflation Reduction Act (IRA) recently instated in the US[145].

[140] Going to Europe, the battery factory's last stand
[141] Battery factories go to Europe: opportunities abound, but thorns grow
[142] David Shepardson, Nora Eckert. Reuters (2024). GM in talks to buy EV batteries built with Chinese tech in US, source says
[143] Sina Finance (2024). Zeng Yuqun of CATL: Will promote technology licensing cooperation model in Europe and the United States
[144] Zeng Yuqun's latest statement: CATL will cooperate with more European and American automakers
[145] Using a technology licensing model, General Motors and CATL may build battery factories in the U.S.

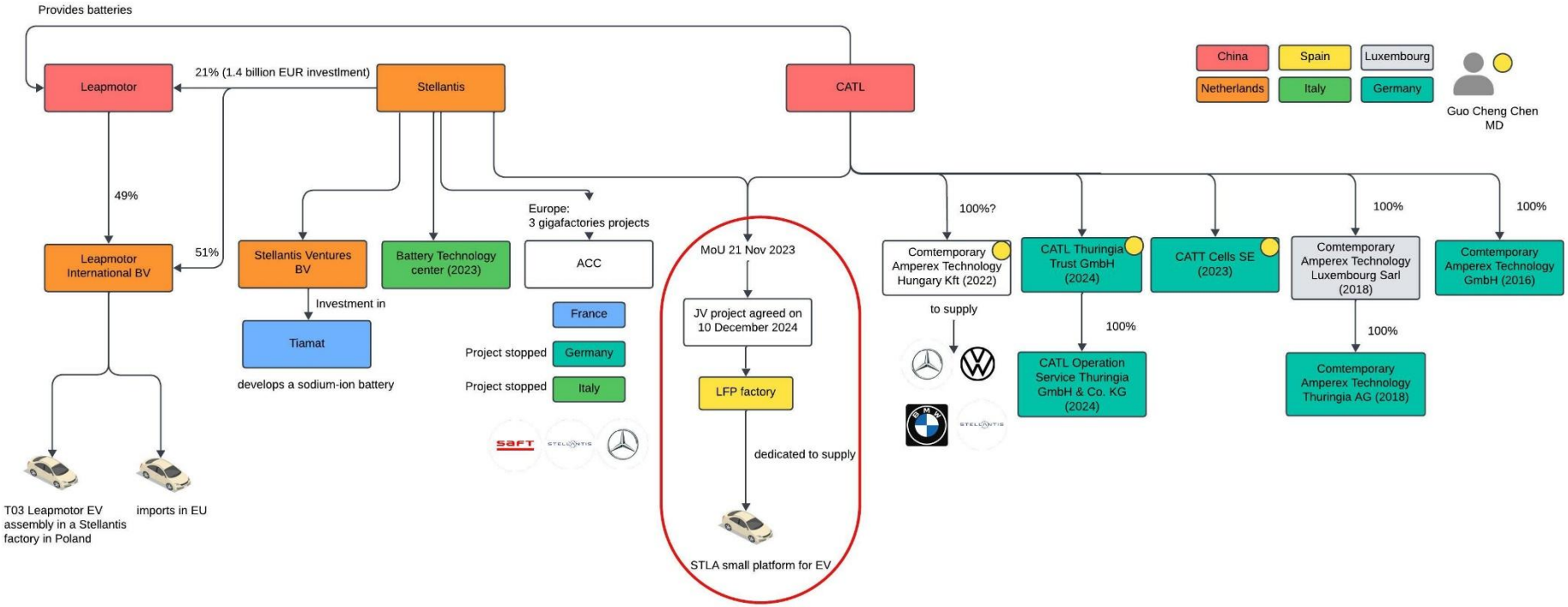

Figure 7. Ownership structures between CATL and Stellantis