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How to Meet the Industrial Challenge of Electric Mobility in France and in Europe?



Center for Energy
& Climate

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Abstract

The deployment at scale of electric mobility in France and in Europe withholds significant industrial, societal, geopolitical and financial challenges, against the backdrop of strategic dependencies along the value chain of the electric vehicle (EV). A lack of vision by policies of the value chain as a whole, of the needs and objectives at each stage, and of how to ensure consistency and follow-up over time adds up to the concerns of industry players, who not only need to catch up from a technology point of view, but also to innovate, to secure the value chains, the workforce, the supply in low-carbon affordable energy and to scale up production and recycling capacities. Gigafactories are a major industrial step forward but should not obscure the complex and much broader nature of the battery value chain, and more generally of EVs' value chain. This note summarizes the key findings of Ifri's extensive study published with the same name in French and its ten key recommendations for overcoming the industrial challenges of electric mobility deployment in France and Europe:

- Developing a holistic approach to the supply of critical raw materials, focusing on five key areas: domestic extraction, refining, mining diplomacy and environmental, social and governance (ESG) standards and recycling.
- Ensuring the stable and competitive supply of low-carbon electricity.
- Building integrated partnerships with European players at all stages of the EV value chain, with a view in particular to rapidly securing a certain number of cathode and anode active material (CAM and AAM) and precursor cathode active material (PCAM) production capacities, and supporting innovation in battery chemistry, which is the only way for Europeans to distinguish themselves from China.
- Planning in order to acquire an integrated mastery of the value chain, to develop the skills and train the workforce.
- Moderating the demand in critical raw materials as a key to resilience, as alternative means of transport, fewer car sales and smaller batteries, contribute to reduce the future increase in raw material needs.
- Re-imagining mobility to make it more sustainable, accessible and fair.
- Setting up and calibrating a support system for the deployment of the different stages of the electric mobility value chain in France, whose cost to the national budget could be in the region of €8-9 billion a year, over the next few years.

- ▀ Protecting industries from unfair and less virtuous practices.
- ▀ Exploiting the growth of electric mobility to strengthen the integration of variable renewable energies into power systems.
- ▀ Ensuring that the European Union (EU) has the appropriate resources to meet the multiple industrial and technological challenges linked to EVs in the context of polycrises. Only some of these have been covered in this study, as EV value chains cannot be reduced to batteries alone, and involve many other key equipment and issues, hence the need to have an EV based approach, as opposed to one centered around battery-cells.

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Introduction

Disclaimer: This note presents the key takeaways and recommendations put forward by the study “Comment gagner le pari industriel de la mobilité électrique en France et en Europe” (available only in French). For the details of the analysis, the reader is invited to turn to the full version of the study.¹

The ban on the sale of new carbon-emitting internal combustion cars and vans in 2035 in the European Union (EU) is triggering an all-out turmoil in the automotive industry, propping up a shift towards electric vehicles (EVs). This is marked by multiple challenges (industrial, economic, technological, geopolitical, and societal, etc.), against a backdrop of geo-economic tensions, exacerbated by a systemic Sino-American rivalry and a growing asymmetry in EU-China relations.

Europe faces an existential industrial challenge. Its players used to dominate the internal combustion vehicle value chain, but now they have to catch up with China in EV technology, develop industrial value chains in Europe, and come to terms with the fact that many of the key, and often little-known, stages in this highly complex value chain are Chinese. Strengthening the control and resilience of value chains is essential for economic and environmental security. Yet Europeanizing these stages is complex, costly and sometimes impossible in the short and medium term. The challenge is all the greater as there is a certain lack of vision of the value chain as a whole, of the needs and objectives at each stage, and of how to ensure consistency and follow-up over time. Moreover, ensuring consistency in the implementation of multiple, highly interconnected pieces of legislation, and supplementing the legislative framework with implementation tools is a long-term, substantial task. This is of great concern to industry, which needs to quickly resolve uncertainties and inconsistencies through ongoing, constructive public-private dialog.

Major advances in the deployment of electric road mobility are underway, including: increasing sales, deployment of charging stations, multiple public support measures, massive investment in gigafactory projects, as well as European and national industrial policies. The impact on Europe’s industrial base is already visible: an EV requires 40% less labor

1. M.-A. Eyl Mazzega, D.-P. Gherasim, C. Vannier and A. Contu, “Comment gagner le pari industriel de la mobilité électrique en France et en Europe”, *Étude de l’Ifri*, Ifri, November 2023.

and can be assembled in one day, compared with three days for a combustion-powered vehicle. The logistics and industrial chains are very different, and thousands of skilled jobs need to be filled, particularly in the new gigafactories, in a context where the European automotive sector has gone through years of structural job decline.

In the present context of prolonged polycrises, the mass adoption of EVs and the Europeanization of value chains remain uncertain. Producing 1 million EVs in France in 2027 and 2 million in 2030, as envisaged by the government, is a huge challenge, given France's trade deficits in the automotive sector, amounting to €19.9 billion in 2022.² There are still many vulnerabilities.

Some successes are emerging with the development of gigafactories in France: the first phase of the Automotive Cells Company (ACC) plant is now operational (with a capacity of 13 gigawatt-hours (GWh) by the end of 2023), while three other plant projects will cover French needs. This is very encouraging. Gigafactories are a major industrial step forward but should not obscure the complex and much broader nature of the battery value chain, and more generally of EVs' value chain.

The aim of this research, which focuses on the battery value chain, is to identify these, to set out priorities and to make recommendations to fill as many gaps as possible. The analysis highlights the weaknesses and even structural vulnerabilities of the industry, particularly in the strategic upstream stages (i.e., mining, refining, production of inputs as well as active anode and cathode materials), along with the recovery and treatment of scrap.

2. Direction générale des douanes et droits indirects, "Le chiffre du commerce extérieur. Analyse annuelle 2022", available on page 21 at this link: www.lekiosque.finances.gouv.fr.

The upstream of the battery value chain: the Achilles heel of the French and European electric vehicle industry

The energy transition is ushering Europe into a new “metalized” era, in which mining and refining are key sectors for the strategic autonomy of the present and the future. The accelerating growth in demand for materials, against a backdrop of fierce competition for uses, comes after years of under-investment in mining and runs into the inability of mining production to adjust quickly enough, even though numerous projects are currently underway. The mining industry will transform itself through a gradual shift away from coal and gold mining towards other materials, through the exploitation of mining waste and associated metals, and by the need to improve its practices and impacts to fulfill robust ESG standards, so as to remain competitive and meet changing customer demands. Some resource-holding states also need to make themselves more attractive to draw in quality investment, while others seek to leverage their resources to develop infrastructure or industrial value chains locally. This is one of the hallmarks of “mining nationalism” and reflects a desire for economic and societal development to escape the resource curse.

Specific challenges relate to the long lead times involved in projects, in a difficult context of fluctuating raw material prices, making capital expenditure very high (and rising due to inflation). These problems are compounded by geological, regulatory, political and societal uncertainties. To accelerate mining investment, long-term contracts between mining players and consumers are promising, as are credits from multilateral banks. In addition, mining production must comply with high standards of corporate social responsibility (CSR), based on ESG standards, and traceability. The demand for electricity for mining activities in Europe and worldwide is set to increase considerably – by several hundred terawatt-hours (TWh) per year – and while currently it is still largely supplied by coal or fuel oil in many countries, it will have to be decarbonized. It will also be necessary to electrify large mining machines, pursue efforts to improve processes (notably water treatment and recycling) and make progress on decarbonizing supply chains.

Another challenge is geopolitical and geo-economic. China has acquired a decisive role in determining metal prices: indirectly via the size of its market and its economic weight; and directly via its extensive control over the global production of many raw materials, EV purchase subsidies which impact demand, as well as export restrictions and material stocks. While the rest of the world was unconcerned about metal supplies, as prices were low and demand sluggish, Chinese players, backed by state-owned banks, were systematically investing in many countries. These players have also taken a dominant position in the refining of many metals, which feeds an integrated Chinese ecosystem of electric mobility (and other technologies). This also ensures that a large proportion of the world's extracted metals is transformed in China, using cheap electricity, but at the cost of significant – albeit accepted – pollution. Thanks to this formidable strategy, Chinese products are ultra-competitive and attractive, and European players are faced with economic and technological risks, not to mention threats, as China is not a typical market economy.

Against this background, every effort possible must be made to revive mining activity in Europe and France. An emerging European objective is to cover 10% of strategic raw materials needs through domestic mining by 2030 – which seems hard to achieve. Yet many projects, particularly in France, could be profitable, provided that costs are kept under control and that they are accompanied by social acceptability and strong political will. These projects must benefit from genuine political and societal support, administrative fluidity, and financing, as well as abundant, decarbonized, and competitive electricity. The measures being implemented by European mining companies point to the emergence of sustainable, but also more expensive, European mines. Projects will have to be developed in France, a country which has real know-how (Bureau des Ressources Géologiques et Minières [BRGM], École des Mines, Commissariat à l'Énergie Atomique [CEA], and industrial players such as Orano, Eramet or Imerys). This will not only strengthen its resilience, but also its credibility in terms of mining diplomacy.

Outside Europe, while waiting for the deployment of new, more sustainable mines, France and the EU must support the improvement of practices in existing mines abroad, notably through: financing schemes to support the costs of modernization and decarbonization, the strengthening of monitoring mechanisms and the sharing of best practices, as well as continued efforts to harmonize ESG standards across the global mining industry. Finally, cooperation with European players should be made more attractive to resource-holding countries, while encouraging them to improve their practices and regulatory frameworks.

If it is to play a strategic role in the metals sector, France must choose its battles carefully. For EV batteries, the main metals are lithium, cobalt, manganese, nickel, graphite and copper. Lithium is abundant on Earth,

and while consumption is set to rise sharply, production is set to keep pace, as is investment in recycling (which remains difficult). Nevertheless, there is a need to further improve the environmental footprint of lithium supplies. The efficiency of cobalt recycling will increase, and the use of cobalt in new battery chemistries will be limited. However, the increase in EV sales implies a sustained demand for cobalt. Manganese is playing an increasingly important role, and although it does not currently raise any supply challenges, its recycling has hardly begun. Nickel raises problems given its carbon footprint in Indonesia and the imperative of refining, controlled by Chinese players. Producing cleaner nickel can be done in Europe, as in Finland, but it is more expensive. Copper mines are long and costly to build, and the quality of resources tends to decline, while recycling has yet to be developed: the large quantities of copper currently used in drinking water pipes and telephone wires will be replaced by polyethylene terephthalate (PET)³ and optical fibers. Finally, graphite supplies could be scarce, and supply is largely controlled by China.

Priorities for action thus include improving the environmental footprint of lithium mining and refining as well as manganese refining; copper mining and recycling; cleaner nickel production and processing; and supporting the complete graphite value chain. The final major challenge is the production of low-carbon aluminum, for which a country with a fleet of nuclear power plants (like France) is particularly well positioned. France and the EU need to maximize national and European production potential. But we also need to be prepared to finance and develop extractive projects in “gray” countries and zones, by equipping ourselves with the instruments to do so, and by forging appropriate industrial and diplomatic partnerships. This is not just a question of security of supply, but also of the gradual dissemination of the best ESG standards, and confidence in the technologies of the energy transition.

With the Batteries Regulation adopted at the European level in 2023, the EU has taken a holistic approach to the sustainability and environmental performance of batteries (which could be further adjusted to promote smaller batteries). This regulation encompasses the entire battery life cycle, giving a key role to recycling obligations and the reintegration of recycled metals into batteries. In addition to the regulatory obligations of circularity, the development of the recycling industry in Europe will provide European automotive players with a powerful tool to reinforce their strategic autonomy in terms of supplying critical metals, especially after 2026 when the volumes to be processed will increase sharply from year to year (in the order of 50% to 60% per year). Initially, the main material to be

3. Plastic used in the manufacture of vehicle body components and automotive floor coverings, as well as in the production of printed circuit boards, cell phone housings and other electronic devices.

recycled will be waste from battery production, up until around 2030. However, the competitiveness of the European battery recycling industry will depend on its ability to secure supplies of factory scrap in the short term, and of used batteries (black mass) in the longer term. It will also depend on reduced transport costs, improved performance (including environmental performance) in terms of metal recovery and the control of input costs (such as energy), the availability of land, rapid licensing, and a well-trained workforce. A challenge is that current scrap is not recycled in Europe, which should be addressed rapidly.

Last but not least, Europe is working towards setting for itself the ambition of processing and refining at least 40% of its annual consumption of strategic raw materials within its borders by 2030. This seems hard to achieve under current circumstances, but should provide a strong impetus for change, although Europe faces the structural disadvantage of higher energy prices than its competitors. Thus, the first condition for achieving Europe's ambitions is to ensure the massive deployment of decarbonized electricity. However, while battery cell production is taking off in Europe and France (projects pop up and several factories already opened, which is a great success as they are very capital intensive and technologically complex, yet possible delays are a risk for the industry), the landscape is still very uncertain regarding the production of precursor cathode active materials (PCAM) as well as cathode and anode active materials (respectively CAM and AAM).⁴ The latter are essential but currently largely supplied by non-European players, mainly from Asia. These are also capital-intensive elements of the value chains, which are technologically complex and comprise also environmentally challenging production processes. The supply of low-carbon aluminum and semiconductors also remains uncertain. Several critical points need to be taken into account to strengthen this intermediary part of the value chain in Europe, including: the implementation of competitive, easily accessible financing options at the European level; the ability to stock gigafactory scrap and black mass (the black powder obtained by crushing battery components, whose elements must then be separated, processed and reused) in Europe and recycle them in Europe; the supply of competitive, low-carbon electricity; and the guarantees of a level playing field to enable the value of "virtuous" European production to be enhanced in terms of ESG standards.

4. CAM refers to cathode active material and AAM to anode active material.

The resilience challenge: bridging the gap between raw material needs and domestic supply capacities in France under different scenarios

Given the importance of and the challenges related to critical metals in the development of an EV value chain in France, and more broadly in Europe, this study has analyzed and quantified the gap between domestic raw material requirements and domestic supply capacities (extraction and recycling) between now and 2035.

Five demand scenarios are examined by varying: 1) vehicle fleet size (i.e., the return to pre-Covid sales dynamics vs. a moderation dynamic implying that not every internal combustion vehicle leaving the fleet is replaced by an electric vehicle, hence assuming a 15% reduction in sales thanks to other forms of mobility); 2) battery size (55 kilowatt-hours [kWh] in the business-as-usual scenario, 40 kWh for the moderated demand scenario, and 30% at 80 kWh and 70% at 55 kWh for the large cars scenario); 3) and the composition of battery chemistries (pure domination of NMC chemistry vs. 30% penetration of other chemistries).

This analysis shows that for France:

- ▀ Domestic supply (taking into account both extraction and recycling projects) is far from meeting demand, except in certain cases for lithium, where demand could be largely met in the long term (assuming that all extraction and refining projects come on stream) but only in the demand-moderation scenarios that involve a reduction in the overall size of the vehicle fleet and in the size of EV batteries.
- ▀ If the EV fleet in France were to develop based on a growing share of large vehicles (30% with 80 kWh batteries and 70% with 55 kWh batteries), then this would significantly increase pressure on demand for raw materials (up by 14% for all the metals studied).
- ▀ Compared with the business-as-usual scenario, the scenario combining demand-moderation (a reduction in the number of cars and battery size) and a diversification of chemistries makes it possible to achieve a reduction in requirements of the order of 36% for lithium, 57% for cobalt, nickel and manganese, 30% for graphite and 29% for copper.

- In the demand-moderation scenario (with a 15% reduction in the number of cars on the road and average battery size limited to 40 kWh), the reduction in requirements is 38% for all raw materials, while the diversification of chemistries considerably reduces the need for cobalt, nickel and manganese, by 30%. Towards 2040, recycling could become a key lever in the security of supply of critical raw materials. The potential for recycling is promising (corresponding to the quantities of metals that would be extracted if all available material were processed, both from the scrap that gigafactories are set to produce and from EV batteries reaching the end of their lives), as it could potentially cover up to 80% to 85% of needs, depending on the metal envisaged. However, the projects currently announced are significantly below the potential.

The study replicated the five scenarios for Europe as a whole, providing an overview of the balance between raw material requirements and domestic supply capacities, based on existing sales projections. It follows that, in a business-as-usual scenario:

- The sector's needs up to 2050 cannot be met solely by domestic supply. But if all the recycling potential (i.e., available black mass and scrap) is used, a coverage rate of around 50% (or more) of requirements for the main battery metals could be achieved. The gap to be bridged in the case of lithium supply remains substantial, despite a scenario where recycling potential materializes, hence the importance of significant lithium production and refining capacities in Europe.
- The recycling of used batteries is a decisive factor in strengthening the strategic autonomy of the European automotive sector, but only in the long term. Over the next few years, it will mainly concern scrap from gigafactories and will remain marginal, before being more significantly supplemented by end-of-life batteries as of 2028-2030. The recycling projects announced at the EU level so far do not match the total recycling potential. But the gap is much smaller at the EU level than in France. Recycling copper and steel is of immediate priority.
- Europe will need to set up mining partnerships with third countries to secure the supply of around half of its requirements in critical metals for batteries (lithium, cobalt, nickel and graphite), as well as acting quickly to ensure that scrap and black mass remain in Europe, to avoid increasing dependence on imports. As in the case of France, levers such as demand-moderation, diversification of battery chemistries and the deployment of alternative means of transport will be key to reducing the need for metals.

Winning the industrial challenge of the battery value chain for clean mobility thus involves focusing on ten levers:

- ▀ Developing a holistic approach to the supply of critical raw materials, focusing on five key areas: domestic extraction, refining, mining diplomacy and CSR standards, strategic stockpiling and recycling.
- ▀ Ensuring the stable and competitive supply of low-carbon electricity.
- ▀ Building integrated partnerships with European players in all stages of the EV value chain, with a view in particular to rapidly securing a certain number of CAM and PCAM production capacities, and supporting innovation in battery chemistry, which is the only way for Europeans to distinguish themselves from China.
- ▀ Planning in order to acquire an integrated mastery of the value chain, to develop the skills and train the workforce.
- ▀ Moderating the demand in critical raw materials as a key to resilience, as alternative means of transport, fewer car sales and smaller batteries, contribute bring down the raw material requirements.
- ▀ Re-imagining mobility to make it more sustainable, accessible and fair.
- ▀ Setting up and calibrating a support system for the deployment of the different stages of the electric mobility value chain in France, whose cost to the national budget could be in the region of €8-9 billion a year, over the next few years.
- ▀ Protecting industries from unfair and less virtuous practices.
- ▀ Exploiting the growth of electric mobility to strengthen the integration of variable renewable energies into power systems.
- ▀ Ensuring that the EU has the appropriate resources to meet the multiple industrial and technological challenges linked to EVs in the context of polycrises. Only some of these have been covered in this study, as EVs cannot be reduced to batteries alone, and involve many other key issues.

Ten key recommendations to succeed in the industrial challenge of electric mobility

1. A holistic approach to the supply of critical raw materials needs to be developed. It should focus on five key areas: domestic extraction, mining diplomacy, mining investment outside the EU, strategic stockpiling and recycling

- ▀ **Domestic extraction:** At this stage, France's mining potential to meet the needs of the automotive industry only stands out concerning lithium. Also, some European countries have significant but insufficient reserves. It is thus vital to relaunch underground exploration, especially in deep layers. This needs to be accompanied by solutions to support mining projects, such as one-stop shop(to simplify procedures), funding at preferential interest rates (to boost project viability) and access to decarbonized, competitive electricity. The metals fund managed by InfraVia and initiated by France2030 could be a useful tool for the development of such projects, while the financing of a mining inventory, particularly in deep substrata, needs to be formalized. In addition to speeding up permitting, a conducive environment for mining projects, favoring their acceptability by the populations, must be created. This requires a concerted effort by all stakeholders to establish the golden rules of responsible mining in the areas where projects will be developed, in terms of consultation, project design, implementation and site reconstruction.
- ▀ **Mining diplomacy:** First and foremost, an international framework of definitions and standards for sustainable mining needs to be established. It should be harmonized and stable over time, and accompanied by adequate support for implementation (training, certification, funding, etc.). Resource-holding states must be made accountable for the application of this sustainable normative framework by mining companies. However, it is necessary to work with countries that are not yet virtuous and provide them with support. This has to be part of a broader economic partnership that also aims to meet their needs in developing their value chains. A country committing to such a partnership and making progress must be fully recognized in certification mechanisms. The European taxonomy, which deserves to include mining activities, must play a role here. The establishment of strategic

partnerships between the EU, France and resource-holding countries must be pursued with a view to a better distribution of wealth and more widespread, unhindered access to resources. Actions to be implemented include: preferential interest-rate financing and de-risking instruments for take-off (via the European Bank for Reconstruction and Development [EBRD], the European Investment Bank [EIB], national development agencies such as Agence Française de Développement [AFD], or via European programs such as Global Gateway and national investment funds), export credits, or financing for infrastructure packages. From this point of view, it is essential to lead a structured effort concerning sub-Saharan Africa, with win-win partnerships in the fields of renewable energies and electricity power systems, public infrastructure, metals and biodiversity.⁵ The bilateral agreements (Memorandums of Understanding) signed by the European Commission (EC) are a step in the right direction (notably with Kazakhstan, Ukraine, Namibia and Argentina), as are those signed at the French bilateral level (Canada, Australia). However, these now need to be driven forward by ambition and concrete achievements. Finally, it is also important to work towards the establishment of mechanisms at the international level to enhance the transparency of metal markets. France and its European partners must be in a position to offer high-quality partnerships that can be implemented quickly and effectively, in countries where the urgency of underdevelopment requires us to “strike fast and hard”. But it is also important to work on improving governance frameworks and help stakeholders to better define the responsibilities of governments, local communities and businesses.

- **The mining diplomacy and security of supply for French industries cannot succeed without an active strategy of investments in mining and partnerships abroad.** France has some truly competent players (Eramet, Orano, Imerys), water specialists such as Veolia, banks active in these sectors (Natixis, Société Générale, BNP Paribas), the AFD, the metals fund managed by InfraVia, and specialized infrastructure funds. Partnership opportunities exist with foreign players such as the Japan Organization for Metals and Energy Security (JOGMEC). Other European players can be mobilized (including Germans, Swiss, and Poles in particular, large and small trading companies specialized in countries or metals, with logistics know-how). The challenge is to get off the beaten track, to take risks, and to accept working quickly, with the right players, in complicated countries and under conditions that will be far from optimal at the outset. This means moving forward as a team, with resources, partnerships and agility, because the competition from China and the Middle East already has such assets.

5. M.-A Eyl-Mazzega, “Quel cadre pour un partenariat énergétique et climatique Europe-Afrique gagnant-gagnant ?”, *Notes de l’Ifri*, Ifri, July 2023.

- **Strategic stocks:** Building up strategic stocks of certain critical metals for the automotive industry – mainly copper – could provide a solution to problems such as the manipulation of metal prices, increasing export restrictions or crises affecting the mining sector. Ifri has already detailed the form this strategic stockpile project should take, coupling it with a central purchasing unit and an active metals management hub.⁶ The preferential purchase and recycling of gigafactory scrap, for which there is strong competition but which governments have co-financed, could form part of this stocks strategy. So could the provision by governments of land and storage sites. However, funding is expected to come mainly from European sources.
- **Refining:** It plays a crucial role in obtaining battery-grade materials, which can be decisive in battery performance. This is, however, a very costly capex stage in the value chain, that is very energy-intensive and very polluting. It will not be possible to bring all refining back to Europe or France, and mining companies ideally want to set refining facilities up next to their extraction sites. It is therefore necessary to choose target materials carefully, primarily lithium, nickel, manganese and copper.
- **Recycling:** As illustrated in this study, battery recycling could enable France and the EU to achieve a very high level of self-sufficiency in the long term. It is therefore imperative to ensure that battery and plant waste from every stage of production is recycled on European soil, and that reincorporation targets are met for each material. To this end, their classification as hazardous waste is key, as is the creation of sufficiently large recycling capacities. Support for research and development (R&D), aimed at reducing the environmental impact of recycling and metal transformation processes, must be reinforced.

For all these steps, governments must ensure that land and electricity connections are made available, that the deployment of renewable energy sources complements nuclear power, and that permit procedures are expedited.

2. Ensuring a stable and affordable supply of clean energy

The creation of a comprehensive electric mobility value chain in France and Europe requires the construction of electricity-intensive facilities (mines, conversion plants, CAM, AAM and PCAM plants, gigafactories, and recycling plants). This means that the price and carbon content of electricity will be a key competitive factor for the European electric automotive industry, surpassing the importance of the labor cost factor, as factories are highly automated. Electricity market reform at the European level must

6. V. Donnen, “Vers une ère métallisée: renforcer la résilience des industries par un mécanisme de stockage stratégique de métaux rares”, *Notes de l’Ifri*, Ifri, May 2022. See also the work of economist Emmanuel Hache on this subject.

reassure industrial players that decarbonized electricity will be available at predictable and competitive prices, not only in the long term, but also in the immediate future. Power purchase agreements (PPAs) for the supply of renewable electricity need to be made more accessible to manufacturers and equipment suppliers, including through public guarantee schemes for small and medium-sized enterprises. Moreover, their implementation must be facilitated by speeding up approvals for renewable energy installations and their connection to the grid, as well as by strengthening transmission and distribution networks. For those countries wishing to do so, the extension of existing nuclear power plants, as well as investment in new nuclear facilities, should also be facilitated in the same way as renewable energies. The development of storage, interconnections and the deepening of energy system integration should enable stable electricity supplies, hence the need for greater collaboration between European countries to deepen the Energy Union, particularly with a view to the 2040 horizon.

3. Building integrated partnership with European players in all stages of the EV value chain, with a particular view to rapidly securing a certain number of CAM, AAM and PCAM production capacities

From this perspective, a European Sovereignty Fund would also serve to finance this type of projects, to improve resilience in the field of PCAM, CAM and AAM, as these could eventually become bottlenecks for European battery factories. Yet it is important to remain lucid about the industrial time frame. To supply future PCAM and CAM plants, it is essential to ensure that black mass does not leave Europe to be processed in Asia. Its classification as hazardous waste seems necessary, as does a possible extension of the EU's carbon border adjustment mechanism (CBAM) to the battery precursor and active materials sector. This is necessary to encourage more sustainable production in Europe and elsewhere in the world (potentially including criteria other than carbon content, while also extending the CBAM to semi-finished and finished products). France still needs to consolidate its R&D policy, which is at the heart of the industrial battle for clean mobility (involving battery chemistries, recycling, metal refining, software, Vehicle-to-grid (V2G), autonomous driving, etc.). Tax credits are essential, but so are public-private partnerships and the protection of research in such a strategic field. French and European players can overcome the technological catch-up with Chinese players only if they succeed in developing their own chemistries and processes. Resilience will also be strengthened by the use of diversified chemistries. Last but not least, consistency among different European legislations must be ensured, as for instance the ongoing discussions around the REACH regulation are raising concerns in the automotive industry about the medium-term ability to produce batteries in Europe.

4. Planning to acquire an integrated mastery of the value chain and ensuring an appropriate workforce

Following the example of the French Atomic Energy Commission in the 1960s, France should develop a similar instrument, such as a General Committee for Electric Mobility and New Forms of Mobility. This would be the executive arm of a Strategic Industry Committee and would also draw on the work of the French Metals Observatory for Industrial Sectors (OFREMI).⁷ This would enable France to develop integrated expertise in all stages of the electric mobility value chain (including thermal management, semiconductors, and high-performance materials), as well as genuine know-how and a strong capacity for innovation. It is necessary to better coordinate and support the scaling-up of innovations to ensure that new solutions are industrialized in France and Europe. This must be supplemented by a robust training policy, developed in close coordination with industrial players, to ensure that training and educational institutions can supply the technicians, engineers, managers, chemists, etc. who are essential to the development and maintenance of new infrastructures and state-of-the-art equipment. The inclusion of women in these professions will be a major condition for meeting the needs of these new industrial sectors.

5. Demand-moderation as a key to resilience

Europe and France will be faced with severe constraints in the supply of critical raw materials. These will be exacerbated if sales of large electric cars take off. Producing large batteries for large vehicles makes no sense in terms of the effects of immobilizing large volumes of raw materials, the footprint associated with extracting them, the worsening security of supply risks, and consequently the potential effects of slowing down the switch to electric mobility and increasing pressure on the environment and communities living near mining sites (as there is no such thing as 100% clean and sustainable mining). Bonus-malus car-pricing strategies based on battery power are relevant and deserve to be tightened up and extended to the whole of Europe, as well as to all G7 and G20 countries, but with exceptions, such as for short-term rentals, in order to favor backup solutions. By the same token, limiting freeway speeds to 110 kilometers per hour (km/h) or 120 km/h as in Belgium and Portugal, and stepping up speed controls, will reduce fuel consumption not only by internal combustion vehicles, but also by EVs, which would then require less autonomy. More generally, societies need to think more about the cost of immediacy and the need to optimize occupancy rates and journeys (for example, for deliveries). A concerted effort by all public, private and citizen/consumer players is needed to meet the industrial and societal challenge of electric road mobility.

7. OFREMI stands for « Observatoire français des métaux pour les filières industrielles » in French.

6. Re-imagining mobility to make it more sustainable, accessible and fair

In an era of digital and energy transitions, replicating the model of internal combustion mobility to the field of electric mobility would not be in line with French and European climate objectives. Public authorities need to speed up the introduction of new forms of shared mobility (carpooling to increase occupancy rates, trains, buses, taking bicycles on trains and buses at peak times, etc.) and mobility as a service. This requires coordinating with users and industry players, notably with the help of digital tools and artificial intelligence (AI). Other forms of mobility must also be favored, while it is essential to help low-income households access EVs (for example, facilitating EV leasing at €100/month). A system of incentives/penalties could be useful to discourage the purchase of a second family car and the use of other types of mobility, without penalizing people living in hard-to-reach or disadvantaged areas. Rail should be modernized and reinvested in, not only to reduce road freight, but also to make trains more attractive by promoting fares for groups/families/low-income earners, the possibility of transporting one's car by train, serving more destinations at more hours (including with night trains). The number of public transport solutions in towns and cities must be expanded, cycling and walking should be encouraged with protected routes, while teleworking, the reorganization of working hours and vacation periods should be reconsidered. Twenty percent of French people live in rural areas, and many of these alternative solutions are not suited to them. These people, who often have old vehicles that are used little, must not be trapped and ignored, and specific assistance will be needed for them. EVs alone will not solve the problem of increasingly polluting mobility if there is no societal effort focused on a more moderate consumption, more flexibility and territorial inclusion.

7. Support for the deployment of the clean electric mobility value chain in France must be calibrated and long-term. Its cost to public finances in the coming years could be about €8-9 billion a year

The costs of deploying the main stages in the electric mobility value chain are more than €100 billion in France over 15 years. These will be shared by automakers, the central government and local authorities, as well as by organizers of the EV charging infrastructure and by users. All in all, the estimated cost to the national budget will thus be around €55-60 billion for over a little more than ten years, which is at least €5 billion a year on average. Yet it will be much more in the next few years in order to kick-start capital-intensive investments. Costs will only fall later, once the plants, terminals and mines have been built, and when supporting EV purchases will be the main area of intervention. If we estimate that 70% of the sums must be allocated over the next five years, then this represents an expenditure of €40 billion, or about €8-9 billion per year between now and

2030, which is considerable. These sums deserve to be included in budget forecasts, which should be able to be planned over several years and not be called into question every year. This multi-year budgeting must also take into account the gradual decline in tax revenues linked to the drop in fuel consumption, as well as other tax opportunities, such as the increase in revenues linked to carbon taxation. It should be recalled that France's oil bill reached €58.6 billion in 2022. The substantial public spending efforts should therefore help to reduce this bill considerably, in a context in which the oil price is likely to remain high (due to continued high demand and chronic under-investment). At the same time, however, spending on certain imported materials will rise. Although France's Finance Bill for 2024 does not set out such multi-year forecasting, it nevertheless includes a first major step in this direction. Henceforth, the government will have to submit a multi-year strategy to Parliament each year (along with the annual Finance Bill), setting out financing for the energy transition, which will be debated in France's National Assembly and Senate.

8. Protecting industries from unfair and less virtuous practices

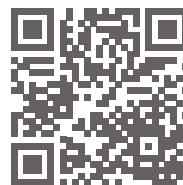
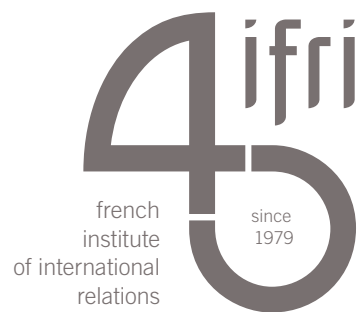
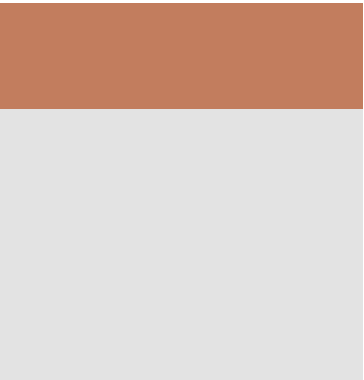
Public authorities must protect European players against dumping, intellectual property violation and hostile share purchases and takeovers. But it is also vital to face off competitors benefiting from unfair advantages and operating with high carbon footprints, while not being subject to similar regulatory constraints. The CBAM has now been adopted and should be extended to include semi-finished and finished goods such as EVs and batteries, and to avoid side effects. The latter include a rise in the price of European steel to the detriment of competitiveness within Europe itself, and unfair competition on semi-finished goods and equipment. The ambitious eco-design policy that is taking shape must be effectively implemented, in line with progress in decarbonizing the European steel industry. This also requires progress on emissions accounting standards, together with progress on reporting and traceability systems so that the efforts of European players, including equipment manufacturers, are safeguarded. That said, it is important to avoid the trap of industrial decoupling. Chinese investment in France and Europe should be possible, provided that it complies strictly with all the rules to which European manufacturers are subject, and it seems that some of these Chinese players are already able to demonstrate good environmental performance in certain stages of value chains. Finally, Europeans and Britons should do their utmost to amend existing agreements, which are about to tax EVs and risk penalizing industries on both sides of the Channel, at such a crucial time.

9. Exploit the growth of electric mobility to strengthen the integration of power systems

Electric mobility could facilitate the integration of renewable energies and the management of consumption peaks by the intelligent control of EV recharging. This requires electricity grids to be adapted to accommodate a large number of EVs, not only as grid users but also as storage service providers. This opportunity must first be fully mastered and understood in terms of its impact on battery life, understanding associated uses/practices and barriers/opportunities, etc. It then needs to be integrated as quickly as possible into plans for power system developments and be supported thorough coordination with grid operators. In addition, priority should be given to lithium-iron-phosphate (LFP) and second-life batteries, as well as to other technologies (such as heat and cold networks, flywheels, etc.) for stationary electrical storage, to limit pressure on demand for critical metals in battery manufacture.

10. Ensure that the EU has the appropriate means to respond to polycrises as well as to different industrial or competitiveness challenges

While work needs to continue with respect to clarifying the support schemes available to European industries through various European funds, the EU needs to tackle other factors to improve its competitiveness in the face of support mechanisms such as the United States's Inflation Reduction Act (IRA). This means notably strengthening training and R&D policies, building the infrastructure essential to industry (electricity and hydrogen networks, land assets, railroads, ports, etc.), and facilitating investment, including tax credits for strategic stages in value chains. The EU budget must be increased to enable it to compete in the global industrial arena, but also to prevent fragmentation of the single market through the unequal granting of state aid to industries, which would be unfavorable to countries with limited budgetary capacity. Last but not least, the EU's strategic approach to EVs should not be focused only on battery cells but encompass all the pieces of technology and equipment, such as semi-conductors, controls, software, plastics, aluminum.



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