Industrial Policy for the Battery Age

Lessons from China, Indonesia, and Morocco

IISD REPORT

International Institute for Sustainable Development

July 2026

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**Industrial Policy for the Battery Age:
Lessons from China, Indonesia, and Morocco**

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Acknowledgements

The authors would like to thank the IISD team—Ieva Baršauskaitė, Alice Tipping, Rashid S Kaukab, Satish Triplicane, and Isabelle Ramdoo—for their contributions throughout the development of this publication. The authors also wish to acknowledge the valuable input of the trade negotiators and experts who reviewed earlier drafts of this publication. We also thank the Open Society Foundation for its generous support.

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Abbreviations and Acronyms

BESS	battery energy storage system
CFPP	coal-fired power plants
DRC	Democratic Republic of the Congo
EU	European Union
EV	electric vehicle
FDI	foreign direct investment
FTA	free trade agreements
GHG	greenhouse gas
IBC	Indonesia Battery Corporation
ICE	internal combustion engine
IEA	International Energy Agency
LFP	lithium iron phosphate
MIIT	Ministry of Industry and Information Technology
NEV	new energy vehicle
NPI	nickel pig iron
NZE	net-zero emissions
NMC	nickel manganese cobalt
OCP	Office Chérifien des Phosphates
R&D	research and development
SEZ	special economic zones
TDKN	domestic component-level requirements
WTO	World Trade Organization

1.0 Introduction

By Aaron Cosbey

Industrial policy is now a fact of life for national policy-makers worldwide. A recent World Bank report characterized industrial policy as “back with a vengeance” (Fernandes & Reed, 2026). Indeed, it can be argued that it was never “gone” but rather was quietly practised by most economies, even during the years when it was officially out of fashion.

Its drivers are diverse and include a desire for strategic autonomy in sectors deemed critical in a world where free trade is no longer assumed; a competitive desire to capture market share in the growing sectors of the future, many of them clean technology based, and to maintain market share in evolving legacy sectors; and a desire to dramatically reshape economies in line with the imperative of sustainability in the face of the triple crisis of climate change, pollution, and biodiversity loss.

The present report is born of the need to better understand the implications of the rise in the use of industrial policy, in terms of geopolitical implications, effectiveness in achieving domestic objectives, impacts on trading partners—in particular, developing and least developed—and systemic implications for international trade policy.

Because every exercise in industrial policy is unique, shaped by a national context of politics, economics, and industrial starting points, among others, the quest for that deeper understanding is well served by a case-study approach. This report brings together analyses of three cases of industrial policy support for modern battery value chains, spanning from extraction and processing of raw materials through battery production and, ultimately, the manufacture of electric vehicles (EVs) and battery energy storage systems (BESSs).

The battery value chain is a significant focus of industrial policy worldwide, for good reason. Batteries are the costliest component of EVs. Historically, they have accounted for up to half of EVs’ costs (Ritchie, 2022), but in recent years, they have fallen to between 30% and 40% (Cepnik & Linder, 2026). In tandem, demand for EVs is growing exponentially, accounting for one in every four new cars sold in 2025, or five times the share from 2020 (IEA, 2026b). From a climate perspective, batteries are the main driver of affordability in the decarbonization of transport—the world’s third-biggest sectoral source of emissions after energy and industry. Batteries are also critical for providing stability for intermittent sources of renewable electricity such as wind and solar, and rising global investment in that technology has driven cost decreases on the order of 20% per year over the last decade (Ember, 2025). As a result, in 2025, the world added 108 GW of storage capacity of this type (enough to power almost 100 million houses), up from additions of just over 6 GW in 2020 (IEA, 2026a). Serving those two dynamic main end uses, the battery sector is experiencing explosive growth, with the IEA scenarios showing investment by 2030 at between USD 500 billion and 800 billion—an increase over 2023 of between 250% and 400% (IEA, 2023). Industrial policy in many countries seeks to capture a share of the lucrative global markets that growth entails.

The case countries considered in this report are China, Indonesia, and Morocco. The report starts with China, as an example of a coordinated suite of policies that has managed to capture global market share along the entire value chain. The Indonesian case offers insight into the difficulties of such an approach—Indonesia's policies have been highly successful in fostering investment in the downstream processing of battery-grade nickel, but face challenges in moving further into battery or EV manufacturing. Morocco's case starts with similar ambitions of vertically integrated production, building on existing strengths from mining to manufacturing, but is still in early stages.

Each case offers a very different perspective on objectives and policy tools, and on the areas along the value chain in which those tools are employed. The sections immediately following are careful descriptions of each case. These are capped by a concluding section synthesizing the lessons that they offer, in terms of effective use of industrial policy; the nuances the cases highlight for spillover effects of industrial policy, both positive and negative; and the implications for trade policy and governance. Unavoidably, these lessons are specific to the cases from which they are drawn, but they still hold important general value as we consider how to move forward in an area of international economic governance that would be well served by international cooperation and accord.

This report is part of a suite of work from the International Institute for Sustainable Development on the trade aspects of industrial policy. That work has, over the past 2 years, drawn on expert input in a workshop format and last year produced a foundational survey of the challenges and opportunities of "green" industrial policy (Altenburg et al., 2025). This report will be followed by further case study work focused on industrial policy in the steel sector.

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2.0 China: Building battery dominance through adaptive industrial policy

By William Davis and Bertram Lang

2.1 Introduction: China's rise as a battery powerhouse

China's dominance in global battery value chains today appears overwhelming: in addition to being the main refiner of most metallic materials used in batteries, the country also accounts for the vast majority of component production (e.g., cathode active materials, anode materials, and battery cells), of batteries themselves, and key downstream products such as EVs (International Energy Agency [IEA], 2025b; Lombardo et al., 2026).[1] The present case study explores how China's industrial policies have laid foundations for this dominance, and their implications for the country itself and the rest of the world. This includes an examination of the political drivers and macroeconomic mechanisms behind China's rise, as well as recent adaptations to mounting geopolitical challenges.

The development of China's battery industry is best understood within the larger industrial policy framework that has sought to balance innovation promotion and long-term economic growth with political control and economic security. The leadership's attention to economic security has been further heightened by exacerbated geopolitical friction and China's perceived vulnerability in terms of access to strategic raw materials and energy. All these concerns are reflected in the Dual Circulation strategy, first presented by President Xi Jinping in 2020 and integrated into the 14th Five-Year Plan for Economic and Social Development (2021–2025) as a party-led political economy concept that prioritizes sovereignty, security, and technological self-reliance rather than merely aiming for a macroeconomic demand stimulus. Dual circulation reconfirms the necessity of "international circulation"—a partially open economy relying on transnational supply chains and export markets—but unambiguously aims for "a new development pattern with domestic circulation as the mainstay" (National Development and Reform Commission, 2021). In this regard, Vice Premier Liu He further stressed the need for Chinese policy-makers and firms to "make good use of the strategic advantage of the large domestic market" (Sina Finance, 2020). Indeed, China's huge domestic market and the party–state's ability to steer it toward both macroeconomic and political ends have been critical factors for Chinese industrial policies that are hard to emulate for any other country or national economy alone.

[1] This paper focuses on lithium-ion batteries, which are the most commonly used to power EVs. Sodium-ion batteries, which have a much smaller production, are discussed briefly.

2.2 China's Development Policies in the Battery Industry

A core rationale of China's industrial strategy, embodied in the National Medium-and Long-term Science and Technology Development Plan (2006–2020) and specified in the Made in China 2025 policy adopted in 2015 (Zenglein & Holzmann, 2019) has been to lift the country's manufacturing industry from low-cost to higher-value products while aiming for technological leadership in selected strategic sectors and gradually reducing dependencies on foreign technology and know-how across all industries.

2.2.1 Supply-side Industrial Policies, Technological Upgrading, and Vertical Integration

China's strategic industrial policy has consistently targeted EVs, batteries, and related technologies as core components of national economic transformation. The state's consistent strategic guidance, spanning the 10th Five-Year Plan (2001-2005), Made in China 2025, the Automobile Industry Mid- and Long-Term Development Plan (2017), and recent new energy vehicle (NEV) development plans (State Council, 2020), enabled China's industry and knowledge ecosystem to amass know-how and technological advantages in lithium-ion batteries that other countries today can hardly match—even though the technology was first developed, invented, and commercialized in Europe, North America, and Japan (Reddy et al., 2020). This policy focus on the EV supply chain resulted in part from the government's realization that foreign automakers had an unassailable lead in internal combustion engine markets and technology. Political concerns about energy security and air pollution in China's increasingly motorized mega-cities also played a role (Heggelund, 2021; Reid, 2023).

The competitiveness of local firms strengthened over time, not only through central-level fiscal subsidies but also through numerous competing local government incentives and concessional financing from state-linked banks. Local and regional clusters supported the emergence of vertically integrated national champions, enabling China to consolidate leadership across different segments of the lithium-ion battery supply chain (Deutsche Bank Research Institute, 2025; IEA, 2022; Kennedy, 2024; Whitfield & Wuttke, 2026). Earlier subsidy regimes for EVs and batteries were often conditional on performance, technology requirements, and benchmarking, with standards tightened over time to push firms toward improved product quality and advanced technologies (Chu, 2021, p. 5; Hove, 2024, pp. 6–7). The use of such incentives for subsidy recipients to become more competitive over time aligns with some of the recommendations from the industrial policy literature (Rodrik & Stiglitz, 2025). A shift to more market mechanisms only occurred as domestic firms' technological capabilities matured (Gary et al., 2024). Rather than relying on direct purchase subsidies alone, the "dual-credit" system, formally implemented in 2018, established tradable performance standards for automobile manufacturers, with NEV and fuel-efficiency credits for beating the standards, creating a market-oriented and technologically agnostic mechanism to encourage corporate beneficiaries to engage in technological upgrading with massive research and development (R&D) investment (Yang et al., 2022).

Notably, this dual-credit system was also applied to foreign manufacturers located in China, encouraging domestic manufacturers to upgrade their productivity and compete with foreign firms (Allan & Nahm, 2025, p. 427). At the same time, local content and technology transfer requirements forced foreign automakers to establish joint ventures and invest in domestic supply chain development, facilitating technological learning and industrial upgrading by domestic firms (Ezell, 2024; Kennedy, 2018). The gradual relaxation of joint-venture caps after 2018 reflects China's increased technological confidence in the sector.

Crucially, rather than simply propping up a single industry, the Chinese government pursued a comprehensive value-chain strategy, combining upstream raw material acquisition, domestic refining capacity expansion, and cell manufacturing support (Boni De Nobili & Binta Maïga, 2025; Lapi et al., 2025). Supported by Chinese state and commercial bank loans, as well as sustained diplomatic outreach to mineral-rich countries, Chinese miners made strategic investments in key critical minerals across the world (including long-term offtake agreements and equity stakes in numerous local mining companies), and pursued vertical integration, including through overseas refining and precursor material investments (Deberdt, 2024; Sanchez-Lopez, 2023).

Beyond central-level state guidance and support, China's EV boom was also driven from below: shut out of lucrative joint ventures by central regulations and entrenched state-owned enterprises (SOEs), local governments allied with private manufacturers, leveraging capital markets, policy loopholes, and post-2008 credit to attract investment into local manufacturing clusters (Lu & Ma, 2026). This reflects a well-documented feature of China's reform-era political economy: the inter-jurisdictional competition built into its "regionally decentralized authoritarian" system (Xu, 2011), in which subnational governments run the bulk of the economy and experiment locally with how to best implement central-level objectives. More recently, fierce competition among innovation-driven private firms and the ready availability of relevant talent and skills in the Chinese economy were crucial in building a world-leading, vertically integrated lithium-ion battery ecosystem based on highly integrated local clusters and industrial parks (Zhao & Luethje, 2025). Leading battery firms—most notably Contemporary Amperex Technology Co., Ltd. (CATL)—pursued specialized vertical integration, moving into precursor, cathode, and cell production and recycling to close supply-chain loops. This interplay of top-down industrial policy and bottom-up firm expansion fundamentally reshaped global battery value chains and underpinned China's concentrated market position across multiple segments (Craig-Scheckman & Moore, 2025; Whitfield and Wuttke, 2026; Zhao & Luethje, 2025).

2.2.2 Enhancing the Domestic Market

In addition to the supply-side policies aimed at firms' productive capacities, the Chinese government has also pursued demand-side policies to provide a strong domestic market for EVs and battery storage systems, including

- massive support for the deployment of EV charging infrastructure (Chu, 2021, pp. 8–10);

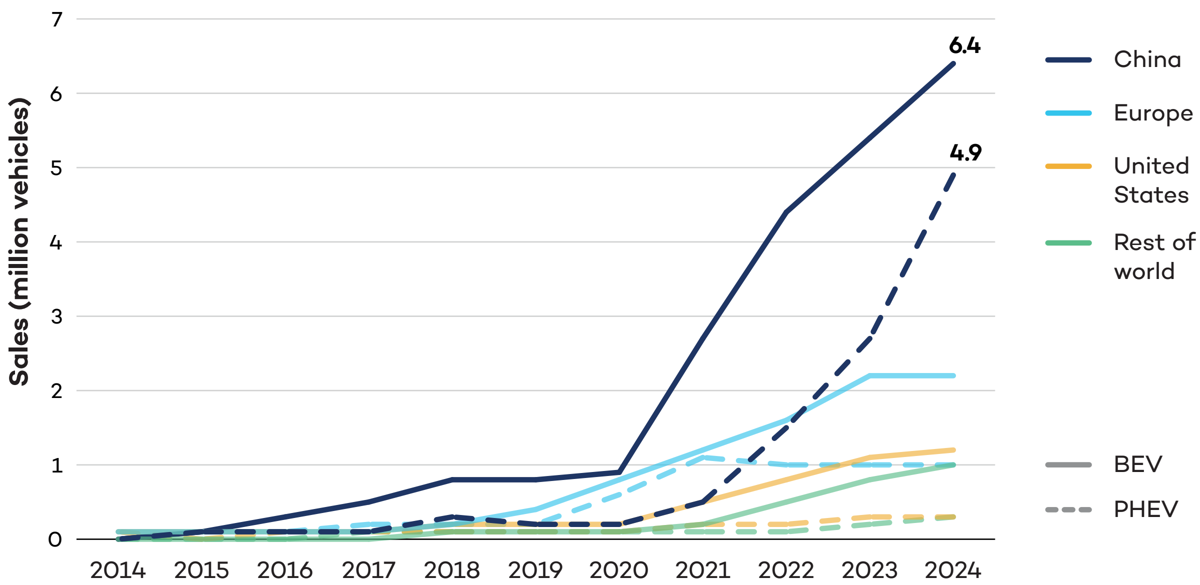
- subsidies for EV purchase until 2022; these appear to have increased the sales of Chinese-manufactured EVs and discouraged those of foreign-manufactured vehicles as a higher subsidy was offered for the former (Zhang et al., 2024);
- vehicle trade-in subsidies and tax purchase rebates (Reuters, 2025b; Xinhua, 2025);
- tax exemptions, free parking, access to bus lanes, and waivers of road tolls for EVs (Li et al., 2018);
- public procurement of and easing regulatory requirements for purchasing EVs, compared to those with internal combustion engines, also facilitated EV adoption (Gunter et al., 2025; 中国汽车报, 2013); and
- use of targets for deployment of BESSs, leading to efforts from local governments to encourage their use (Osezua & Tomomewo, 2025).

2.3 Effects of China's Industrial Policies on the Battery Value Chain

2.3.1 Accelerating EV Uptake and Dominating the Battery Value Chain

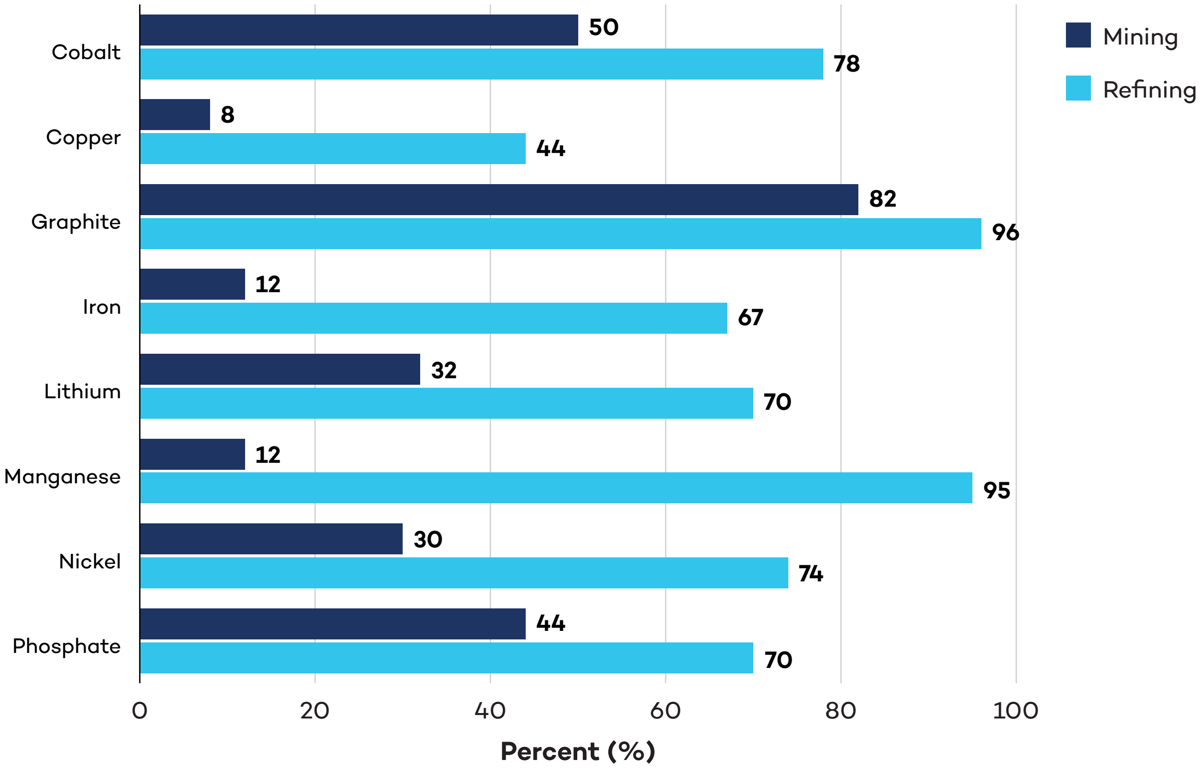
The policy framework described above laid the basis for an unparalleled boost in EV sales within China, which only made up 1% of new passenger vehicle sales in 2016, quadrupled to around 4% by 2020 (International Council on Clean Transportation, 2018, p. 10), and then surged further to surpass 53% in 2025 (Reuters, 2026b). In absolute numbers, China not only expanded its lead in the battery-electric market but also surged to world leader in the plug-in hybrid market in 2023 as a result of more flexible and technologically agnostic policy adjustments like the dual-credit policy and consumer subsidies (see Figure 1) (Li et al., 2022).

Figure 1. Global electric car sales by region and powertrain (2014–2024)



Source: Data compiled by authors from IEA, 2025 (from data last updated April 1, 2025).

Figure 2. China's estimated market share in mining and refining of key battery materials



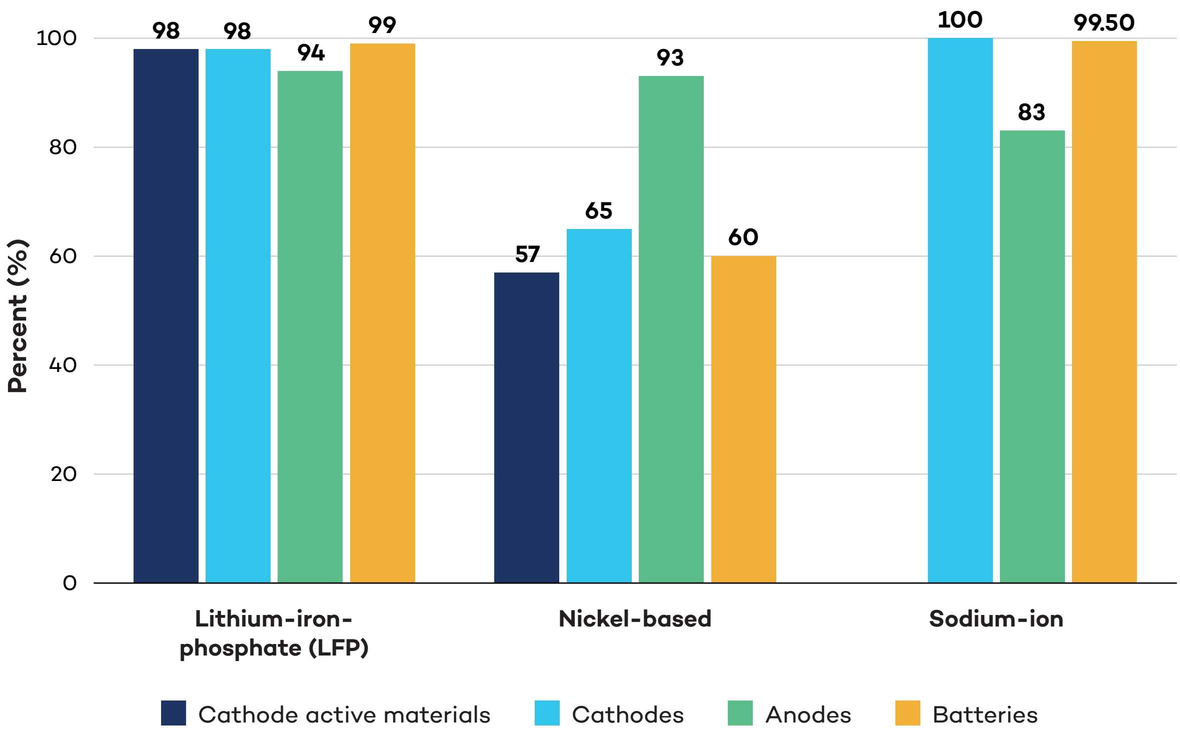
NB: Mining figures for cobalt, manganese, nickel, and lithium, and refining figures for nickel, show global market shares for Chinese companies, regardless of location and relate to various years. Other data show market shares for operations located in China and relate to 2024. The portion of the supply chain that is either controlled by Chinese companies or in China may be considered to reflect the market dominance of Chinese industry; therefore, this figure uses whichever variant (geographical or company ownership) is higher. Refining data for cobalt relate to refining for low-emission technologies; refining data for manganese relate to production of high-purity manganese sulphate; refining data for lithium relate to production of lithium chemicals; refining data for nickel relate to nickel chemicals; refining data for phosphate relate to battery-grade phosphoric acid; and refining data for iron relate to pig iron production. Mining data for graphite refer to China's share of global natural graphite mining, and refining data for graphite relate to battery-grade graphite, both natural and synthetic.

Source: Authors' calculations based on Greitemeier et al., 2025; IEA, 2024a, 2025a; Institute for Energy Research, 2023; Mining.com, 2023; National Minerals Information Center, 2026.

The sharp acceleration in 2021 reflected the convergence of several mutually reinforcing factors. The first key factor for accelerating consumer adoption was the large-scale rollout of charging infrastructure, which reduced range anxiety and strengthened network effects: China's stock of public charging points more than tripled from 2019 (0.52 million) to 2022 (1.8 million), accounting for about two thirds of global growth (IEA, 2025b). Second, the tightening of China's dual-credit policy during its second phase (2021–2023), with mandatory NEV credit targets rising from 14% to 18%, shifted the system from primarily demand-side subsidies toward a stronger regulatory supply-push model that compelled manufacturers to expand EV production (Ministry of Industry and Information Technology [MIIT], 2020). Third, rapid declines in lithium-ion battery costs substantially improved EV price competitiveness and enabled mass-market diffusion (Barwick et al., 2025). Finally, post-COVID stimulus measures, including extended purchase subsidies, tax exemptions, and accelerated charging infrastructure investment, reinforced both consumer demand and industrial supply chains during the recovery period. Together, these factors created a self-reinforcing cycle of policy support, industrial scaling, and consumer uptake, further stimulated by major cities' evolving registration controls and incentives, such as the restriction of free licence plates to battery-powered EVs in Shanghai in February 2021 and Beijing's increase of the NEV quota for new licence plates to 70% as of 2022 (Xinhua News Agency, 2021).

China's EV surge has restructured domestic industries by pushing incumbents toward electrification while low-cost models (e.g., sub-CNY 100,000 Wuling/Geely entries) have accelerated mass domestic uptake. Notably, China has not only boosted domestic demand for EVs but has simultaneously come to dominate global battery supply chains by investing heavily in the mining, beneficiation, and refining stages for key battery materials (Figure 3).

Figure 3. China's estimated market share of battery production for selected battery types



NB: Data relate to 2024, except for those on cathode active material production and overall lithium-ion battery production, where the year is unclear. Data on production of cathode active materials of lithium-iron-phosphate batteries are based on production by Chinese companies regardless of location; other data relate to production in China, regardless of company ownership. Data on cathode, anode, and battery production for lithium iron phosphate chemistry also include the respective items made using lithium iron manganese phosphate chemistry. Data on nickel-based cathode active materials relates to nickel manganese cobalt cathode active materials. Data for sodium-ion anodes relates to hard carbon anodes.

Source: Greitemeier et al., 2025; IEA, 2025a; Lombardo et al., 2026.

China's dominance over battery supply chains further extends to the technological sphere, particularly in refining minerals such as graphite at globally competitive prices. Further downstream, Chinese predominance is even more overwhelming in battery manufacturing (Figure 3); overall, over 80% of lithium-ion batteries are produced in China. Competition among Chinese battery and EV producers has been a major factor in driving global battery prices down[2] and improving performance to levels that have allowed the large-scale rollout of lithium-ion batteries and EVs worldwide and encouraged greater uptake by improving value for money offered by EVs. Chinese companies are leading the expansion of EV sales into emerging markets that are rapidly increasing their EV uptake (accounting for, e.g., 85% of EV sales in Brazil) (Mazzocco & Featherston, 2025). Battery energy storage systems reliant on LFP batteries manufactured in China are also being rolled out rapidly (Lombardo et al., 2026).

Chinese companies have also achieved crucial innovations in battery technology that promise to address concerns about EV range and critical mineral availability. They have notably pioneered applied research and the development of battery chemistries such as lithium-iron-phosphate (IEA, 2025a) and, more recently, sodium-ion that allows batteries to be manufactured with minerals that are more readily available and less geographically concentrated (e.g., avoiding the use of cobalt and nickel in batteries) (CATL, 2024; Hove, 2025).

2.3.2 Environmental and Social Effects

In China's first-tier cities, battery EV substitution has contributed to notable improvements in air quality, particularly compared to other megacities in countries at comparable development levels (Lyu et al., 2024). Uptake of EVs is also an important part of tackling climate change, in China and around the world (Hausfather, 2019; Myllyvirta, 2024). For greenhouse gas (GHG) emissions in the transport sector, China's rapid electrification already delivers substantial oil displacement and life-cycle CO_2 reductions relative to new internal combustion engine (ICE) sales, with EV expansion central to transport decarbonization trajectories to 2030 (IEA, 2024b, 2025b; Lyu et al., 2024).

Even if the emissions intensity of China's energy production is being reduced by massive investments in renewable energy production, the concentration of the battery industry in China at present may increase emissions along battery supply chains due to the continued use of coal-based electricity generation, including by leading producers of the minerals used in battery production (Davis, 2025). National-scale empirical research has also linked intensive mining activities to serious environmental harms and health risks across China, from deforestation to damage to crops and water contamination: a recent synthesis of water samples from mining areas found acidic, metal-rich drainage to be pervasive, with unacceptable carcinogenic risk in roughly half of the mining areas assessed (Yin et al., 2025). While mining has emerged as a leading source of farmland contamination through accumulation of cadmium, mercury, lead, and arsenic over decades, strengthened environmental regulation since the mid-2010s appears to have contributed to a plateauing of soil pollution (Shi et al., 2023). Furthermore, labour concerns continue to arise, including both occupational health

[2] For example, average battery prices fell by 8% in 2025 (Lombardo et al., 2026).

and safety conditions at mine sites and forced labour in processing and battery assembly factories (Ewe & McDonell, 2026; Murphy, 2023; Office of the High Commissioner on Human Rights, 2026).

Another potential negative systemic effect of China's processing dominance within mineral value chains is that it risks undermining the production of battery minerals over the longer term. A lack of local processing where minerals are extracted can reduce the economic benefits and undercut the "social licence to operate," thereby raising the risk of disruptions and conflict in mining regions that are already bearing a heavy environmental and public health toll for the production of critical energy transition minerals (Beland Lindahl et al., 2023; Diene et al., 2022; UNSG, 2025). Relocating battery processing closer to where battery minerals are mined and/or sold in final consumer products could reduce transport-related greenhouse gas emissions along the supply chain.[3]

2.3.3 Economic and Political Effects

The overall effect of China's industrial policies on foreign firms in battery value chains may be unclear. On the one hand, consumer subsidies have significantly raised overall battery demand. As a result, countries that supply battery value chains, rather than competing with them, are likely to have benefited from this trend; this includes, notably, producers of battery minerals (since China's policies have not focused on increasing domestic production of these minerals) and countries such as Indonesia that have encouraged midstream and downstream industrial development based on Chinese demand. However, for countries that compete with—or would have competed with—China further down the battery value chain, it is unclear whether the market share left to their companies in an expanded, but Chinese-dominated, battery value chain is larger than what would fall to them without China's interventions.

2.4 Economic Challenges: Overcapacity and "involution"

While China's industrial policies have helped the country achieve global domination of the battery value chain, the government now officially highlights overcapacity risks in the battery industry, as well as several other sectors (Reuters, 2026a). Indeed, CRU Group estimates that China's current battery production capacity is around 60% higher than total **global** demand (Reid, 2025). As a result, in the last few years, Chinese policy-makers have identified an undesirable trend framed as "involution" (*neijuan*)—intense competition where firms focus on price cutting and volumes rather than innovation and quality, to the extent that it is financially unsustainable for firms involved (McKerracher, 2024). This trend is leading the country to further widen its price advantage on the global battery market, but also depressing margins for EV makers worldwide (Gunter et al., 2025; IEA, 2024b, 2025b). LFP cathode producers are facing similar issues, leading many to face losses (Sanderson, 2025).

Ultimately, China's industrial policies may lie at the root of "involution." Support to EV manufacturers from local governments in China in the form of land grants, subsidies, and tax incentives has likely caused investment in production capacity to exceed economically

[3] China has challenged such measures at the World Trade Organization (WTO, 2026).

efficient levels, leading manufacturers to produce vehicles even when the market price ends up being below the cost of production (M&G Asia Pacific Equities and Sustainability teams, 2025; Reuters, 2025a). Poor enforcement of bankruptcy laws also allows unprofitable firms to continue operating, even if they default on their debts, which can worsen problems of oversupply (Deutsche Bank Research Institute, 2025; Woo, 2019).

Subnational governments' continued policy support, including for unprofitable firms and economically unsustainable business models from local governments, has certainly been further encouraged by President Xi's 2023 call to promote "new quality productive forces" (*xinzhi shengchanli*), a slogan for innovation-driven growth that is typically viewed as including NEV technologies. Notably, the official central-level policy, which explicitly draws on the Marxist notion of "advanced productive forces," focuses on building productive capacities through breakthroughs in frontier technologies without mentioning the need to keep industrial capacity in line with the level of demand (Pomfret et al., 2024). This mirrors a broader trend in Chinese industrial policy where the development of productive capacity in favoured industries is pursued without adequate attention to demand-supply balances or emerging signs of overcapacity (Gunter et al., 2025). In addition, whereas local government competition for supporting local industrial development did play a crucial role in propelling the take-off of many future industry champions, excessive industrial policy incentives in response to central government policy signals also tend to cause massive overcapacities at the national level. Although other economies experience overinvestment (e.g., through asset price bubbles), the levels currently seen in China are exceptional and can only be explained with excessive and not ideally coordinated government support at different levels (Boullenois et al., 2024; Tran, 2024).

The central government is certainly trying to encourage manufacturers to focus on innovation and competition based on quality, rather than price and volumes (Taylor, 2026). However, this may not resolve issues with overcapacity if higher prices reduce demand. Thus, the government is also reducing central tax incentives for EV manufacturing and enforcing stricter regulations to reduce production capacity, including outlawing sales priced below production cost (M&G Asia Pacific Equities and Sustainability teams, 2025). Nevertheless, automakers' importance to local governments as a source of employment and GDP to meet their policy targets may encourage them to continue to support firms and production sites that are not commercially viable by themselves. Recent empirical research confirms that by preventing the market's elimination mechanism from functioning, this kind of industrial policy is itself an underlying cause of China's overcapacity and eventually comes at the expense not only of international competitors but also innovation capacity and sustainability (Ge et al., 2024). Historically, other jurisdictions outside China have financially supported or protected unprofitable car industries, perhaps driven by similar considerations.

2.5 Global Backlash and Adjustments to Geopolitical Upheaval

Heightened geopolitical tensions, as well as the dangling threat of Chinese competition to their established automotive industries, have led regulators in several key downstream markets, notably the European Union and the United States, to raise trade barriers against Chinese EV carmakers and even battery manufacturers. For example, in response to concerns about their dependence on China for battery industries, other countries and regional blocs such as the European Union and the United States have developed protective policies for their own battery industries (Nhan, 2022). These policies have included local content requirements, subsidies, local sourcing targets and higher tariffs, and other restrictions on imports from China (Davis, 2025, pp. 33–42; Song et al., 2024). At the same time, many mining countries with their own ambitions to localize mineral processing and downstream mineral-based industries are turning to export restrictions or taxes on raw materials in response to the fact that potentially lucrative processing activities are being lost to outside competitors, mainly from China (Davis, 2024; Scurfield et al., 2025).

The reactions to this mounting backlash against EVs and components made in China testify to the adaptiveness of Chinese companies and policy-makers alike: most notably, Chinese outward investment into countries such as Mexico accelerated in recent years, with flows into manufacturing and automotive electrification sectors increasing and the stock of investment rising significantly to leverage Mexico's access to the U.S. market under the United States–Mexico–Canada Agreement (USMCA) (Interesse, 2025). In Morocco, Chinese firms have equally been scaling up battery sector investments—including multi-billion-dollar gigafactory projects and upstream precursor and cathode facilities—to leverage the country's strategic position close to European automotive markets along with its natural resource endowments in phosphate and cobalt (Bortok, 2024; Umar & Yang, 2025).

Similarly, the outsourcing of Chinese-owned refining operations to third countries has been driven simultaneously by producing country requests and restrictions on the export of raw materials—Chinese investments in Indonesian nickel processing being the strongest case in point—and by the tightening of environmental standards within China (Lebdioui & Bilek, 2021). Combined with the now world-leading role of Chinese companies in commercially mature processing technologies for key battery minerals—including graphite, nickel, and lithium—this integrated upstream-to-manufacturing model has entrenched China's central role in global battery supply chains, rendering meaningful "decoupling" efforts highly challenging.

2.6 Conclusion

China's rise along battery value chains underscores not only the potential of large-scale industrial policy but also its critical preconditions and unintended effects and pitfalls. A combination of long-term, gradually evolving, central-level industrial policy guidelines and local-level experimentation with different forms of industry and innovation support has allowed the country to dominate all stages of the battery value chain (aside from the extraction of raw materials, where its dominance is restricted to only certain minerals, such as graphite). China has achieved this through long-term planning, gradually adjusted production incentives with investment in R&D, domestic battery adoption, measures to speed technology transfer, simultaneous development of industries along the value chain, and demand-side measures like subsidies and government procurement. This experience offers key lessons for industrial policy-makers.

First, it underscores the potential for whole-of-value-chain industry strategies to be successful, in contrast to advice that is often given for industrial policy to focus on narrow segments in which one country has a competitive advantage. That said, China's immense workforce, economies of scale in production and regional economy development, and massive domestic consumer market have all facilitated such a whole-of-value-chain strategy.

Second, the case study also highlights how industrial policy support to drive down costs can accelerate the uptake of EVs and result in the transformation of entire sectors. However, industrial policy overshoot means Chinese battery and EV producers now face serious overcapacity issues, despite soaring export figures, with many becoming loss-making. This demonstrates the risks of applying overly generous production subsidies, in part driven by uncoordinated competition among local authorities.

Finally, the mixed impact of China's industrial policies on the rest of the world also precludes any easy recipes for other countries' policy responses. China's policies are arguably speeding up the transition to low-emission transport by boosting the adoption of EVs even in markets without consumer-side subsidies due to technological innovation and massive reductions in consumer prices. However, Chinese state interventions risk distorting global markets to the point of hampering innovation and production capacities elsewhere. Related concerns have triggered increasingly assertive industrial and trade policy responses in developed economies. Policies more aligned with international trade rules, such as public investment in skills development, R&D, infrastructure, and non-discriminatory tax incentives, might have prevented some of these responses, particularly from the EU side. Moreover, policies supporting battery and EV companies with more flexibility regarding the location of different value chain segments might have attenuated trade tensions with mining countries and destination markets. Thus, the next development to watch is whether China's investments in both offshore processing and production in emerging economies such as Morocco or Mexico can help reduce some of these tensions.

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3.0 Indonesia: Leveraging nickel for battery value chain upgrading

By Poppy S. Winanti

3.1 Introduction

Industrial policy has been a vital economic tool in Indonesia's development since gaining independence. This policy has become even more significant in recent years as the Indonesian government works toward its 2045 Golden Indonesia Vision of becoming a high-income nation. Indonesia's goal of developing an integrated EV supply chain and establishing itself as an EV battery manufacturer and exporter exemplifies this effort. The aim is to create a fully integrated EV ecosystem where all stages, from critical mineral processing to battery manufacturing and final vehicle assembly, occur within the country.

This analysis of Indonesia's approach to implementing trade-related industrial policies in the battery value chain illustrates how a developing country can leverage its abundant natural resources to move up the global supply chain, from exporting raw materials to producing intermediate goods and, ultimately, final goods. This effort also helps create jobs and promotes development at the local level, especially in mining regions. This approach closely reflects Indonesian resource nationalism, marked by state ownership and control of natural resources—a principle embedded in Indonesia's constitution (Walker & Palaon, 2025; Winanti & Diprose, 2020). Additionally, it supports Indonesia's commitment under the Paris Agreement to combat climate change by reducing transportation-related GHG emissions through increased EV production. However, these gains can come at the cost of social and environmental impacts, which, if not properly addressed, could have severe long-term consequences. Furthermore, because this industrial policy has drawn mixed reactions from trading partners, it is crucial to balance efforts to attract foreign investment with the risk of becoming overly dependent on a single dominant investor country.

3.2 Main Drivers and Reasons Behind the Policy

Indonesia's industrial policy in the battery value chain is primarily driven by two goals: strengthening its position in global supply chains and meeting its international commitment to transitioning to a green economy. As a country rich in natural resources—home to the world's largest nickel reserves, the second-largest tin reserves, the sixth-largest bauxite reserves, and the seventh-largest copper reserves—Indonesia has implemented policies to support its industry by maximizing resource use and increasing value addition (Coordinating Ministry of Maritime Affairs and Investment, 2024). Indonesia's downstream policy aims to stimulate resource-based industrialization by processing raw commodities into products for export and domestic consumption. Indonesia is developing a comprehensive battery supply chain, from raw ore to finished nickel-manganese-cobalt (NMC) cathodes. By prioritizing NMC over LFP, Indonesia aims to capitalize on its nickel resources, shifting from mere raw material exports to becoming a key participant in the global EV battery industry. However, it also constitutes a strategic risk as LFP batteries, which do not require nickel, are increasingly being adopted because of their cost advantage and safety improvements compared to NMC (Evro, et al., 2024). This trend is likely to reduce NMC's market share in the future.

The second key driver is Indonesia's global commitment to addressing climate change by transitioning to a green economy. This involves its pledge to reduce GHG emissions by 31.89% (unconditional) and 43.20% (conditional) by 2030 and reach net-zero emissions (NZE) by 2060 or earlier (Republic of Indonesia, 2025b). The government has committed to a comprehensive, multi-sector decarbonization plan to reduce GHG emissions. In the energy sector, in the latest update to the National Energy Policy, as regulated under Government Regulation No. 40 of 2025, the government lowered the renewable energy share targets—from an initial 23% by 2025 and 31% by 2030 to a revised range of 19%–23% by 2030 (Hartree Consultores and Kolibri, 2025). Batteries are crucial for integrating renewable energy into the power grid (Hartree Consultores and Kolibri, 2025). In 2022, to support Indonesia's renewable energy goals, PLN Group and Indonesia Battery Corporation (IBC)[4] initiated the development of BESSs. BESSs are essential for managing the intermittency of variable renewable energy sources, such as solar and wind, to ensure grid stability and reliability (Hartree Consultores and Kolibri, 2025).

The transportation sector is the second-largest source of energy-related emissions and oil demand in Indonesia, accounting for roughly 22%–28% of energy-related GHGs and over 90% of transport energy use. Road transport accounts for roughly 90% of these emissions, largely due to high private vehicle ownership (Institute for Essential Services Reform, 2023). To reduce GHG emissions in the transportation sector, the government is focusing on electrification as its primary decarbonization strategy. In 2019, Indonesia set targets to reduce GHG emissions from transportation, including a goal to put 2 million electric four-wheelers on the roads and to achieve a domestic production goal of 943,764 EVs by 2030 (Hartree Consultores and Kolibri, 2025). A key part of this strategy is the development of domestic EV production capacity.

3.3 Key Strategies and Policy Instruments

Indonesia is pursuing a comprehensive carrot-and-stick strategy to build a fully integrated EV supply chain and ecosystem, aiming to become a major producer and exporter of EVs and EV batteries. This involves targeting both the supply side, by attracting investment in EV and EV battery production, and the demand side, by encouraging EV adoption. It began with Law No. 4 of 2009 on Mineral and Coal Mining, which increased government control over mineral and coal resources (Republic of Indonesia, 2009). The law, which effectively came into force in 2014, has been amended four times. The law was initially amended by Law No. 3 of 2020, which placed greater emphasis on mining governance, transferred permit authority from subnational governments to the central government, and reinforced requirements for domestic processing and value addition. The most recent change is the enactment of Law No. 2 of 2025, which obliges coal and mineral companies to prioritize supplying the domestic

[4] IBC is owned by the PLN Group, but they operate as two separate corporate entities and have distinct roles in BESSs.

market and supporting national strategic initiatives. Additionally, several policy measures have strengthened the Law on Mineral and Coal Mining across the upstream, midstream, and downstream sectors, including Presidential Regulation No. 55 of 2019, which aims to accelerate the EV battery program. Through these policy instruments, the Indonesian government formalized fiscal incentives, performance standards, domestic component-level requirements (TKDN),[5] and subsidies, while also strengthening its control mechanism by establishing a new state-owned enterprise dedicated to this sector. Furthermore, as part of its core strategy, the Indonesian government encourages foreign investors because local companies still lack advanced technology and skills. By partnering with foreign firms, it aims to acquire capital, facilitate technology transfer, create skilled employment, and gain expertise to strengthen the domestic industry.

Upstream activities, such as mining and processing, utilize Indonesia's nickel reserves and are supported by restrictive policies, including export bans and mandates that require raw natural resources to be processed or refined within the country before export. This policy requires mining companies to process raw minerals locally and to begin smelting operations in Indonesia within 5 years of the law's enactment (Winanti & Diprose, 2020). To encourage foreign investment that would eventually lead to increased local critical mineral processing, from 2009 to 2014, mining companies could still export limited raw materials while constructing their domestic smelters. In the midstream of EV battery production, the government has implemented policies such as tax incentives (including deductions and holidays) and import duty exemptions for joint ventures engaged in mineral processing.

Downstream, in EV manufacturing, the government also introduced policies similar to those in the midstream sector, including tax incentives to attract foreign direct investment (FDI). In addition, the government supports the development of industrial zones as designated project areas that offer integrated infrastructure and simplify permitting to attract investment from EV battery component producers and EV manufacturers. To support local companies in the supply chain, the government implemented TKDN under Presidential Regulation No. 79 of 2023, which amended the previous Presidential Regulation No. 55 of 2019 (Republic of Indonesia, 2023a). This policy requires foreign companies to meet minimum mandatory thresholds for local content. To meet the minimum mandatory threshold, manufacturers must source a significant portion of their components locally; for example, 40% for two-wheeled EVs from 2019 to 2026 and 35% for four-wheeled EVs from 2022 to 2026. In addition, the Minister of Industry Regulation No. 6 of 2022 sets a mandatory minimum threshold for EVs at 60% from 2027 to 2029 and at 80% from 2030 onward (Republic of Indonesia, 2022). Battery components constitute the largest share in TKDN calculations for EVs. Based on the Minister of Industry Regulation No. 28 of 2023, TKDN for battery components of EVs is 30% from 2020 to 2023, increasing to 40% from 2024 onward (Republic of Indonesia, 2023b). Furthermore, under Minister of Industry Regulation No. 35 of 2025, foreign companies are automatically granted a baseline TKDN fulfillment of 25% if at least 50% of their total direct factory workforce consists of Indonesian citizens (Republic of Indonesia,

[5] *Tingkat Komponen Dalam Negeri* (or *Tingkat Kandungan Dalam Negeri*), which translates to Domestic Component Level or Local Content Level. It is an Indonesian certification and regulatory metric used to measure the percentage of local materials, labour, and manufacturing processes used in a product or service (Sinoqual, 2026).

2025a). This incentive is intended to strengthen the EV industry's contribution to the local workforce.

To become a leading global EV battery producer, the Indonesian government established the IBC in 2021. The IBC functions as a holding company managing the entire EV battery supply chain from upstream to downstream. It comprises four SOEs, each holding a 25% stake: PT Indonesia Asahan Aluminum (Mind ID), PT Aneka Tambang Tbk (ANTAM), PT Pertamina (Persero), and PT Perusahaan Listrik Negara (PLN). The first two are involved in mining, PT Pertamina operates in the oil sector, and PT PLN is the country's electric utility and sole electricity distributor. Although foreign companies are not required to partner with Indonesian firms to operate in Indonesia, they view such partnerships as strategic and practical necessities. Such collaborations are essential for accessing government incentives, which are mainly aimed at domestic entities, and for navigating the TKDN. Therefore, recognizing IBC's role as a key player in the battery ecosystem—controlling mineral resources and serving as the government's investment vehicle—most foreign investors, especially from China and South Korea, who seek long-term guarantees of raw material supplies and integrated projects from mining to production, are eager to partner with IBC. These collaborations focus on battery chemicals and materials, manufacturing, and EV assembly (Wijaya & Sinclair, 2025).

The main examples of these collaborations are the Dragon Project and the Titan Project, which aim to establish an integrated EV battery ecosystem in East Halmahera, North Maluku, and Karawang, West Java. The Dragon Project, initiated in 2022, involves CATL from China, through its subsidiary Contemporary Amperex Technology Thriving Clean Energy, Co., Ltd., as well as MIND ID, PT ANTAM, and IBC, with a total investment of USD 5.9 billion (Aurelia, 2026). The Titan Project was initially scheduled to launch in 2022 alongside the Dragon Project. However, after extensive negotiations, South Korea's LG Energy Solution, the original primary foreign partner, withdrew. Its role was then taken over by China's Zhejiang Huayou Cobalt, which partnered with PT ANTAM and the IBC. The project's estimated value ranges from USD 6 billion to USD 8 billion, with completion expected by late 2027 (Adhinegara et al., 2025). Besides these two projects, another example is PT HLI Green Power, a partnership formed in 2021 between South Korean companies Hyundai Motor Group and LG Energy Solution, along with the IBC. While the Dragon Project and Titan Project focus on creating a comprehensive EV battery ecosystem, PT HLI Green Power specializes in battery cell manufacturing and plans to export 98% of its production (mainly to South Korea) instead of serving the domestic market (Hidayat, 2025).

On the demand side, to encourage EV adoption, the government aims to stimulate the domestic market by implementing a relaxation policy that exempted completely built-up EVs from import duties and luxury taxes until 2025. This encourages EV manufacturers to test market potential before deciding on local production.[6] If demand increases, companies are more likely to set up manufacturing facilities in Indonesia. To increase demand, the government also supports consumers through various policies, including exempting EVs from the 15% luxury sales tax, thereby significantly lowering their prices compared to ICE vehicles. Especially in the Jakarta area, EVs are exempt from the "odd-even licence plate" traffic restrictions, allowing them to be used on all roads daily. However, the recent Regulation

[6] But this can also delay domestic production of EVs due to the incentives on offer for imported EVs.

No. 11 of 2026 by the Minister of Domestic Affairs could significantly hinder efforts to boost domestic demand, as it permits local governments to impose taxes on EVs to increase their local revenue (Republic of Indonesia, 2026). This regulation by the Minister of Domestic Affairs highlights inconsistencies within Indonesia's broader EV policy. It illustrates how different ministries have varying policies, which could negatively affect Indonesia's objectives to boost demand and strengthen the domestic market for EV adoption.

3.4 Assessing the Results

Indonesia's trade-related industrial policies in the battery value chain can be examined from three perspectives. First, given Indonesia's policy objectives and status as the home of the world's largest nickel reserves, a key question is whether the country has achieved its goal of establishing a fully integrated EV ecosystem, from mine to consumer. A second key question is what effect the various policies have had on domestic economic growth, including the extent to which they have attracted foreign investment and increased Indonesia's exports of EVs and their related materials. The assessment of economic impacts should also be complemented by an evaluation of socio-environmental impacts. Third, the policy's implications for Indonesia's trading partners, including its redistributive impact on other regional nickel-producing countries, is important.

Indonesia has made partial progress toward creating a fully integrated EV ecosystem. Before 2019, Indonesia exported approximately 30 million tonnes of nickel ore each year, worth around USD 6 billion to 7 billion. Following the export ban, raw ore exports nearly ceased, while exports of processed nickel products—such as nickel pig iron (NPI) for stainless steel, and those for the emerging EV battery sector, including mixed hydroxide precipitate, nickel matte, and nickel sulphate—grew substantially, surpassing USD 30 billion in 2022 (Guberman, et al., 2024). This marked a significant increase from just USD 1 billion in 2015 (Guberman et al., 2024). In the first quarter of 2024, iron and steel exports hit USD 7.5 billion, accounting for 2.2% of GDP—up from less than 0.5% in 2014. Processed nickel products (a combination of NPI, mixed hydroxide precipitate, nickel matte, and nickel sulphate) now rank among the top three exports, alongside coal and palm oil (Equity Team, 2024). This shift demonstrates Indonesia's successful efforts to strengthen its role in the global supply chain, transitioning from raw material exports to manufacturing battery components. However, while the country has successfully promoted increased processing of raw materials, it has yet to see significant growth in battery and EV manufacturing. Indonesia only began exporting completely built-up EVs in 2023—manufactured by South Korea's Hyundai and China's Wuling—to other Association of Southeast Asian Nations countries (Indonesian Business Council Institute, 2025).

The growth in processed exports resulted from foreign investors reacting to the export ban by investing to develop local processing capacity for critical minerals. Investors, mainly from China, began investing in Indonesia's nickel supply chain, particularly in smelter construction. Before 2013, the country had only two smelters; by 2020, this number had increased to around 13. By 2024, Indonesia operated over 60 nickel smelters, marking a significant growth compared to a decade earlier (Guberman et al., 2024; Walker & Palaon, 2025). The country is projected to account for half of the world's increase in processed nickel production by

2025 (Walker & Palaon, 2025). FDI in nickel processing increased dramatically from USD 2 billion in 2019 to over USD 30 billion in 2023, mainly driven by Chinese companies aiming to secure access to the battery supply chain (Tribhakti, 2025). China leads FDI in Indonesia's nickel sector, accounting for about 70% of the total, with Japan, South Korea, and European firms following (Tribhakti, 2025). Chinese firms are increasingly pursuing vertical integration in their supply chains, expanding their operations from refining to battery manufacturing and vehicle assembly.

The government has established integrated industrial parks in several mining areas, such as in Morowali, Central Sulawesi (known as the Indonesia Morowali Industrial Park), and the Indonesia Weda Bay Industrial Park in North Maluku, which have attracted investment across multiple sectors, from mining to downstream activities. These regions have drawn approximately USD 12 billion in investment, mainly from China, in basic metal manufacturing, including for the production of downstream nickel products, both NPI for stainless steel and products for the emerging EV battery sector. In addition to metals, significant funds have been invested in chemical manufacturing, accounting for 10.8% of Morowali's total investments (Abdullah & Sumner, 2025). The industrial park also benefits from investments in related sectors such as power, hospitality, and transportation/logistics, totalling USD 1.9 billion, or 11.2% of regional investments. These investments from top firms have transformed Morowali's economic profile. Historically known mainly for mining, the sector contributed only 0.9% of investment between 2009 and 2022 (Abdullah & Sumner, 2025). This change emphasizes the region's shift from a mainly extractive economy to a diverse industrial centre.

Across the value chain, Indonesia plays a crucial role in the upstream segment of the EV industry; Indonesia now accounts for 54% of the world's total nickel mine output. In 2023, its nickel production increased by nearly 29% compared to 2022 (Idoine et al., 2025). British Geological Survey (Idoine et al., 2025) data indicate that worldwide nickel production has risen by 47% over the past 5 years, with more than a 15% increase in the last year alone, primarily due to significant growth in Indonesia.

Indonesia's industrial policies' domestic effects are spread broadly across the region that hosts the mining industry. In 2023, Central Sulawesi and North Maluku, both rich in nickel resources, experienced annual GDP growth of 20.5% and 11.9%, respectively. Halimatussadiah et al. (2025) demonstrate that from 2021 to 2023, several nickel-producing provinces, including North Maluku and Central Sulawesi, experienced significant economic growth compared to 2014–2019. North Maluku's growth surged from 6.73% from 2014 to 2019 to 20.07% between 2021 and 2024, while Central Sulawesi's growth increased from 11.17% to 12.94% in the same periods. Domestic industrialization has created around 80,000 to 85,000 jobs, roughly a 3% increase in the local mining sector. Despite domestic industrialization having created employment, most of these jobs are low-skilled and often involve short-term contracts. Additionally, concerns about worker safety are becoming more prevalent due to the neglect of labour welfare within manufacturing companies (Halimatussadiah et al., 2025).

Downstream, Indonesia is experiencing a notable rise in EV sales, aligning with its goal of boosting domestic EV adoption. According to data from the Indonesian Automotive Industry

Association (GAIKINDO). EV sales increased from only 43,188 units in 2024 to 103.931 units in 2025. Although ICE vehicles still dominate Indonesia's automotive market, this trend shows an encouraging early sign of growing acceptance of EVs in the country. It also suggests potential for domestic demand growth, which could foster the development of domestic battery pack assembly and EV production. However, for the moment, the rise in EV sales mainly reflects increased imports, which are duty-free, rather than growth in domestic manufacturing.

The economic gains achieved in terms of smelting and processing have come at a social and environmental cost. Halimatussadiah et al. (2025) report that nickel mining has caused deforestation and habitat destruction, removing 76,031 ha of forest within concessions covering 1,037,435 ha—68% of which overlaps with forested areas. Between 2001 and 2022, about 153,364 ha was lost to mining. Similarly, Djamhari et al. (2024) highlight the significant negative impacts of the industry on Indigenous communities in regions like South Konawe, North Konawe, and Central Halmahera, including the loss of their traditional lands and livelihoods. Near the Morowali Industrial Park, residents faced severe flooding, pollution, industrial waste, and threats to their fisheries livelihood (Kurniawan et al., 2025).

Another major challenge is the recarbonization paradox. As previously discussed, one of the primary motivations for Indonesia's industrial policy in the battery sector is to fulfill its international commitments to transition to a green economy. However, improving environmental sustainability might be challenging if EV and battery manufacturing, which depend on critical minerals, lead to excessive mining and the depletion of resources such as minerals, forests, and other materials essential to EV production (Kurniawan et al., 2025). Mining activities and their processing require significant energy, primarily from fossil fuels like coal. In this context, coal-fired power plants (CFPPs) continue to serve as the primary energy source, thereby supporting economic growth, industrialization, and the development of the nickel industry. Investments in fossil fuels are increasingly perceived as compatible with, rather than opposed to, decarbonization initiatives and Indonesia's green transition. Therefore, to justify coal-derived energy in nickel processing, the use of CFPPs in developing the nickel industry and EV production is regarded as "sustainable" (Reuters, 2024). This, in turn, reveals another inconsistency within Indonesia's overarching green transition policies. Consequently, Indonesia should harmonize its policies and address environmental and social impacts within its industrial strategy; this is not only of intrinsic importance but also essential for enhancing Indonesia's position as a responsible provider within the global supply chain.

Indonesia's policies have received mixed reactions from its main trading partners. Wijaya and Sinclair (2025) reveal that the Indonesian government's industrial policy in the mining sector, including the battery industry, has created clear "winners" and "losers." The losers mainly include Western multinational mining companies such as Newcrest Mining, which have exited the Indonesian market and have been sold to local firms (Wijaya & Sinclair, 2025). Furthermore, Japanese automakers such as Toyota and Honda, which have dominated Indonesia's ICE vehicle market, face disadvantages stemming from their reluctance to invest in battery and EV supply chains. This could put them at risk of future marginalization. Although they are not permanently excluded, they are currently temporarily sidelined from Indonesia's EV ecosystem.

One of the primary positive outcomes of developing an EV battery ecosystem could be enhancing Indonesia's strategic role within global supply chains and attracting FDI. Data from the Indonesian Investment Coordinating Board/Ministry of Investment and Downstream Industry show that China is undoubtedly the leader in total investment value within Indonesia's EV ecosystem, with a total of around USD 14 billion–16 billion. South Korea is the second-largest foreign investor, though its investment value does not match China's, at a current total of USD 2.3 billion. This is followed by Japan, with an estimated value of USD 1.8 billion–2 billion, and Vietnam, at USD 1.2 billion (Ministry of Investment and Downstream Industry & Investment Coordinating Board, 2024).

Despite attracting FDI, Indonesia's protectionist policies have led to disputes with trading partners. The European Union has taken Indonesia to the WTO dispute settlement process over concerns that the export ban and the domestic processing requirement for nickel may breach WTO rules. From the European Union's perspective, Indonesia's policy of banning raw mineral exports and mandating domestic processing for nickel breaches WTO rules, particularly Article XI:1 of the GATT 1994, which prohibits members from imposing quotas, bans, or non-tariff restrictions on exports. Although Indonesia lost the initial ruling, it has appealed, demonstrating its strong commitment to its strategy despite international pressure (Rezki, 2025).

The impact of Indonesia's domestic nickel production on regional neighbours, such as the Philippines, is also worth examining. Since both countries have nickel reserves, their supply chains are closely connected. Indonesia's efforts to develop its downstream nickel industry appear to have directly and indirectly affected the Philippines' similar initiatives (see Syahrir, 2026). As argued by Syahrir (2026), the Indonesian government's decision to reduce annual nickel ore production in 2026 has led to an increase in nickel ore imports from the Philippines to secure supply. Although higher nickel exports might increase short-term revenue, they could obstruct the Philippines' long-term downstream development. This is because domestic supply to its downstream industry would compete with the immediate profits from simply exporting nickel ore to Indonesia. Similarly, Indonesia's nickel and EV downstream policies have both positive and negative effects on Australia. The surge in Indonesian nickel output has led to a worldwide surplus, causing prices to plummet. Indonesia's low-cost, high-volume nickel production has led to the closure of mining companies in Australia, as they cannot compete with Indonesian nickel (Baskaran, 2024). However, this also presents an opportunity for strategic partnership, as Indonesia lacks domestic lithium critical components for EV batteries, which could be supplied by Australian companies. As Wardana (2026) argues, Indonesia's ban on nickel exports has reallocated costs and opportunities among the region's nickel-producing and nickel-consuming countries.

3.5 Conclusion

Indonesia's experience with trade-related industrial policies aimed at building a fully integrated EV ecosystem shows only partial progress. While the country has successfully increased raw material processing, it has yet to see significant growth in battery and EV manufacturing. The policy has elevated Indonesia's position in the global battery value chain, moving from merely exporting raw materials to developing midstream and downstream nickel processing. However, challenges persist when it comes to increasing domestic battery and EV production. First, although export values have improved and there are early signs of domestic industrial growth within the EV ecosystem, the ongoing reliance on a single dominant investor country that also controls the market remains an issue. In this context, China's dominance in Indonesia's nickel industry raises questions about whether this improved position in the global supply chain is a genuine achievement or an illusion based on Chinese ownership of the factories and the technology involved.

Second, given that Indonesia has the world's largest nickel reserves, prioritizing NMC over LFP constitutes a rational policy decision. Nonetheless, this strategy could pose long-term risks to Indonesia's EV ecosystem because it primarily centres on nickel for batteries. Such a policy may need to be reconsidered in the future, especially since battery development might not necessitate the use of nickel. Third, the government faces the challenge of balancing development and social welfare with environmental considerations, including addressing how to mitigate the "recarbonization paradox." EV and battery manufacturing not only depends on critical minerals and could lead to excessive mining but is also energy intensive and requires the extensive use of CFPPs.

Fourth, another crucial issue is the need to enhance policy coherence and institutional coordination. As previously mentioned, policy inconsistencies across various ministries could obstruct Indonesia's goal of creating a comprehensive battery ecosystem. Success depends on maintaining consistency and creating a business environment that reassures foreign investors. Although numerous ministries and agencies support the battery ecosystem, their efforts often lack integration and at times conflict. For instance, offering generous tax exemptions for EV imports may help achieve EV targets, but can inadvertently undermine incentives designed to promote domestic manufacturing. Additionally, this approach has led to dissatisfaction among current investors, who were forced to establish factories due to export bans and now see the tax exemptions as unfair. Aligning sectoral policies, harmonizing targets, and creating a central coordination mechanism—possibly within the Ministry of Investment or a dedicated battery authority—would create a more predictable and supportive environment for investors and developers.

Finally, Indonesia's policy to foster a domestic battery ecosystem has produced mixed outcomes among trading partners. It has benefited "winners" who can invest in and engage with Indonesia's downstream nickel and EV supply chains. Conversely, it disadvantages "losers" who depend on raw materials or struggle with new restrictions and local content mandates. Reactions to this policy range from increased investment to formal disputes. Indonesia must carefully balance attracting foreign investments with the risk of becoming overly dependent on a single leading investor country. Diversifying investors and encouraging more balanced partnerships are essential strategies for maintaining a sustainable and resilient battery industry strategy.

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4.0 Morocco: An industrial ecosystem for EV batteries

By Poorva Karkare

4.1 Introduction

Morocco has successfully established itself as a pivotal manufacturing hub by capitalizing on its strategic location between Europe and Africa, robust infrastructure (including special economic zones [SEZs]), and extensive free trade agreements (FTAs) with over 60 countries. As an important "connector" economy alongside Indonesia, Morocco punches above its weight by straddling significant geopolitical fault lines and superpower rivalries and attracting investments to become the "go-between" stop in increasingly longer supply chains as the West seeks to decouple or derisk from China (Curran et al., 2023).

While production has yet to begin, the country's advantageous position in the EV battery global supply chain results from a convergence of domestic policies, external opportunities, and an existing industrial base. This section will examine some of these policies, as well as opportunities, in more detail.[7]

4.2 Industrial Ecosystem Foundations

4.2.1 Automotives

Morocco has cultivated a robust, export-oriented automotive ecosystem, evolving from an earlier import-substitution model (starting with state-owned Somaca in 1959), which yielded weak results (Mendez-Parra et al., 2025; Vizier, 2025). A decisive policy shift in the early 2000s under King Mohammed VI's economic modernization agenda led to a strategic partnership with Renault in 2007 focused on vertical integration and manufacturing for exports. This effort, secured through high-level political coordination (by the then prime minister and the CEO of Renault), helped establish Tangier as Renault's largest global manufacturing site by 2012. By 2025, Morocco surpassed South Africa to become Africa's largest car manufacturer, producing over a million cars (Assahifa, 2026). Automotive exports surged from 12% of total exports in 2010 to 34% by 2023, becoming Morocco's leading export sector, overtaking phosphate (Oqubay, 2025).

The automotive industry is organized along a tiered supply chain, with Morocco specializing in high-value components like "wiring harnesses, cables, seat covers, spare parts, embedded electronics and air conditioning systems" (Mendez-Parra et al., 2025, p. 97). Integrated industrial platforms like Tanger Automotive City have fostered agglomeration effects, supporting 17 first-tier suppliers by 2024 to original equipment manufacturers, while

[7] This study builds on previous and ongoing European Centre for Development Policy Management analysis on battery manufacturing initiatives in African countries, complemented by a series of expert interviews carried out in the first half of 2026.

Morocco overall counts some 250 Tier 1 and Tier 2 suppliers (Ibold, 2024). As a result, the local integration rate currently stood at 69% by late 2025, with a target of 80% by 2030 (Vizier, 2025). Other automotive hubs helped attract additional lead firms, including Stellantis (producing Citroen, Opel, Fiat, and Peugeot vehicles) with operations in Kenitra (Vizier, 2025). By 2023, Morocco surpassed China and Japan to become the largest car exporter to the European Union in value terms (Ben Driss, 2024).

Through proactive industrial policy, Morocco is now leveraging this automotive base to prepare for the transition to EVs, especially in mature markets. Since most car exports go to the European Union, Morocco's strategy closely aligns with EU policy changes, such as the anticipated 90% reduction in emissions target for internal combustion engine vehicles. This is driving new investments by capitalizing on Morocco's existing automotive base, robust infrastructure, skilled workforce, and preferential access to EU and U.S. markets via its FTAs (Mendez-Parra et al., 2025). Stellantis is already making Opel EV models in Morocco and may move Peugeot e-208 production from Slovakia (Tanchum, 2022), while Renault is also considering a new EV plant to capitalize on lower labour costs (Renault Group, 2021).[8]

Morocco is strategically focusing on manufacturing automotive components, not just on simple assembly. This includes high-tech areas like electronic chips, as shown by Franco-Italian STMicroelectronics supplying electronic chips to Tesla from its plant near Casablanca (Tanchum, 2022). This, in addition to its existing capabilities, demonstrates Morocco's ability to successfully capitalize on global industrial trends, specifically severe post-COVID semiconductor supply disruptions, to attract "nearshoring" investments (King et al., 2021). This opportunity arises from the private sector identifying opportunities that the state can then adapt to by providing flexible assistance. Future growth relies on investments in the lithium-ion battery value chain, particularly in component manufacturing (battery cells, cathodes, and precursors) from local phosphate and cobalt. Such vertical integration could significantly increase the local integration rate of future EVs manufactured in Morocco and boost GDP by 1.9% (Arbouch, 2025).

4.2.2 The Office Chérifien des Phosphates Ecosystem Around Phosphate

With 70% of the world's phosphate rock reserves, Morocco, has developed a sophisticated ecosystem beyond traditional bulk exports to create a "multi-business model" led by the state-owned Office Chérifien des Phosphates (OCP). As the focus shifted to producing high-value fertilizers and other speciality products, their share in total phosphate earnings increased from 27% to 74% (Oqubay, 2025). OCP's diversification has been accompanied by substantial investments in research and innovation via the Mohammad VI Polytechnic University (OCP, 2024). More recently, its subsidiary, InnovX, has focused on new industries and net-zero targets for OCP's exports that will be affected by the European Union's Carbon-Border Adjustment Mechanism (Tanchum, 2024).

This accumulated expertise, specifically in chemistry, is now opening opportunities in emerging high-tech industries, particularly battery materials. For instance, Al Mada—a private

[8] There are also plans to manufacture cars for the domestic market, e.g., Dacia (Mendez-Parra et al., 2025).

equity holding firm that is majority owned by the Royal family—partnered with China's CNGR Advanced Materials to establish COBCO at Jorf Lasfar. This USD 2 billion joint venture has begun producing precursor cathode active materials using NMC technology for exports to the European Union and the United States, with plans to develop an LFP cathode active materials facility. This shows that Morocco's existing industrial base is being strategically upgraded for next-generation energy and industrial value chains (Amouzai, 2025; Lasfar, 2025).[9] However, Morocco's phosphate is primarily sedimentary rock, which is less ideal for LFP batteries due to high levels of impurity and the highly capital-intensive procedure needed to extract the appropriate element (di Grandi, 2023).[10]

4.2.3 Cobalt

An emerging cobalt ecosystem in Morocco is anchored by Managem, majority-owned by Al Mada, which mines cobalt at Bou-Azzer and operates a domestic processing plant to supply the EV battery industry and recycling. Managem has acted as a strategic coordinator by securing long-term offtake agreements with global automakers (Hajbi, 2023).

Despite having just a fraction of the reserves of the Democratic Republic of the Congo's (DRC)—the world's largest cobalt producer—Morocco is increasingly appealing to Western EV makers, as it has presented itself as a key supplier of stable and responsible cobalt.[11] This contrasts with the DRC, where supply is dominated by Chinese firms and plagued by issues of child labour and poor labour conditions in artisanal mining. Morocco's ability to meet stricter environmental, social, and government requirements, coupled with the high purity of cobalt from its Bou-Azzer mine, enhance this appeal (Emran & Tayebi, 2025). Nevertheless, a recent report hints at social conflicts and labour unrest around Managem operations (Amouzai, 2025).

These dynamics have already translated into concrete supply-chain linkages, including a EUR 100 million contract in 2020 by BMW for Managem to supply 20% of the cobalt for its next-generation electric drive-trains and a 2022 7-year agreement with Renault for 5,000 tonnes of cobalt sulphate annually, produced with renewable energy, resulting lower carbon footprint (Tanchum, 2022). The ecosystem is further strengthened through a 2022 partnership with Glencore to recycle cobalt, lithium, and nickel from end-of-life lithium-ion batteries at Managem's hydrometallurgical facilities near Marrakech. If successfully scaled, this could allow Morocco to domestically source all major metals used in NMC lithium-ion batteries, reinforcing its role in the EV battery value chain (Tanchum, 2022).

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[9] At the same time, demand for LFP batteries will account for only about 5% of the current global phosphate demand (Spears et al., 2020), suggesting that other use-cases like fertilizers will remain important for Morocco.

[10] Though, igneous rocks, more suited for LFP production, constitute only 5% of global deposits (di Grandi, 2023).

[11] According to data by the African Minerals Development Centre. (n.d.), the DRC accounts for 48% of global cobalt reserves and 72% of global cobalt production, as opposed to Morocco's share of 0.2% and 1.4%, respectively.

In addition to cobalt, Morocco is also seeking to attract processing of other critical minerals, capitalizing on relatively lower energy costs.[12] Managem is leading a proposed copper smelter to produce copper cathodes for batteries, but this remains at the feasibility stage, with supply constrained by limited domestic copper output (Emran & Tayebi, 2025). Separately, a USD 12 million lithium refinery project led by LG Energy Solution and Yahua Group seeks to produce battery-grade lithium (Argus, 2025), even if Morocco lacks domestic lithium production (Emran & Tayebi, 2025). Together, these projects show early momentum for a critical-minerals ecosystem, which remains fragile and requires a coherent national and regional strategy given significant deposits of these minerals elsewhere in Africa, with the potential to leverage the African Continental Free Trade Agreement.

4.3 Institutional Set-Up and Coordination

Morocco's relative industrial success is rooted in a state-led industrial policy emphasizing export-led industrialization and economic diversification driven by FDI since the 2000s (Oqubay, 2025).

4.3.1 State-Led Industrial Policy and Institutional Coordination

The government transitioned from the liberation era focus on trade agreements and cheap labour to pursuing pragmatic strategies (Oqubay, 2025). Key actions included streamlining processes, expediting land acquisition, and investing in necessary infrastructure and workforce training, acting as a strategic partner to foreign investors (Vizier, 2025). This conducive business climate was maintained through macroeconomic and political stability. Prudent fiscal and monetary policies, including debt management and forex regime reforms boosted investor confidence while strong institutional coordination ensured regulatory effectiveness, administrative transparency, and enforcement of property rights.

Crucially, Morocco achieved "embedded autonomy" in state-business relations by maintaining productive relations and avoiding collusive ties between officials and firms (Mendez-Parra et al., 2025). This was the result of a combination of factors, including a deeply connected (i.e., embedded) state through its social and economic networks—for example, the royal family's large stake in important sectors of the economy including mining (through Al Mada)—combined with sufficient independence and capacity (i.e., autonomy) to drive progressive and open economic policy and attract foreign investment.

The state played an active role beyond being a facilitator. The government put in place the Industrial Acceleration Plan 2014–2020, with a follow-up phase in 2021–2025, prioritizing **industrial ecosystem** (Mendez-Parra et al., 2025).[13] Large conglomerates like OCP and Managem played lead roles in upgrading natural resource exports (phosphate and

[12] Morocco average electricity price for businesses is lower than many countries in the EU (Global Petrol Prices, n.d.).

[13] Apart from fiscal benefits such as a corporate income tax exemption for the first 5 years and value-added tax exemptions on capital goods, key incentives of the plan include access to land (including land acquisition grants) and infrastructure (which SEZs are usually pre-equipped with), a focus on human capital and training, and financial support, including subsidies (PV KnowHow, 2025).

cobalt) through downstream value addition, in addition to securing offtake agreements. In the automotive sector, the state emphasized strategic private partnerships, supply-chain localization, and export discipline. In the industrial policy literature, the latter is a key element of the state's time-bound support to firms, essentially providing them "learning rents"—breathing room to absorb new technologies and become competitive (Khan & Jomo, 2012). In successful cases of industrial policy, this support was conditioned on firms achieving international competitiveness by benchmarking their performance to global standards. Such a mechanism ensures accountability by "culling losers" that do not perform rather than "picking winners," thereby avoiding a misuse of funds (Studwell, 2013). In other words, the governance of these arrangements played a major role in attracting foreign investments to Morocco (Jaïdi, 2026). The dominance of small and medium-sized enterprises (including the Moroccan Agency for Sustainable Energy [MASEN] and National Office for Electricity and Drinking Water [ONEE], see below) allowed the state to undertake politically ambitious projects, including major infrastructure development, and create integrated industrial ecosystems (Oqubay, 2025). The country's industrial policy successes were compounded by continuous expansion into adjacent and more complex industries, such as aerospace, railways, and the chips sector, among others.

4.3.2 Integrated Industrial Platforms (SEZs and Ports)

Morocco has leveraged specialized industrial platforms to enhance efficiency and competitiveness. Central to this strategy are SEZs, such as Tangier Automotive City and Kenitra Free Zone, which offer tax incentives, infrastructure meeting international standards, and integrated supplier networks. Tanger Med port-industrial complex has emerged as a global trade artery. Proximity to Europe, enabling under 48-hour delivery times to continental markets, helped secure Renault's landmark investment (Tanger Med, 2021; Vizier, 2025). Competitive legal services, high operational efficiency, and cost advantages, have helped outcompete Spanish ports (Assahifa, 2024). Tanger Med's ecosystem, spanning 2,000 hectares of tax-advantaged zones for automotive, aerospace, and tech firms, now generates over half of Morocco's exports, and 130,000 direct jobs (Africatalyst, 2026; CBRE, 2022). With a capacity of over 10 million containers and 185 connections to 77 countries (Financial Ports, 2025), it is ranked fourth in the World Container Port Performance Index for 2023, drawing comparison with China's Shenzhen port's ascent (Vizier 2025; World Bank Group, 2024). Automation and the blockchain-driven PortNet platform ensure seamless logistics (streamlined customs and cargo tracking) and supply chain efficiency (co-locating suppliers, assembly plants, and export terminals). This industrial clustering has fostered new opportunities, such as the domestic Neo Motors brand producing vehicles with 90% local components (currently at a prototype stage) (Vizier, 2025).

4.3.3 Energy and Water Provision

Automotive (vehicle) production is resource-intensive, directly requiring 4.94 m^3 of water and 2.74 MWh of energy (Babel et al., 2020). Although EVs use less energy over their lifespan, their manufacturing is more energy intensive than conventional vehicles due to battery manufacturing and the associated mining and refining to make their components. Morocco's planned transition to EV production, while raising its local content (domestically manufacturing components) and powering them by renewables, requires substantially more (renewable) energy and (desalinated) water.

Morocco's 2009 National Energy Strategy was launched to address rapidly rising demand, projected to triple by 2030, and reduce heavy dependence on imported fossil fuels (over 90% of energy supply) by prioritizing renewable energy (Royaume du Moroc, 2009). By 2023, renewables accounted for nearly 41% of installed capacity, on track to reach the 52% target by 2030, though their share in actual generation remains lower (18% in 2022) (Berahab & El Aynaoui, 2025; El Hafdaoui et al., 2025). Progress has been driven by a supportive institutional framework, notably the Solar Plan (2009), the establishment of specialized institutions like MASEN and the ONEE to coordinate and implement renewable energy projects, and opening the market to private players. MASEN used a blended financial model by leveraging concessional financing from funds such as the Clean Technology Fund, but also multilateral development banks like the World Bank and the African Development Bank, and development finance institutions like the German Development Bank, the French Development Agency, and the European Investment Bank.[14]

To mitigate pressure on water resources in a highly drought-prone region,[15] investments have been made in desalination plants in line with the National Water Management Plan 2020–2050. Morocco currently has 17 operational plants producing about 345 million m^3 of water, with four additional plants under construction with a total capacity of 540 million m^3 by 2027 (Eljechtimi, 2025). Freshwater storage capacity is being boosted by accelerating dam and basin construction and increasing the share of reused wastewater following treatment (Kateb, 2024), with plans to supply 60% of the country's drinking water from treated seawater by 2030, up from 25% in 2025, which is increasingly powered by renewable energy (Reuters, 2025).

4.3.4 Workforce Development and Skills

Morocco has prioritized workforce development to attract efficiency-seeking investments while capitalizing on low labour costs, particularly in the automotive sector. Specialized agencies entered into public–private partnerships with Renault and others to provide "practical training along with direct interaction with production lines" (Mendez-Parra et al., 2025), ensuring a pipeline of skilled labour. In the energy sector, the Institute of Renewable Energy and Energy Efficiency Training Jobs provides vocational education and specialized diplomas in areas such as solar photovoltaic, wind systems, biogas and energy-efficient buildings, and trains technicians, operators, and executives for renewable energy and energy-efficiency jobs, with the goal of graduating up to around 1,000 trained workers per year (IEA, 2022). In addition,

[14] At the same time, there is competition among MASEN, ONEE, and the Ministry of Energy Transition and Sustainable Development due to overlapping responsibilities and fragmented efforts. According to Berahab and El Aynaoui (2025), in the electricity market, which follows a hybrid model, ONEE dominates the regulated segment, while the open segment is small, accounting for 7% of the total traded electricity. Moreover, MASEN's reliance on sovereign guarantees and power purchase agreements with ONEE as the sole electricity buyer limits investor confidence and constrains market-driven renewable expansion because the sector is largely controlled by a monopoly.

[15] The country officially "emerged" from a 7-year drought in January 2026 (North Africa Post, 2026).

there have been investments in higher education—for instance, in Mohammed VI Polytechnic University—along with specialized organizations, such as the Solar and New Energy Research Institute, that partner with international universities.

In summary, Morocco has a set of pragmatic industrial policies with relatively strong institutional coordination, accompanied by robust infrastructure investments and special attention to workforce development. At the same time, there are concerns that megaprojects that the state has successfully attracted to the country do not sufficiently translate into broader socio-economic development, which could lead to tensions. Thus, there are questions about how to build an industrial base that overcomes economic backwardness, while avoiding social deterioration and ecological collapse (Amouzai, 2026).

4.4 External Factors

4.4.1 Trade Deals and FDI

Morocco's trade architecture, including an EU Association Agreement in force since 2000 and an FTA with the United States in 2006, gives it a decisive advantage as one of only three nations (with Israel and Jordan) holding simultaneous FTAs with both the European Union and United States.[16] Leveraging these trade relations alongside targeted industrial policies, Morocco has successfully positioned itself as a production hub close to the European Union, attracting Western European carmakers who sought to relocate production in search of lower costs (as explained above).

This positioning has helped attract about USD 40 billion FDI in greenfield manufacturing since 2020 and exports have risen by two thirds over the same period (The Economist, 2025). While Renault and Stellantis started operations in the 2000s, more recently, Morocco has emerged as one of the countries attracting most Chinese FDI, ranking second outside the Association of Southeast Asian Nations (Olander & Neema, 2024; Xue & Larsen, 2025). About USD 10 billion in Chinese investments have gone into EV and batteries production specifically, representing 5% of global Belt and Road Initiative investments in 2023-2024 (The Economist, 2025). This influx—including the planned Gotion gigafactory to manufacture battery cells (the country's second-largest investment, on par with planned gigafactories in Germany and Sweden) (Buckley, 2024; Rise of Africa, 2025), but also others, like CNGR, BTR, Youshan, and Shinzoom—are driven by Chinese firms seeking to leverage Morocco's automotive base, FTAs, and mineral reserves, and circumvent U.S. tariffs.

4.4.2 China's Strategy to Access Mature Markets

As Chinese battery and EV makers seek places where cars for the EU market are already produced, Morocco stands as an obvious choice. Firms bring capital investments and technical expertise that can strengthen Morocco's industrial capacity, particularly in

[16] Apart from this, the country has FTAs with Turkey and several countries in the Middle and Near East such as Jordan, Tunisia, Egypt, and the United Arab Emirates (Oqubay 2025).

midstream refining and manufacturing, while meeting the European Union's relatively stringent standards (Agyeman & Abudu, 2025).

This strategy dovetails with the approach of European carmakers, who can leverage their manufacturing presence in Morocco to locally source Chinese technology (in this case, batteries) for their EV production. This allows them to produce cost-competitive EVs despite higher energy and labour costs in Europe, while also mitigating direct competition from Chinese EV imports into Europe. Volkswagen's stake in Gotion makes it more credible in the European Union, where automakers are seeking stable battery supply (Rise of Africa, 2025), while other Chinese firms have European automaker clients (Buckley, 2024).

Chinese investors in Morocco also aim to access the U.S. market. While some African countries face lower U.S. tariffs than other destinations of Chinese investments (e.g., Vietnam), only Morocco can absorb manufacturing that exits, or now avoids, Vietnam. For instance, Boway Alloys, which makes materials for electronics, automotives, and other industrial applications, scrapped plans for a plant in Vietnam to invest in Morocco instead (Seese, 2025). The decision was explicitly to take advantage of the 10% U.S. tariff in Morocco, as tariffs on Vietnamese exports made the plant there commercially unviable (Energy Trend, 2025; Nedopil, 2026).

Morocco has benefited in the current geopolitical landscape by actively seeking Chinese investments to create more jobs and value added in the manufacturing sector (Ezzehouany, 2025; Neema Byamungu, 2024), yet there is a risk that the country gets caught in superpower competition (Aboudouh, 2024). Chinese investments may dry up as U.S.–China tensions escalate further, or Morocco may face higher U.S. tariffs. Although the EU market arguably remains attractive, the bloc is also taking measures to reduce (over)dependence on Chinese imports (see below). Moreover, large-scale projects, like elsewhere, are associated with derailment risks related to sourcing, cost overruns, and labour tensions (Rise of Africa, 2025).

4.4.3 Relevance of Domestic and Regional Demand

Morocco's orientation toward the European Union, the United States, and other mature markets carries inherent risk as it designs strategies to strengthen supply chains, often focusing on domestic production. With some 30 planned battery gigafactories across Europe over the coming years (Herbert Smith Freehills Kramer, 2023), it is a question of whether Moroccan production will be prioritized. Heavy reliance on the European Union[17]—80% of car and component exports go to the bloc (Lechheb, 2024)—constitutes a risk in light of geopolitical tensions (Chinese dominance in Moroccan green tech may be perceived as a risk) and vulnerability to any slowdown in growth in the bloc.

[17] "In 2022, the EU accounted for 49 percent of Morocco's goods trade, with 56 percent of Moroccan exports destined for the EU and 45 percent of its imports originating there. That year, total trade in goods between the two parties reached $56.1 billion, while two-way trade in services amounted to $12 billion. The EU is also Morocco's largest foreign direct investor, with a cumulative inward FDI stock of around $24 billion in the country. Additionally, Morocco has been one of the largest recipients of EU funds under the European Neighborhood Policy, receiving $1.6 billion in bilateral assistance between 2014 and 2020" (Kateb, 2024).

This, in turn, underscores the necessity to explore new opportunities in the domestic and regional/continental markets (Verdier-Chouchane, 2025), as domestic demand alone is insufficient to justify capital-intensive battery investments. Although the EV market in Africa is likely limited, there is great potential demand for two- and three-wheelers, as well as battery energy storage, in the continent (Diene et al., 2022; Medinilla & Byiers, 2023). While one of the aspirations of the African Continental Free Trade Agreement is to develop regional value chains, Morocco's industrial strategy, unlike South Africa's, for instance, does not rely on the supply of inputs from the wider region in Africa (Mendez-Parra, 2025), mainly due to weaker integration in North Africa compared to Southern Africa.

This status quo, however, may change as Morocco's cobalt (and other) refining operations require feedstock from other African countries. This is already seen in increased cooperation with the DRC and Zambia (Bankable, 2025; United National Economic Commission for Africa, 2024). Managem entered a strategic Joint Venture with Chinese Wanbao Mining in the DRC to produce 5,000 tonnes of cobalt hydroxide, though currently the output goes to China rather than to Morocco for further processing into refined products (Reuters, 2021).

4.4.4 Assessing the Impact of Morocco's Industrial Policies

Morocco successfully established itself as a competitive automotive hub that can serve the EU market through deliberate coordination and strategy, combining its trade agreements with the European Union with policies to become productive and competitive. It acquired an edge not only over non-EU auto manufacturing rivals like Egypt and Türkiye thanks to its access to the EU market, but also over those in Central Europe—such as Czechia, Slovakia, Hungary, Poland, and Romania, who arguably benefit from membership in the European Union—through policies to ensure a skilled workforce and conducive industrial infrastructure.

Nevertheless, while the country attracted investments from French and other automakers, German automakers pivoted to China to produce cars for the European market, then made them for the vast Chinese market before losing market share to (Chinese-made) EVs. This suggests that these are arguably corporate decisions where Morocco's policy decisions became potential pull factors to attract (selected) European investments.

This same combination of factors now allows Morocco to attract significant EV and battery FDI from Chinese manufacturers seeking EU market access, navigating geopolitical rivalries. While this is raising some concern in Brussels that the country could become a launch pad for heavily subsidized (Chinese) goods via "transshipment," threatening European industry (Foster & Bounds, 2026), the analysis in this section shows that Morocco has successfully built interconnected ecosystems that could increase the local content of the batteries and EVs manufactured there. This positions Morocco to not only move up the green value chain by leveraging its existing capabilities,[18] but also offers a potential solution to European concerns of (over)dependence on China.

4.5 Comparative Experience

Morocco's trajectory in the EV battery value chain differs from China, whose leadership started from the consumer electronics sector before building automotive-specific knowledge through strategic partnerships (see Section 2 in this report), and Indonesia, whose path hinged on its nickel endowment (see Section 3 in this report). Morocco leveraged its preexisting automotive base, driven by policy changes in its primary export market (i.e., the European Union). Its experience in developing an **industrial** ecosystem around its minerals and infrastructure and skills, evidenced by the production of relatively complex products, such as fertilizers and refined cobalt, provides a base of industrial capabilities for battery component manufacturing.

Productive transformation in Morocco—the ultimate goal of industrial policies—involved sectoral upgrading through technological capability development and export diversification, supported by a sound macroeconomic framework. Strategic vision driven by political ambition was accompanied by pragmatic policies and strong institutional coordination (explained in Section 4.2 above), which ultimately helped attract investments in EV battery manufacturing. Despite some challenges, the overall trajectory points toward accelerating investments.

4.5 Conclusion

Morocco has successfully positioned itself as a pivotal "connector" economy, strategically benefiting from its FTAs to attract substantial FDI, all while straddling today's geopolitical fault lines. This position has been strengthened by the existing and emerging industrial ecosystems, especially automotives, phosphate, and cobalt. This has been complemented by pragmatic state-led industrial policies with strong institutional coordination and the integrated provision of industrial infrastructure and related services, including energy and water, as well as soft infrastructure in terms of skilled labour.

Despite this successful trajectory, risks also remain. The orientation toward mature markets exposes Morocco to geopolitical uncertainties. Domestic risks around the labour market and linkages between these megaprojects and the wider economy can also limit their benefits. While only nascent, Morocco could explore mitigation strategies by orienting itself toward the African market, in addition to, rather than instead of, the strategy to target mature markets, while also focusing reforms on better linking large projects to the local economy.

18 Morocco's approach in this regard reflects one of the strategies identified by Medinilla and Byiers (2023) for how countries pursue green industrialization.

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5.0 Synthesis and Conclusions

By Aaron Cosbey

The three cases presented here provide some insights with wider applicability, as limited as they necessarily are by a small sample group and the unique elements that characterize each case. Those insights can be loosely grouped into lessons about the successful deployment of industrial policy, observations on the international spillover effects of such policies, and musings about what it all means for trade policy and governance.

5.1 Effective Industrial Policy

While the success or failure of any industrial policy is necessarily specific to the complex web of economic, social, and political interconnections in which it is situated, it is still worth assessing the effectiveness of policies in place. Many of the insights from these three cases underline lessons about industrial policy that support findings in the broader literature on this subject.

The Moroccan case speaks to the value of a broad approach to industrial policy. Morocco employed tools that began with horizontal measures, including prudent macroeconomic policies such as debt management and an effective foreign exchange regime, the enforcement of property rights, and the conclusion of free trade agreements with prospective markets, while also facilitating business by streamlining processes such as land acquisition, permitting, and others. It went further to implement vertical measures that targeted specific sectoral investments, such as dedicated SEZs complete with necessary infrastructure linked to modern port facilities, the diplomatic pursuit of specific investors as anchors for agglomeration, investments into research and innovation (especially around phosphate), supporting workforce training, and targeted fiscal incentives, such as tax exemptions, subsidies, and grants.

In a related vein, policy coherence across these different types of measures and initiatives has been important, and resolving the institutional tensions among the agencies responsible for energy and electricity will be key going forward. This same lesson is clear from the Chinese case as well.

While the Moroccan case shows the value of vertical policies, it is striking in showing how much value can be attached to broad policies that are uncontroversial from a trade policy perspective. Morocco's success owes much to its access to both the EU and U.S. markets under FTAs, its modern port facilities, and its reputation for political and macroeconomic stability.

This case also speaks to the value of focusing on sectors that can build on existing capacity, resources and expertise—that are close in "product space" to established sectors (Hidalgo et al., 2007). Morocco's pursuit of domestic production along battery value chains builds on its existing experience in the conventional automotive sector, its experience with heavy industrial chemistry (fertilizers), and its experience in the mining sector, in particular with phosphate and cobalt. These foundations made the leap to batteries and EVs a viable one, founded on existing expertise, natural resources, and human resources.

In a related vein, the Chinese case shows the value of focusing on sectors in which competitors are not dominating—the "blue ocean" strategy. China pursued excellence in EV manufacturing in part because it knew that it would be challenging to compete against the incumbents in the ICE space.

China's case also demonstrates the value of long-term planning and policy consistency. Made in China 2025 set a 10-year course for the success enjoyed by the battery value chain sectors today, and that was preceded by even earlier policies under the 2006 National Medium-and Long-term Science and Technology Development Plan.

It also demonstrates the value of conditional support. Early grants and subsidies were specifically conditioned on firm-level performance, with benchmarks that tightened over time. The evolution of support also trended over time from supporting instruments such as subsidies to market-based instruments, such as the dual-credit system. This echoes a broader point in the literature, drawn from the East Asian tiger economies' experience, on the virtues of conditional support that incentivizes productivity improvements (Amsden, 2001; Fernandes & Reed, 2026; Rodrik, 2004).

This case also demonstrates the difficulty of terminating support, with state-level governments propping up a significant number of firms that may never be able to compete unassisted, with results that include extreme competition, low margins, and overcapacity.

The Chinese case strongly shows the value of demand-pull measures and a domestic market, including public procurement for infant industries. Measures such as public procurement, investment in charging infrastructure, consumer subsidies, and perks of ownership effectively stimulated demand in the world's largest automobile market. China's unique internal market size means that this lesson may not be broadly applicable, but the basic lesson is valid for all countries: governments need to somehow ensure that there are lead markets for the products of their supported firms, including domestic or regional markets on which export viability can eventually be founded. This is a challenge with which Indonesia struggled, and the lack of domestic demand has been one factor in its difficulty moving down the value chain to EV manufacturing. Morocco, by contrast, is focused—at least for the time being—entirely on export markets for its EVs. But its success with that strategy rests, in part, on a special set of circumstances that include proximity to the European Union and market access through FTAs.

The Chinese case is an excellent example of success along the entire value chain, planned by strategy and facilitated in part by industrial park development that allowed the various related industries to benefit from "agglomeration effects." That is, the co-location of many different actors in the value chain—especially high-technology value chains—has demonstrated benefits, including lowering the cost of public infrastructure investments, lowering costs of transport of inputs, and, most importantly, knowledge spillovers that come from the faster circulation of new ideas (Gorning & Schiersh, 2024; Ren & Tang, 2024).

China's full-value-chain approach was the result of careful policy coordination that saw concerted efforts to lock up raw materials, promote processing, support battery production, and foster a domestic EV manufacturing sector. This sort of coordination—not just across policies, but also among actors and mandates—is challenging to achieve in any country, but some degree of it is critical to successful industrial policy.

The Indonesian case demonstrates the ability of resource-rich countries to leverage those resources, conditioning access to them on downstream processing. Importantly, such measures are available even to governments with fiscal constraints that make large subsidies an unviable policy option. Of course, this strategy is not a silver bullet; using such conditions only works where the host country exercises meaningful leverage, such as Indonesia's globally significant share of nickel reserves. And governments forcing downstream processing need to consider that less profitable operators will translate into foregone tax and royalty revenues—revenues that could have been used for other sorts of economic development (Kolstad & Kinyondo, 2016).

Indonesia's case also shows how challenging it can be to use such conditions to progress beyond the processing stage to manufacturing intermediate or final products. While Indonesia's policies have been extremely successful in bringing processing investment to the country, there has been less success to date in fostering battery manufacturing that uses those processed materials, much less in EV manufacturing.

This case also demonstrates the value of a quasi arm's-length intermediary as a vehicle for partnership with foreign investors looking for surety about access to resources, seeking platforms that will guarantee them eligibility under domestic content laws, and searching for government-savvy local partners. The IBC—a joint venture of four Crown corporations with a full battery value chain focus—successfully served as such a vehicle.

5.2 International Spillover Effects

One thing these cases show clearly is the complex nuance of international spillover effects from industrial policy, and especially green industrial policy, such as that used to support the new battery supply chains.

China, through its dominance of those supply chains, has benefited the rest of the world by massively lowering the consumer cost of EVs. Chinese industrial support offers other countries the potential to affordably bring a sector—road transport—that in many national inventories accounts for 25%–30% of the total, to near-zero emissions while reducing dependence on imports of cyclically priced fossil fuels. Indonesia may offer the same benefit to others by efficiently producing one of the supply chain's critical ingredients, and Morocco may do the same through its export-oriented success along the value chain all the way to EV manufacturing.

Of course, that only holds true if these countries successfully lower production costs relative to their competitors, whether through learning by doing, scale/agglomeration effects, or other means. This seems to have been the case in China, but in Indonesia and Morocco, we do not yet have the data to say. If they have not, then these countries will have simply spent their way to an increased market share at the expense of more efficient—and potentially more innovative—producers in other countries. If those from whom investment and market share had been diverted were to include less developed countries such as Philippines, this would be doubly problematic.

It also bears noting that in all three countries, battery supply chain activities are based on practices such as land use and coal-fired electricity generation that are both globally and locally environmentally harmful. Ultimately, the benefits they offer the global environment—including in decarbonizing countries that have historically done much more to contribute to climate change than they have—may be traded off against negative local pollution and social impacts.

The case of China also lays bare the problem of too much success. One of the classic challenges with industrial policy is being able to scale back support at the appropriate time, allowing less competitive producers to wither in the face of international competition. Some Chinese battery manufacturers seem resilient to that sort of pruning, in part due to enduring subnational-level support in the face of painful economic reality. Involution in the vehicle manufacturing end of the value chain is, in part, a symptom of the same sort of problem. The Chinese case illustrates that this sort of over-shooting is a risk particularly when subsidies or grants are linked to production levels.

The resulting apparent excess capacity has led to geopolitical backlash via trade restrictions and competing industrial policy in other countries—backlash that may erode the very environmental and economic success that Chinese industrial policy has achieved. To be clear, the drivers of that backlash extend beyond overcapacity. Even where there does seem to be clear overcapacity, at the level of battery manufacturing, the international reaction is also to the dominance of Chinese producers like Contemporary Amperex Technology Co., Limited (CATL) and BYD, based on their record of superior innovation. This is clearly also part of the dynamic further down the value chain at the level of vehicles, where there may also be excess capacity, but where Chinese producers are simply winning the race to better and cheaper vehicles.

That backlash is in part responsible for Chinese producers' moves toward outward investment—a strategy that has clear benefits in countries such as Morocco and Indonesia, where it helps build increased capacity to compete in parts of the global battery value chain, with all the significant economic benefits that entails. This must count as another sort of positive spillover effect.

5.3 Implications for Trade Policy

One starting point for thinking about the trade implications drawn from these cases is the observation that many of the surveyed industrial policies are uncontroversial from a trade perspective. Table 1 lists the various policies described in the case studies, including many so-called horizontal industrial policies that aim to create broadly favourable conditions for investment, rather than focusing on the pursuit of excellence in specific sectors. It is a useful perspective to consider that the universe of industrial policies is much larger than the subset of industrial policies with trade implications.

That said, many of the policies surveyed do, in fact, have trade implications. Some of them, in fact, seem to breach trade rules. Indonesia's export ban and domestic processing requirements, for example, have been found—at the panel stage, anyway—to do so. China's use of local content requirements as a condition of support may have breached subsidy rules, and its technology transfer and joint venture requirements, to the extent any are still in force, run counter to the provisions built into many modern investment agreements.

Table 1. Selected industrial policies drawn from the case studies

Horizontal industrial policies surveyed	• General education and innovation policies • General infrastructure – electricity, transport, communications, water • Strengthened property rights, including intellectual • Streamlined bureaucracy (permitting, etc.) • Policy coordination across ministries • Macroeconomic stability • Strengthened rule of law • Market access through free trade agreements
Vertical industrial policies surveyed	**Subsidies** • Targeted grants • Targeted low-interest or guaranteed loans • Provision of dedicated R&D • Provision of dedicated infrastructure • Purchase of output at above market rates • Tax holidays, concessions • Consumer subsidies for industrial output **Export bans** • Local processing requirements • Local content conditions on subsidies, or as condition of investment • Targeted education policies • Sector-specific industrial parks/SEZs

Source: Author.

The obvious question is whether trade and investment rules should allow more policy space to use such tools. Part of the answer must rest on an assessment of the complex web of spillover impacts that these cases illustrate. Those types of measures are prohibited in large part because of the role they play in diverting trade and investment from other countries. Such prohibitions are at the heart of the agreements countries make in forums such as the WTO; they place limits on behaviour that benefits everyone when universally observed. But there are both positive and negative spillovers to account for, and today's trade and investment rules arguably do a poor job of accounting for the former, especially if they manifest in the form of global environmental benefits.

Another part of the answer must consider the lessons these cases provide on the effectiveness of the measures in question. Industrial policy that is ineffective has the dubious distinction of not only diverting trade and investment from others, but also potentially of draining scarce fiscal resources from the user countries. In the case of green industrial policy, failed measures may also mean eliminating international competition that might have been more innovative and that could have delivered more global environmental benefits. But these three cases arguably show that industrial policy can be successful as well, in which case it can bring the sort of economic development that is particularly acutely needed in developing countries, as well as delivering progress on global priorities such as mitigating climate change.

The reactions to such success, however, give rise to another set of issues. Many of the trade restrictions that countries have put in place in reaction to China's dominance of the markets, and the overcapacity that appears to have resulted, are themselves in breach of WTO obligations. And the successful use of measures such as local content requirements and export bans to foster new industries may inspire others to pursue them, in a widening circle of erosion of respect for a rules-based system of global trade. Whether or not such measures are effective or desirable, the systemic effects of that erosion are bad for all concerned—but they are particularly bad for smaller and poorer economies for whom a power-based world order does not work.

All of that endows urgency to the question: is there a landing place for international agreement on appropriate state behaviour in industrial policy—one that maximizes the positive economic, social, and environmental effects of those policies while minimizing the negatives? Finding that balance point would relieve some of the stress being put on the multilateral trade system, to the benefit of all. Among other things, it will demand more in-depth work, like the cases presented here, to provide a solid grounding of the realities of industrial policy in practice. Further reports in this series will explore experiences from other sectors to help build out the picture of what that landing place could look like.

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Published by the International Institute for Sustainable Development

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