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A Regulatory-Developmental Turn Within EU Industrial Policy? The Case of the Battery IPCEIs

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Abstract

The European automotive industry is transitioning from combustion engines to electric vehicles but lags behind international competitors. This geoeconomic competition has contributed to the revival of industrial policy in the EU. However, EU competition policy restricts more vertical industrial policy approaches. In this context, the Important Projects of Common European Interest (IPCEIs) have emerged as a novel governance tool. This article examines this transformation in EU industrial policy by focusing on the Battery IPCEIs. The article includes an in-depth case study of the Battery IPCEIs, using secondary literature and 11 expert interviews. It concludes that IPCEIs represent a gradual regulatory-developmental turn within EU industrial policy by drawing on developmental state theory in a European context, critical EU integration literature, and global production networks research. In response to geoeconomic competition and the region's lack of productive capacities, the EU is indirectly facilitating the development of European battery innovation and production networks by issuing direct state aid at the national level. However, the EU's participation in the subsidy race and the global green-tech race via "green" industrial policy indicates only a partial shift in the relationship between states and markets.

Keywords

batteries; competition policy; developmental state; European Union; global production networks; industrial policy; IPCEIs; subsidies

1. Introduction

International economic dynamics can affect the design of industrial policy (Hannon et al., 2011, p. 3696). Since the late 1970s, EU policy has been aligned with a broader neoliberal policy paradigm shift. This neoliberal

era is associated with less interventionist modes of economic governance and seeks to ensure "undistorted" competition. The EU's neoliberal policy orientation has become even more pervasive since the Maastricht Treaty was ratified in 1992. This has limited the policy space for vertical industrial policy, including subsidies, and favored horizontal industrial policy (Pianta et al., 2020). However, Wade (2014) has identified a "return of industrial policy" which presents a challenge to this neoliberal paradigm and indicates that developmental state functions also exist in industrialized Western countries. In the case of the EU, there is indeed growing evidence of an increase in "state interventionism" (McNamara, 2023) and the presence of "state capitalist elements" (Alami & Dixon, 2023). Similarly, other authors identify industrial policy in the EU as having an increasingly supranational "market-directing" character (Seidl & Schmitz, 2023) and serving "developmental functions" (Di Carlo & Schmitz, 2023). However, this return of industrial policy could also be interpreted as a "weak" return of the state, as an approach that ultimately enables "corporate welfare" due to the lack of conditionality tied to industrial policy programs (such as state aid) and thus as a type of subordination to business interests (Bulfone et al., 2023, p. 253). Alternatively, current developments could be understood as a more "gradual shift" in EU economic governance that reflects a willingness to embrace new forms of state intervention, including in industrial policy (Gräf & Schmalz, 2023). These changes in industrial policy have even been interpreted as a type of "de-risking" measure implemented by (green) capitalist states within a continued neoliberal paradigm (Gabor, 2023).

Despite these varying interpretations, five key drivers have stimulated the return of industrial policy in the EU (Eder & Schneider, 2020), and have once again introduced debates about industrial policy to the political agenda. The first driver, the global financial crisis of 2007–2008, laid the groundwork for the EU to embrace more vertical industrial policy within an otherwise horizontally-oriented post-Maastricht industrial policy arena. A second driver is the shifting thematic focus of industrial policy. "Green industrial policy" (Rodrik, 2014) has emerged as a priority and focuses on industrial transformation towards a clean energy and low-emission industrial base. In the EU, this is most prominently exemplified by the European Green Deal and programs related to the energy transition such as the Net-Zero Industry Act (Gräf & Topuria, 2023). The third driver is the EU's intention to create a digital single market, which would require the digital transition of European industry through industrial policy. The fourth and most recent driver results from the risks related to global value chain dependencies, which became particularly apparent during the Covid-19 pandemic. While approximately 70% of international trade involves global value chains (OECD, 2023), this has remained a "neglected issue" in industrial policy so far (Chang & Andreoni, 2020). The final driver, increased geoeconomic competition, has resulted in a "geo-dirigiste turn" (Seidl & Schmitz, 2023) in industrial policy.

The European Industrial Strategy 2020, updated in 2021 in light of lessons learned during the Covid-19 pandemic, defined strategically important global value chains (European Commission [EC], 2021b, p. 12). One of these is the battery value chain; European firms are lagging behind significantly in battery innovation and production, a fact recognized as early as 2018: "The EU only had about 3% of the global production capacity of Lithium-ion (Li-ion) battery cells, while China had about 66% and South Korea together with Japan and other Asian countries about 20%" (EC, 2021a, p. 68). Since then, the EU has launched several industrial policy initiatives to enhance its position in battery innovation and production in an effort to establish competitive European battery production networks. These initiatives are intended to narrow the technological gap between Europe and major Asian competitors (EC, 2021a, p. 68). With this in mind, European public policies are intended to "target the whole value chain of strategic green sectors, including large-scale deployment and access to raw materials" (von der Leyen, 2022) in the context of the "global clean-tech race."

In this context, the Important Projects of Common European Interest (IPCEIs) have emerged as a novel governance instrument in the EU's updated industrial policy toolkit. IPCEIs are cross-country industrial policy projects where firms from multiple EU member states collaborate on the development, production, and "roll-out" of key strategic technologies and their value chains. These technologies are more advanced than current state-of-the-art technology and require significant research, development, and innovation in areas where European firms are currently lacking geoeconomic competitiveness (IPCEI Batteries, 2024). In addition to private funding, participating firms receive public funding in the form of state aid (subsidies/direct grants) from their respective member states in accordance with EU state aid regulations, namely the IPCEI funding scheme (EC, 2024). Hence, IPCEIs are industrial policy projects that are interconnected with competition policy. Among others, there are two IPCEIs on batteries targeting the battery value chain. The IPCEIs may even "serve as a blueprint" (Letta, 2024, p. 39) for further EU industrial policy aspirations (Letta, 2024, p. 11).

Taking the Battery IPCEIs as an example, this article analyzes the question: Is EU industrial policy transforming, and, if so, is industrial policy becoming more developmental as it actively shapes European battery innovation and production networks? Section 2 outlines the relevant theoretical tenants, which build on developmental state theory in a European context and critical EU integration literature. These approaches are further complemented by global production networks (GPN) research. Section 3 explains the methodological approach for the empirically grounded case study of the two Battery IPCEIs based on 11 expert interviews. Section 4 analyzes the Battery IPCEIs empirically. Section 4.1 contextualizes the EU's lack of lithium-ion battery innovation and production networks and explores how this deficit has contributed to a variety of key policies and programs targeting battery production, including the IPCEIs. Section 4.2 explains the vertical orientation of the IPCEIs as a specific state aid mechanism. Section 4.3 conducts an empirical investigation of the Battery IPCEIs and their developmental functions. Section 5 concludes that the Battery IPCEIs represent a geoeconomically driven albeit regulatory-developmental turn within EU industrial policy.

2. Theoretical Debates on the Return of Industrial Policy in the EU

To analyze the question of whether EU industrial policy is transforming, this section introduces three theoretical tenants: (a) developmental state theory in a European context, (b) critical EU integration literature, and (c) GPN research.

2.1. Developmental State Theory in a European Context

Developmental states target structural economic changes and infant industries by intervening in economic sectors and taking on "a leading role in governing the market…[through] market-steering [and] 'societal mission' roles well beyond neoliberal limits" (Wade, 2018, p. 518). While developmental states can take different forms, they are generally associated with late-industrializing countries that are in the process of catching up. Examples include some Latin American countries which are characterized by "new developmentalism" (Bresser-Pereira, 2019) and most famously the classic East Asian "developmental states" (Wade, 1990). Within these contexts, industrial policy emerged as a crucial governance tool (Meckling, 2018, p. 62).

Industrial policy can take developmental, entrepreneurial, or regulatory forms (Ebner, 2009, p. 383). In contrast to regulatory-oriented industrial policy (focused on market liberalism and rule-making) and entrepreneurial-oriented industrial policy (focused on state entrepreneurship and innovations), policymakers that apply industrial policy in a developmental tradition utilize more significant interventions designed to support the local assimilation of new technologies and pursue long-term goals for economic catching-up. These three outlined functions of industrial policy are often depicted as mutually exclusive, but they can also co-evolve and coexist within the same jurisdiction (Ebner, 2009, p. 381; Meckling, 2018, p. 61). For example, Andreoni and Roberts (2022, p. 1431) identify an "entrepreneurial-regulatory state" approach to governing large digital platforms and the development of industrial capabilities through industrial and competition policies.

Interestingly, a growing body of research also identifies increasingly "developmental" industrial policies in so-called developed and industrialized Western countries (Wade, 2018). For example, Block (2008) famously identified the US as a "hidden developmental state," referred to as a "developmental network state," even during the neoliberal era. The "developmental network state" strategically promotes technologies through targeted resourcing to overcome certain key hurdles, opens windows by providing funding and support for collaborations, acts as a broker to link scientists and engineers, and facilitates the establishment of technical standards that accelerate the commercialization of new technologies (Block, 2008, pp. 188–193). However, the "developmental network state" would not grant subsidies to firms that are already leading in international competition (Block, 2008, p. 172).

2.2. Critical EU Integration Literature

Economic governance in the EU has been neoliberally oriented since the Single European Act came into force in 1987. The resulting "new constitutionalism" (Gill, 1998) marked a shift from positive integration in the EU, where member states focused on spending and taxation, to fiscal consolidation, liberalization, and deregulation. Regulation became the primary form of state intervention at the EU level (Majone, 1997; Meckling, 2018, p. 61). This neoliberal governance was institutionally anchored by the Maastricht Treaty (concluded in 1992) and assumes that market processes, as opposed to state interventions, are better suited to determine which industries and firms are most efficient. Consequently, market actors are seen as the primary producers, while policymakers are expected to refrain from influencing production decisions through industry-specific financial support. One essential outcome of this approach to governance was the EU's adoption of mostly horizontal industrial policies (Pianta et al., 2020).

Horizontal industrial policies are designed to target economic structures broadly, offering support to all firms and industries equally. This approach includes tools such as R&D funding, general tax incentives, and the provision of infrastructure. In contrast, vertical industrial policies are directed at specific industries or firms selected by policymakers. Due to the varying levels of selectivity and diverse implementation methods employed by state entities, vertical industrial policy is associated with stronger state intervention in market processes (Weiss & Seric, 2021). Hence, the predominantly horizontal post-Maastricht institutional framework limits the scope for the EU to implement vertical industrial policy, and, more importantly, to serve developmental functions.

Nevertheless, the EU is increasingly applying developmentally-oriented policies as geoeconomic competition intensifies. In terms of infrastructure policy, a geoeconomic shift in focus towards controlling transnational value chains has led to more state-interventionist governance of projects like Gaia-X and the Hydrogen Strategy (Abels & Bieling, 2024). Similarly, the EC executes developmental functions within EU industrial policy. Comparable to the US, the EC promotes innovation through targeted resourcing by funding projects likely to achieve technical breakthroughs, for example through the European Investment Fund, and brokers the emergence and sustenance of cross-national and cross-sectoral networks, such as industrial alliances. A key difference from Block's (2008) conceptualization is the increased role of the EU in protecting firms from competition with non-EU firms, demonstrated by tools like the Foreign Subsidies Regulation. Moreover, the EC facilitates the adjustment of EU regulatory constraints to promote these networks within the post-Maastricht horizontal institutional framework (Di Carlo & Schmitz, 2023, p. 2069). Additionally, green technologies are emerging as central components of these gradually transforming developmentally-oriented industrial policies (Meckling, 2018). A key difference between classic developmental states and these emergent developmental functions in the EU is their decentralized and networked character (Di Carlo & Schmitz, 2023; Meckling, 2018, p. 62).

2.3. GPN Research

Nowadays, policymakers, including those in the EU, must not only govern markets and firms in a national context but also in transnational value chains (Abels & Bieling, 2024). In contrast to linear and chain-oriented research, these networks are best explained by GPN research. GPNs are comprised of organizationally fragmented and spatially dispersed economic activities yet are functionally interconnected via transnational networks (Bridge & Faigen, 2022, p. 2). These networks intersect horizontal, vertical, and transnational dimensions of production, trade, and distribution, covering both upstream and downstream processes (Coe & Yeung, 2015; Henderson et al., 2002). Typically, research in this field has focused on firms as key actors: "Through [a] process of strategic coupling, national firms have been gradually disembedded from state apparatuses and re-embedded in different global production networks that are governed by competitive inter-firm dynamics," a process "spanning different territories and regions" (Yeung, 2015, p. 70). However, there has been a renewed scholarly interest in the state–GPN nexus and the role this relationship plays in shaping production networks due to the revived involvement of states in governing GPNs, including through industrial policy (Horner, 2017). For example, state actors in a facilitator role assist firms in addressing challenges within GPNs, e.g., through subsidies (Horner, 2017, pp. 7–9). From a spatial perspective, these networks are governed through "vertical governance" which links different tiers of GPNs, while "horizontal governance" connects national political economies (Gereffi & Lee, 2016, pp. 28, 30). Overall, industrial policy serves as a governance tool that has the potential to influence the competitive position of firms and sectors within these production networks (Chang & Andreoni, 2020).

Overall, GPNs are a "contested field" (Levy, 2008) involving diverse actors with unique interests in specific developmental outcomes (Coe & Yeung, 2015). These interests pertain to high value-adding activities distributed across different parts of production networks, related to both innovation and production. However, this depends on varied and asymmetric power resources. Firms can exercise corporate power while states possess institutional power. For example, powerful lead firms have the ability to control and significantly shape GPN outcomes, whereas this power drastically diminishes towards the lower tiers of production and their suppliers. Moreover, GPN actors are embedded within specific institutional contexts

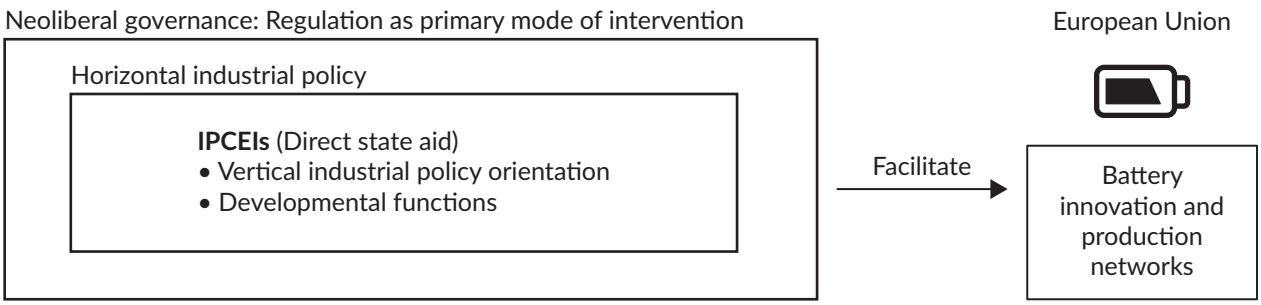

Figure 1. Developmental functions of the IPCEIs within EU's neoliberal governance.

that can be either limiting or supportive (Henderson et al., 2002). Figure 1 summarizes how the IPCEIs remain embedded within horizontal industrial policy and a broader neoliberal economic governance paradigm characterized primarily by regulatory modes of state intervention. Nevertheless, IPCEIs are a form of vertically-oriented industrial policy and reflect emerging developmental functions within this institutional setting. These contribute to the facilitation of European battery innovation and production networks.

3. Research Design

This exploratory study empirically analyzes the early stages of project execution (through the end of 2023) for the two Battery IPCEIs by employing qualitative research methods. It builds on a review of primary sources including relevant governmental documents from the EU and member states as well as press releases, and secondary literature, in particular scientific publications on EU industrial policy. This review primarily informs the analysis of the context of the EU's lack of battery innovation and production networks which has contributed to a variety of policies and programs that target this deficit, including the Battery IPCEIs. It further informs the analysis of the IPCEIs as a state aid funding scheme.

Several key conceptual terms guide the analysis: Since the Maastricht Treaty (1992), European economic governance has mostly facilitated *horizontal industrial policy* (general support intended to assist the entire economy and industry) and limited *vertical industrial policy* (selective support of specific industries or firms). However, as will be demonstrated, the IPCEIs have a more vertical industrial policy orientation, which is characteristic of developmental industrial policy traditions. The resulting regulatory-developmental turn in EU industrial policy is linked to the emergence of new developmental functions within the EU's primarily neoliberal and regulatory governance paradigm. These *developmental state functions* and policies (a) target structural economic change and economic catching-up to (b) support infant industries (c) beyond the limitations of neoliberal governance through (d) specific (financial) resources, including state aid, and (e) aim for the local assimilation of new technologies. In a European context, industrial policy is executed through (f) highly decentralized and networked structures. This is the case for both Battery IPCEIs which facilitate decentralized collaboration on the development of battery cells and systems between several firms across various member states. The IPCEIs include firms responsible for upstream processes (raw materials) and downstream processes (recycling) and link various lead firms and tiers of transnational battery production networks to capture high-value-adding activities. Hence the Battery IPCEIs can be understood as "an organizational platform through which actors in different regional and national economies compete and co-operate for a greater share of value creation, transformation, and capture through geographically dispersed economic activity" (Bridge & Faigen, 2022, p. 2).

Referring to these conceptual key terms, an in-depth single case study of the two Battery IPCEIs was conducted based on 11 semi-structured expert interviews. Experts were selected using "purposive sampling" (Campbell et al., 2020). These experts, which include representatives from firms and member states involved in the execution of the Battery IPCEIs, provided insights into the functioning of the projects. The resulting interview sample is detailed in Table X of the Supplementary Material. As a result of this selection strategy, the sample covers various national contexts, governance scales, firm sizes, and the four work streams to understand the decentralized and networked character of the Battery IPCEIs. Based on Kuckartz (2014), the interviews were transcribed and analyzed using qualitative content analysis. The coding and analysis focused on five areas: geopolitics, innovation, cooperation, funding, and conditionality. Data triangulation validates the results. All interview partners remain anonymous.

4. Analysis

This section empirically analyzes the geoeconomically-driven regulatory-developmental turn within EU industrial policy in three ways: firstly, by contextualizing the lack of lithium-ion battery innovation and production networks in the EU and the emergence of the Battery IPCEIs as one key governance instrument to support the development of these networks (Section 4.1); secondly, by explaining the vertical orientation of the IPCEIs as a specific state aid mechanism (Section 4.2); and thirdly, by conducting an empirical investigation of the Battery IPCEIs which demonstrate emerging developmental functions (Section 4.3).

4.1. Context: The Lack of Lithium-Ion Battery Innovation and Production Networks in the EU

A key trend in global automotive production networks is the shift from internal combustion engines to electric vehicles (EVs). Lithium-ion batteries, in particular, play a crucial role in this transition. While batteries are essential to various markets such as energy storage and e-bikes, the increasing relevance of EVs remains the primary driver of battery demand (Bridge & Faigen, 2022, p. 8). More importantly, batteries constitute up to 40% of the value added to an EV (Bundesministerium für Wirtschaft und Klimaschutz, 2022). This highlights the significance of batteries for the automotive industry. More importantly, this poses challenges to traditional lead firms in particular and their suppliers in the automotive GPNs. The reason therefore is that Asian firms, especially Chinese firms, have already established themselves as key players and are currently dominating emerging battery innovation and production networks within automotive GPNs. To illustrate this, in 2023, China held an 80% market share in global battery cell manufacturing (Racu & Poliscanova, 2024, p. 13). Consequently, current lead firms in the internal combustion engine-based automotive GPNs, particularly European lead firms (e.g., BMW, VW, etc.), have been lacking international competitiveness. Nevertheless, they aim to catch up by transitioning to electric mobility (Interview 4). This classifies the European battery industry as an infant industry (Interviews 6, 7, 11).

To address this lack of innovative and productive capabilities (Interviews 2, 5), the EU has initiated a variety of industrial policy instruments and programs to shape and facilitate an emerging battery industry. This is not only motivated by geoeconomic competition but is further driven by the EU's sustainability goals which aim to achieve climate neutrality and include a planned de facto ban on new internal combustion engines by 2035. The EC's 2018 Action Plan laid the groundwork for these initiatives and was informed by the revised Strategic Energy Technology Plan in 2015 and the 2017 EU Industrial Policy Strategy (European Court of Auditors, 2023, pp. 16–17). Some key policies and programs include CO^2 emission standards, new regulations on batteries and

waste batteries, the EU anti-subsidy investigations into and tariffs on EU imports of EVs from China, as well as the Battery IPCEIs (EC, 2023). These IPCEIs present a novel type of state aid mechanism that contributes to the regulatory-developmental turn occurring within EU industrial policy.

4.2. The Case of the IPCEIs

This section explains how the IPCEIs act as a novel industrial policy instrument as they enable more vertically-oriented industrial policy within the EU's horizontal institutional framework. Due to the EU's shared competence in competition policy, state aid is allocated at the member-state level, but only in accordance with EU state aid regulations. The predominantly horizontal approach taken to industrial policy since the Maastricht Treaty, within the broader neoliberal policy paradigm (see Section 2), restricts direct state aid. Direct state aid is considered a distortion that interferes with competition in the single market. Given this, such aid is only permissible if it is deemed compatible with competition policy and internal market rules (Pianta et al., 2020, p. 787). This reflects the contradictory interconnectedness of competition policy and more vertically-oriented industrial policy in a European context.

However, Article 107(3)(b) of the Treaty on the Functioning of the European Union allows for a specific type of state aid scheme in the form of direct aid to "promote the execution of an important project of common European interest or to remedy a serious disturbance in the economy of a Member State" (Treaty on the Functioning of the European Union, 2008, Article 107(3)(b)). This state aid scheme refers to the IPCEIs. The IPCEIs were already part of the Treaty of Rome but were only formalized in 2014 during the state aid modernization process. The 2014 EC Communication (COM/2014/C 188/02) established the guidelines for evaluating projects as being of common European interest. These IPCEIs must be strategically important to the EU, generate positive spill-over effects across member states, involve several member states, and focus on technologies beyond the state-of-the-art (Gräf & Topuria, 2023). The implementation of IPCEIs was only considered in the context of intensified geoeconomic competition in future technologies and strategic value chains.

These IPCEIs represent a legal and vertically-oriented "loophole" (Gräf & Schmalz, 2023) within the post-Maastricht horizontal competition policy for several reasons. First, IPCEIs target specific sectors deemed strategically important to the EU (EC, 2018). Currently, there are seven approved IPCEIs, including two in microelectronics, two in hydrogen, one in cloud and edge technology, and two in batteries. Two further IPCEIs are planned for solar energy and health (as of April 2024). A key criterion for selection as an IPCEI firm is that the firm is able to meet the high level of technological innovation required for participation (Interview 4). This shows that IPCEIs are unique in being sector-specific and technology-biased in contrast to, for example, the General Block Exemption Rules. Second, IPCEIs are not traditional R&D and innovation projects (Interview 5). Instead, they adopt a unique funding logic, allowing funding up to the "first industrial deployment" (after pilot stages and before mass production). This implies that the EC and member states can fund projects for an extended duration and further into the production process phase up to the market ramp-up phase (Interview 1). Third, IPCEIs reflect an expanded understanding of market failures. IPCEIs are intended to "remedy a serious disturbance in the economy of a member state" (Treaty on the Functioning of the European Union, 2008, Article 107(3)(b)), and hence to address "market failures" by facilitating the scale-up of high-risk future projects amid geoeconomic competition (Interview 10). According to neoclassical theory, government intervention is justified only in cases of market failures, where there is a

lack of investment in high-risk projects (Mazzucato, 2018, pp. 806–807). However, there is a broadened understanding of market failure in the context of a "geo-dirigiste turn" within EU industrial policy, as the EC is more willing to "adequately 'price in' geo-economic competition beyond traditional market failure concepts" (Seidl & Schmitz, 2023, p. 14). Building on this, IPCEIs address a lack of productive capabilities, such as in the battery sector, amidst geoeconomic competition (Interview 4).

Nevertheless, IPCEIs remain embedded in the EU's competition policy and maintain the horizontal character of EU industrial policy by ensuring that multiple countries and firms benefit from this type of funding within a single IPCEI project. The allocation of direct state aid to a specific IPCEI firm is contingent upon several more IPCEI firms receiving direct state aid within selected sectors and production networks. Additionally, the 2014 EC Communication was revised in 2021 to mandate participation from at least four member states to enhance compatibility with the EU single market. Moreover, the public funding received by IPCEI firms ultimately comes from national budgets, without a simultaneous increase in national or EU-level budgets (EC, 2024). Increased state budgets and spending are associated with stronger state intervention as seen, for example, during the Covid-19 pandemic (McNamara, 2023). While still adhering to regulatory modes of governance characteristic of the (still dominant) neoliberal paradigm (Di Carlo & Schmitz, 2023, p. 2063; Majone, 1997), the EU nevertheless makes indirect decisions about production and privileges certain firms and networks, such as battery production. Therefore, the Battery IPCEIs demonstrate a more vertical industrial policy orientation while maintaining horizontal industrial policy elements.

4.3. The Battery IPCEIs: Unpacking the Regulatory-Developmental Turn Within EU Industrial Policy

The Battery IPCEIs are reflective of a regulatory-developmental turn in EU industrial policy, and the abandonment of the previous paradigm of "undistorted" competition via market forces. This section analyzes how the Battery IPCEIs' rationales, governance structures, production network implications, funding, power dynamics, and conditionality contribute to key *developmental functions*. These functions target structural economic change and facilitate the catching-up process of the European industry by funding technological battery development and production via direct state aid to decentralized networks of firms. These functions operate beyond the limitations imposed by neoliberal governance in the EU (particularly in terms of vertical state support; see Section 3):

> If Europe had not been convinced in 2017 that it wanted [the battery] industry and that it wouldn't work under normal market conditions due to geopolitical competitors actively promoting these industries, rather than leaving them to market forces, then there would be no IPCEI. Certainly, the industry here in Europe would have faced many challenges. (Interview 6, translated by author)

Then in 2019, the first Battery IPCEI ("IPCEI on Batteries"/"Summer IPCEI"), comprised of 17 participants from seven member states, was adopted and extended through 2031. In 2021, the second "IPCEI European Battery Innovation (EuBatIn)" ("Autumn IPCEI"), comprised of 42 participants from 12 member states was adopted and extended through 2028 (see Tables 1 and 2). The issuance of the second Battery IPCEI reflects the demand for this type of state support (Interview 4).

Table 1. Overview of the Battery IPCEIs.

IPCEI on Batteries: Firms	Country	Automotive GPN actor	State aid (in €1,000)
Opel ACC	GER	Lead firm	436,812
BASF Schwarzheide	GER	Tier-1/-2	165,107
Automotive Cells Company	FRA	Tier-1	115,000
VARTA Micro Production	GER	Tier-1/-2	101,452
VARTA Microbattery	GER	Tier-1/-2	90,506
BMW	GER	Lead firm	60,092
SEEL	SE	R&D	53,066
BASF	GER	Tier-1/-2	14,899
Rhodia Operations	FRA	Tier-1/-2	7,030
Solvay Chemicals	BE	Tier-1/-2	5,734
BASF Battery Materials Finland	FIN	Tier-1/-2	5,605
Terrafame	FIN	Tier-1/-2	3,206
Keliber	FIN	Tier-1/-2	2,641
Umicore	GER	Tier-1	2,625
Fortum Waste Solutions	FIN	Tier-1	1,047
Elemental Strategic Metals	POL	Tier-1/-2	
Nanocyl	BEL	Tier-2	
Endurance	ITA	Tier-1	
ENEL X	ITA	Tier-1	
FAAM	ITA	Tier-1/-2	
Flash Battery	ITA	Tier-1	

Notes: Information about firms, member states, and share of public funding has been retrieved from the EC's State Aid Transparency Database; due to the two-step funding process, it is possible that some member states, e.g., Italy, have not yet paid the pre-approved funding; firms' position within the battery-based automotive GPN and their relationships to the automotive industry have been identified based on the IPCEI project descriptions, the firms' websites, and further research.

The key (technological) objective of the two Battery IPCEIs is to steer the development and production of "*next generation*" *lithium-ion batteries* among European firms, encompassing not only liquid electrolyte but also solid-state technologies. Each IPCEI is clustered into four work streams covering "raw materials" (work stream 1), "battery cells and modules" (work stream 2), "battery systems" (work stream 3), and "recycling and repurposing" (work stream 4). In addition to addressing the current lack of productive capabilities of battery cells, modules, and systems, IPCEIs shall further contribute to efficient mining and material technologies and exploit the unused potential of existing raw materials through recycling, e.g., second-life batteries. Hence, the Battery IPCEIs focus on developing battery production networks in the EU, including upstream and downstream processes relevant to battery production.

Overall, the IPCEIs are highly decentralized (see also Di Carlo & Schmitz, 2023, p. 2027) and are characterized by indirect dependencies among the participants (unlike, for example, a consortium). Participating IPCEI firms collaborate within, but also across, these work streams (Interview 1) in both intra- and inter-IPCEI networks. These collaborations, outlined in an internal and confidential document called the "Chapeau" document, are not limited to a certain national context, but can be transnational and are

Table 2. Overview of the EuBatIn.

EuBatIN I: Firms	Country	Automotive GPN actor	State aid (in €1,000)	EuBatIN I: Firms	Country	Automotive GPN actor
Northvolt Germany	GER	Tier-1	155,445	Alkeemia	ITA	Tier-2
Manz	GER	Tier-1	71,335	Arkema	FRA	Tier-1/-2
BMW	GER	Lead firm	67,993	Ferroglobe	SPA	Tier-2
Cellforce Group	GER	Tier-1	56,718	Hydrometal	BE	Tier-1/-2
Skeleton Technologies	GER	Tier-1	50,994	Italmatch Chemicals	ITA	Tier-2
SGL Carbon	GER	Tier-2	42,926	Tokai Cobex	FRA	Tier-2
ElringKlinger	GER	Tier-1	33,770	Green Energy Storage	ITA	Tier-1/-2
Northvolt	SE	Tier-1	21,470	Midac	ITA	Tier-1/-2
InoBat Auto	SK	Tier-1	19,192	Sunlight Group	GR	Tier-1
ENERGO – AQUA	SK	Tier-1/-2	15,207	Endurance	ITA	Tier-1
ZTS – Výskum a Vývoj	SK	Tier-1/-2	14,940	Enel X	ITA	Tier-1
Rosendahl Nextrom	AT	Tier-1/-2	10,620	FPT Industrial	ITA	Tier-1
VARTA Innovation	AT	Tier-1	9,197	Rimac Automobili	ITA	EV producer
Alumina Systems	GER	Tier-1/-2	8,700	Engitec	ITA	Tier-1
InoBat Energy	SK	Tier-1	8,495	Little Electric Car	SPA	EV producer
Voltlabor	AT	Tier-1	6,721	Syensqo	ITA	Tier-2
AVL List	AT	Tier-1	6,365			
Valmet Automotive	FIN	Tier-1	4,324			
Miba eMobility	AT	Tier-1	3,837			
Borealis	AT	Tier-1/-2	3,671			
Liofit	GER		2,840			
Fortum Waste Solutions	FIN	Tier-1	1,884			
Keliber Technology	FIN	Tier-1/-2	550			

Notes: Information about firms, member states, and share of public funding has been retrieved from the EC's State Aid Transparency Database; due to the two-step funding process, it is possible that some member states, e.g., Italy, have not yet paid the pre-approved funding; firms' position within the battery-based automotive GPN and their relationships to the automotive industry have been identified based on the IPCEI project descriptions, the firms' websites, and further research.

influenced by pre-existing commercial partnerships, geographical proximity, and national contexts. Nevertheless, new collaborations have emerged within the context of the IPCEIs (Interviews 1, 5, 6). These collaborations do not only encompass the technological development of batteries, including both up- and downstream processes, but also for example the handling of legislative regulations. For example, IPCEI participants have been cooperating on industry standards such as a common recommendation for the development of the new EU digital battery pass, which sets standards for battery production in the EU and on the composition requirements of battery cells for easier recycling (Interviews 1, 6). Additionally, IPCEI firms may engage in additional parallel cooperation and partnerships concerning technological developments that do not relate to the IPCEI projects directly (Interview 5).

European policymakers coordinate these Battery IPCEIs through vertical governance, linking the various transnational, *decentralized*, and *networked* tiers of participating firms across the emerging battery

production networks. The EC defined battery production as a technological priority and implemented this novel form of state aid that permits participating firms to utilize IPCEI state aid in compliance with EU competition policy (see Section 4.2). This process was further influenced by the German and French governments and by consultations with the private sector. At the (sub-)national levels, the EC maintains a lower degree of involvement. The operational and administrative coordination is overseen by the French and German governments. The French government coordinates the IPCEI on Batteries, and the German government coordinates the EuBatIn (Interviews 1, 2, 4). However, the German government has outsourced these tasks to an external German project management firm. This firm undertakes a variety of tasks ranging from idea development, the suggestion of participants, and the preparation of funding approvals to providing supplementary research and facilitating networking among IPCEI participants as well as with external networks and actors. In addition, the German government's plans to expand the second Battery IPCEI to include countries like Portugal and non-EU countries such as Switzerland and Norway faced opposition from the EC. Instead, the EC introduced the option of associated membership in November 2023. Current IPCEI members decide on admission based on the Chapeau document. An associated membership allows participation in networking events and the work streams of the Battery IPCEIs, but without receiving state aid through the IPCEIs (Interview 1). This private intermediation in the German case, coupled with conflicting interests between the EC and the German government regarding the expansion of the IPCEIs, reflects a more fragmented role of state activity in the return of industrial policy in the EU.

Nevertheless, the implementation of the Battery IPCEIs has been enabled by new geoeconomic competition for high-value-added activities in the battery-based automotive GPNs (see Section 4.1). IPCEI firms acknowledge that their main competitors are non-European firms, referring in particular to Chinese firms but also to Japanese, Korean, and US firms (Tesla), who in some instances receive foreign state subsidies (Interview 4). Furthermore, the Battery IPCEIs were driven by an interest in preventing the "Foxconnisation of the automotive industry" (Lüthje, 2022) in the EU (Interview 5). This would imply changing power dynamics as traditional automotive lead firms would have to rely on contract manufacturers and new players such as battery systems producers who capture large shares of the value added.

These conditions led to the implementation of the Battery IPCEIs as a novel type of *state aid* (see Section 4.2), granted when there is a need to catch up to international competition and a lack of innovation vis-à-vis the leading international competitors (Block, 2008, p. 172). This enabled a total share of €3.2 billion in state aid for the first IPCEI, supplemented by €5 billion in private investments, and €2.9 billion in state aid for the second IPCEI, supplemented by €8.8 billion in private investments (for a detailed allocation see Tables 1 and 2). Member states fund the IPCEI firms through their national and subnational budgetary funds. Overall, there is consensus among involved firms and policymakers that the IPCEIs are a helpful instrument and funding scheme, given the *limitations* on direct state aid in the EU in contrast to, for example, the Inflation Reduction Act (concluded in 2022) in the US (Interviews 1, 3, 5, 8, 9, 11).

While Chinese firms, in particular, are currently leading in battery production (see Section 4.1), European firms are nevertheless engaged in a fragile *catching-up process*. Importantly, IPCEI state aid is indeed leveling investments and battery production capacities. For example, Northvolt has announced the provision of 60 GWh of battery cell capacity in Germany, Automotive Cells Company (ACC) in France 40 GWh, and InoBat & Gotion (Slovakia) 20 GWh by 2030 (Racu & Poliscanova, 2024, pp. 14–15). In addition, the Battery IPCEIs support gigafactories, which reflects the global trend of gigafactories becoming central to state and

investment strategies within the global battery GPNs, as they function as key nodes in these networks (Bridge & Faigen, 2022, p. 8). For example, the German chemical firm BASF constructed a gigafactory for cathode materials in Lausitz, Germany, supplemented by upstream products from the BASF site in Harjavalta (Finland); the Swedish battery producer Northvolt is setting up a battery gigafactory in Heide (Germany); and the European joint venture ACC is establishing a gigafactory for battery cells and modules in Billy-Berclau (France) as well as a factory at the Opel site in Kaiserslautern (Germany) that are expected to create cluster effects. Yet, reports of delays and disruptions also exist (Interview 5).

However, if the analytical focus is shifted to power dynamics, it becomes clear that the Battery IPCEIs replicate existing asymmetric corporate power dynamics along several dimensions of the European combustion-engine-based automotive GPNs. The main beneficiaries of the Battery IPCEIs are primarily powerful GPN actors not only in terms of firm size (encompassing lead firms as well as Tier-1 or Tier-2 supplier firms and gigafactories) but also in terms of the position of firms in the combustion-engine-based automotive GPNs. In contrast, only a minority of IPCEI firms are considered small or medium-sized enterprises (see Tables 1 and 2). Moreover, the automotive industry, in particular in France, was quite influential in initiating the IPCEIs on Batteries, and are now among the key beneficiaries. The first "IPCEI on Batteries" was primarily driven by French automotive firms together with the French government (Interview 1). This shows that the automotive industry was not only influential in the design of the Battery IPCEIs but is also one of the main beneficiaries.

In addition, the return of industrial policy in the EU raises questions about the conditionality of funding distribution, such as subsidies (Bulfone et al., 2023). Strong conditionality is lacking for the IPCEI funding (Interview 11). The Battery IPCEIs, particularly the second IPCEI, claim to support social and environmental objectives (IPCEI Batteries, 2024), but these are secondary to technological and economic goals (Interviews 1, 5, 4). Social objectives are primarily focused on the creation of high-skilled jobs, which are, importantly, small in numbers. For example, only about 100 jobs are being created at an IPCEI lead firm in a deindustrialized region (Interview 6). There is even a "war for talent" among IPCEI firms (Interview 7). Environmental goals are assumed to be met through contributions to electric mobility, which is seen as synonymous with environmental sustainability (Interviews 1, 4). This reflects "green industrial policy" (Rodrik, 2014) approaches that are focused on modernizing rather than transforming existing industrial structures, such as new mobility concepts (Pichler et al., 2021).

A condition for funding is, however, the sharing of knowledge among IPCEI participants and with the wider public after project termination, excluding core business secrets (Interview 1). In addition, this requirement was one of the reasons why Tesla opted out of the first Battery IPCEI (Interview 6). Moreover, a so-called "claw-back" mechanism, regulated by the Chapeau document, ensures the repayment of extra profits to their member states after IPCEIs end (Interviews 1, 5). This is a significant financial condition to place on funding. Its effectiveness remains to be seen, with calls to ease this mechanism already being made (Interview 7): "A State Aid framework with common conditionality for disbursement is crucial. The effectiveness and acceptability of State Aid instruments depends crucially on the strategic use of public funds to achieve common public policy objectives" (Letta, 2024, p. 39).

5. Conclusion

Intensifying geoeconomic competition has contributed to debates about the return of industrial policy in the EU, raising questions about whether the character of EU industrial policy is transforming. This study contributes to these debates by analyzing the Battery IPCEIs as a novel governance instrument in the EU's industrial policy toolkit designed to facilitate European battery innovation and production networks.

Despite limitations imposed by EU competition policy, these IPCEIs allow for the distribution of direct state aid to a network of selected firms engaged in the advancement of next-generation lithium-ion batteries across member states, encompassing both upstream and downstream processes. The rationale for these projects is that the EU aims to support structural changes in the European automotive industry by catching up in battery innovation and production, particularly to the Asian firms currently leading in battery production. Notably, batteries account for up to 40% of the value added to an EV. The Battery IPCEIs thereby create opportunities for vertical industrial policy as well as emerging developmental functions within EU industrial policy, which traditionally favors horizontal approaches consistent with a neoliberal governance paradigm, with regulation as the primary mode of intervention.

Hence, this article concludes that EU industrial policy is experiencing a geoeconomically-driven regulatory-developmental turn, and is moving away from the primacy of undistorted competition. Indeed, the Battery IPCEIs have triggered investments in expanding battery innovation and production and are contributing to the process of European firms catching up to their Asian counterparts. Nevertheless, this progress remains fragile within a dynamic and emerging battery industry. Furthermore, from a critical perspective, the Battery IPCEIs tend to replicate asymmetric power dynamics and lack strong conditionality.

As this study examines the early stages of IPCEI project execution, future research should analyze the evolution of these projects and critically assess how emerging developmental functions evolve. It should also evaluate the impact of this state aid mechanism, given that the EU's institutional framework still imposes limitations on stronger public support and intervention, in contrast to, for example, the Inflation Reduction Act in the US.

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Conflict of Interests

The author declares no conflict of interests.

Supplementary Material

Supplementary material for this article is available online in the format provided by the author (unedited).

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