IGES Discussion Paper

Advancing the Energy Transition through Industrial Policy: A Transatlantic Perspective with Lessons for Japan

IGES
Institute for Global Environmental Strategies

Advancing the Energy Transition through Industrial Policy: A Transatlantic Perspective with Lessons for Japan

Michael A. Mehling

Deputy Director, Center for Energy and Environmental Policy Research, Massachusetts Institute of Technology, Cambridge, MA, USA; Professor, School of Law, University of Strathclyde, Glasgow, UK.

Abstract

This paper conducts a comparative analysis of green industrial policy strategies recently advanced by the European Union (EU) and the United States (U.S.), and extends insights to the evolving policy landscape in Japan. Its analysis underscores how the European strategy is characterized by a systematic approach that balances emissions constraints with incentives and support policies under the broader umbrella of the European Green Deal. By contrast, the U.S. approach prioritizes innovation and fiscal incentives to stimulate the clean energy sector, as seen with the Inflation Reduction Act. Japan, navigating its unique socio-economic challenges, can leverage lessons from both regions to tailor its green industrial policy, emphasizing energy security, climate resilience, and supply chain diversification. The analysis underscores the importance of equity and international cooperation in crafting effective green industrial policies. Drawing on these transatlantic experiences, the paper highlights strategic recommendations for Japan, focusing on the significance of adapting policies to national contexts while contributing to global sustainability efforts.

Table of Contents

1 Introduction: How Green Industrial Policy is Accelerating the Energy Transition

Following years of at best incremental progress, the urgency of climate change necessitates a transformative approach to decarbonization of the economy, including in hard-to-abate sectors of industry. Recently, this challenge has given rise to a growing trend towards deployment of green industrial policy to accelerate the transition from a fossil-fuel-based economy to a sustainable, low-carbon alternative. Industrial policy, traditionally aimed at spurring economic growth and competitiveness through government intervention in markets, has found renewed expression in the push for decarbonization. It comprises a suite of strategies designed to catalyze the development and deployment of renewable energy technologies and low- or ultra-low-carbon manufacturing processes, thereby advancing the energy transition and industrial decarbonization. The research question guiding this paper probes the efficacy of this recent turn to industrial policy in promoting not only the energy transition, but also energy security and economic resilience. It weighs the potential risks and costs against the observed benefits, and endeavors to draw lessons from the distinct trajectories adopted by the United States and the European Union. On the basis of that evaluation, it then seeks to synthesize insights and formulate recommendations for Japan and its unique socioeconomic and political context.

The recent pivot towards green industrial policy underscores a collective ambition to reconcile economic advancement with environmental stewardship. The United States, under the Biden administration, has embarked on ambitious legislative measures aimed at invigorating the clean energy sector. The passage of legislation mandating significant investments in decarbonization, namely the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA), marks a strategic departure from conventional environmental law towards a model that stimulates technological innovation and infrastructural renewal (Farber 2023). Similarly, the European Union's Green Deal and the proposed Net Zero Industry Act and Critical Raw Materials Act embody a comprehensive framework to drive the bloc towards climate neutrality by 2050 (Veugelers, Tagliapietra, and Trasi 2024). These policies, while distinct in their approaches and emphases, collectively reflect a strategic alignment towards green industrialization as a conduit for achieving sustainable growth and climate objectives.

At the heart of green industrial policy lies the dual aim of mitigating climate change and enhancing social welfare, a balance intricately poised between decarbonization goals and broader socio-economic benefits. This policy paradigm, by its design, is predicated on a nuanced understanding of industrial policy's capacity to foster structural change and technological advancement. As Juhász, Lane, and Rodrik (2023) describe it, successful green

industrial policies are those that not only incentivize innovation and market transformation but also rigorously evaluate and adapt to emerging outcomes and challenges. The essence of green industrial policy, thus, transcends mere financial incentives or regulatory mandates; it embodies a holistic strategy aimed at engendering a sustainable industrial ecosystem that is resilient, competitive, and aligned with long-term environmental goals.

The United States and the European Union, through their legislative frameworks and policy initiatives, offer compelling – and to some extent competing – models of how green industrial policy can be leveraged to catalyze the energy transition. The Inflation Reduction Act, for instance, aims to reshape the American energy landscape through a combination of subsidies, tax incentives, and regulatory adjustments, but also incurs a significant fiscal commitment (Bistline, Mehrotra, and Wolfram 2023). Conversely, the European Union's strategy, articulated through the European Green Deal, envisages a comprehensive policy and regulatory overhaul to facilitate a green transition, underpinned by ambitious targets for carbon neutrality and a price levied on carbon, including on emissions embedded in imported goods through the Carbon Border Adjustment Mechanism (CBAM) (Tagliapietra and Veugelers 2023).

This paper, in its exploration of the role of green industrial policy in accelerating the energy transition, is structured to provide a granular analysis of these strategies and their outcomes. Section 2 delineates the historical evolution and current state of green industrial policy, situating it within the broader discourse about a revival of industrial policy in the face of the climate challenge. Subsequently, Sections delves into the specific green industrial policy measures adopted or under development in the United States and the European Union, providing a lens through which to assess their efficacy and impact. Section 4 synthesizes these insights, offering a comparative analysis of the transatlantic approaches to green industrial policy. Drawing on these analyses, Section 5 articulates lessons for Japan, contemplating how insights from the U.S. and EU experiences can inform Japan's green transition strategy. The concluding section, Section 6, encapsulates the study's findings, positing recommendations for policy formulation and implementation.

2 The Rise of Green Industrial Policy

Industrial policy has historically elicited mixed reactions, ranging from criticism for its potential to induce market distortions (Cherif and Hasanov 2019; Devarajan 2016; Neely 1993) to acknowledgment – in some cases even by earlier skeptics – of its role in fostering economic development and technological advancement (Krugman 2023). An initial wave of political discussion about the risks and benefits of industrial policy was ironically sparked by the perceived threat of Japan's growing success in global markets for many commodities and consumer products (Thurow 1992; and earlier Cooper 1987; Krugman 1983). More recently, industrial policy has seen ascending popularity as a strategy to counter industrial competition from emerging economies, and in particular the global dominance of Chinese manufacturing, which has benefited from government interventions and trade practices that are widely considered unfair and have contributed to large excess capacities in key markets (Agrawal 2023; Juhász et al. 2023).

Green industrial policy extends beyond the traditional confines of an industrial policy primarily focused on economic growth, and aims to synergize economic policy with climate objectives (Rodrik 2014). It entails a strategic orientation towards supporting industries and technologies that can lead to a reduction in carbon emissions and a transition to a sustainable energy economy (Lamperti et al. 2019; going back to Mazzucato 2013). The global pivot to industrial policy as a way of advancing decarbonization objectives has been accelerated by the growing recognition of climate change as an existential crisis and political priority, necessitating concerted and coordinated policy responses to foster the development of low-carbon technology solutions that are scalable and competitive (Victor and Carlton 2023). In an era of declining industrial output and employment, rising geopolitical tensions and competitive pressures, as well as rising populist and nationalist movements, industrial policy has presented itself as a strategy to secure public support for climate action and overcome stakeholder opposition by promising a number of accompanying economic, social, and strategic benefits.

It would be wrong, however, to consider the present convergence of political and economic headwinds the first and only context in which debates about green industrial policy have found widespread uptake. The aftermath of the 2008 financial crisis, for example, already provided a critical juncture for reassessing the role of industrial policy in economic recovery and sustainability transitions. This period witnessed an intensified focus on green industrial strategies as mechanisms for economic revival and environmental sustainability (Barbier 2010). Similarly, China's assertive move over the past decade to dominate low-carbon technology manufacturing has catalyzed the global shift towards green industrial policy, as it both

highlighted the competitive and strategic dimensions of leading a transition to clean energy, but also exerted competitive pressures and, more recently, concerns about the resilience of sensitive clean technology supply chains (Lewis 2024).[1] More recently, the United States and the European Union have followed this pattern of turning to green industrial policy as a strategic tool, not only in response to environmental imperatives, but also as a means to navigate trade tensions, enhance energy security, and ensure the resilience of supply chains in critical materials and components amid global challenges such as the COVID-19 pandemic and geopolitical tensions (Schreurs 2024).

The present ascendance of green industrial policy is intrinsically linked with the acceleration of climate policy ambitions worldwide. This interconnection reflects a broader trend towards integrating economic and environmental objectives, wherein green industrial policy serves as a bridge between the imperative for economic growth and the necessity for environmental stewardship (Clausing and Wolfram 2023a). The ambition to achieve net-zero emissions, bolstered by international agreements and national commitments, has further propelled the adoption of green industrial strategies as critical enablers of the transition to a low-carbon economy.

Strategic reliance on green industrial policy, while promising, is fraught with complexities. A concern associated with green industrial policy revolves around the potential for policy misalignment and the consequent market distortions. Critics argue that such policies, when improperly calibrated, inadvertently stifle innovation by channeling resources towards less efficient or unproven technologies, crowding out private investment, and perpetuating dependence on government support rather than fostering genuine market competitiveness (Lincicome and Zhu 2021). Moreover, the specter of protectionism looms large, with policies designed to favor domestic industries potentially contravening the principles of free trade and precipitating retaliatory measures from global trade partners (Clausing and Wolfram 2023b; Lewis 2014).

The challenges of implementing green industrial policy are further compounded by the risk of rent-seeking behavior, where industries may leverage such policies primarily for financial gain rather than for achieving substantive environmental outcomes. This phenomenon not only dilutes the efficacy of the policy but also risks diverting critical resources away from areas where they could have the most significant environmental impact. Additionally, the

1 Referencing the low-carbon technologies identified as 'strategically important', such as electric vehicles and renewable energy, in the 'Made in China 2025' strategy, see State Council (2015), and the mandate to "[d]evelop and expand strategic emerging industries" in the 14th Five Year Plan, see National People's Congress (2021).

complexities of global supply chains and the rapid pace of technological evolution necessitate a delicate balancing act in policy formulation to avoid the pitfalls of obsolescence, inefficiency, and protectionism. In the current surge of green industrial policies across a number of regions, concerns have also surfaced that these will disadvantage the most vulnerable members of the international community, notably low-income developing countries that rely on export-led development and lack the resources to deploy similar strategies in order to secure the competitiveness of domestic industries and robust supply chains (Walker and Palaon 2024).

Conversely, the benefits of green industrial policy are multifaceted and potentially far-reaching, explaining why it has proven so compelling as a political strategy in the current economic and geopolitical context. At the forefront is the potential for significant job creation and economic revitalization, particularly in sectors poised for growth within the green economy (Aklin and Mildenberger 2020). By fostering an ecosystem conducive to the development and scaling of clean energy technologies, green industrial policies promises to catalyze new industries, spur employment opportunities, and stimulate economic diversification (Nahm 2021).

Beyond economic revitalization, green industrial policy can play a pivotal role in advancing technological innovation. By providing targeted support for research and development in renewable energy technologies, governments can accelerate breakthroughs that are critical for reducing greenhouse gas emissions and combating climate change (Mazzucato 2022; Popp 2010). This not only enhances a country's competitive edge in the burgeoning clean technology market but also contributes to global efforts to decarbonize in a world of asymmetrical climate action in which not all countries deploy climate policies with the same level of ambition.[2]

Moreover, the strategic application of green industrial policy can significantly bolster energy security and resilience. By reducing reliance on imported fossil fuels and enhancing the capacity for domestic clean energy production, countries can shield themselves from the volatility of global energy markets and geopolitical uncertainties. At the same time, industrial policy can help ensure countries do not simply substitute one import dependence with another by securing more diverse and resilient supply chains for components and materials that are essential for decarbonization, such as rare earth metals and critical minerals, where a small number of countries – led by China – currently dominate the market (Goldthau and Hughes 2020; Goldthau, Hughes, and Nahm 2022; Mertens et al. 2024). This transition to a more secure low-carbon energy and technology manufacturing landscape is increasingly viewed as integral to achieving long-term environmental and economic stability (Farber 2023; Victor and Carlton 2023).

2 See, for instance, the global spillover benefits from solar energy support policies adopted in selected jurisdictions, as describe by Gerarden (2023) and Helveston, He, and Davidson (2022).

Overall, the ongoing debate on the risks and benefits of green industrial policy highlights the need for careful policy design, implementation, and evaluation (Aldy 2022). While the challenges are nontrivial, the potential rewards – spanning economic revitalization, technological innovation, and environmental sustainability – underscore its political appeal, especially in a period in which a record number of countries are headed to the polls in national elections (Andreoni 2024). Climate policy is on the ballot in many of these elections, where it is frequently fettered by political polarization amidst surging nationalist and populist movements that complicate the political economy of decarbonization, further elevating the profile of industrial policy and the economic agenda – often laced by protectionist elements – it represents (Mehling, Driesen, and Popp 2024).

As countries around the world grapple with the challenges of climate change and industrial decarbonization, green industrial policy has thus become an established part of the toolbox to which policy makers are taking recourse, yet given the innate risks and potential costs described above it also remains a tool that calls for judicious application. The next section will delve deeper into the specific contours of green industrial policy initiatives in the United States and the European Union, offering a more granular analysis of their design, implementation, and impact on advancing the energy transition and industrial decarbonization.

3 Transatlantic Approaches to Green Industrial Policy

3.1 Green Industrial Policy in the United States

3.1.1 Background and Context

The United States' foray into green industrial policy can be traced back to the environmental movements of the 1960s and 1970s, which catalyzed the enactment of landmark legislation such as the Clean Air Act and the Clean Water Act. These foundational policies established a regulatory framework aimed at reducing pollution and protecting natural resources, setting the stage for subsequent discussions on sustainable industrial practices (Farber 2023). The early regulatory focus was primarily on environmental protection without explicit linkage to industrial policy. However, these regulations laid the groundwork for the integration of environmental considerations into economic and industrial decision-making. By the late 20th and early 21st centuries, the dialogue around environmental policy began to shift towards sustainable development and clean energy, reflecting a broader understanding of the economic

implications of environmental degradation and the potential for green technology as a driver of economic growth. The concept of green industrial policy started to gain traction, emphasizing the role of government policy in supporting industries that contribute to environmental sustainability and economic resilience (Schreurs 2024).

The 21st century witnessed a more definitive move towards green industrial policy in the United States, spurred by increasing awareness of climate change and the potential of clean energy technologies. The American Recovery and Reinvestment Act of 2009, for instance, represented a significant investment in clean energy and environmental projects, highlighting the role of federal policy in catalyzing the transition to a green economy (111th Congress 2009). The political and economic landscape of the United States at the time provided both opportunities and challenges for the advancement of green industrial policy. A generational economic crisis, the Great Recession, and the urgent need for job creation and economic revitalization presented a compelling case for investment in clean technologies and sustainable industries as a pathway to economic recovery and long-term sustainability (Aldy 2013; Carley, Nicholson-Crotty, and Fisher 2015).

More recently, the Green New Deal resolution, introduced in Congress in 2019, marked a watershed moment in the U.S. discourse on climate policy and decarbonization (Ocasio-Cortez 2019). Though not legislation, it articulated a vision for a comprehensive transformation of the economy to address climate change, social inequality, and economic stagnation through massive investments in clean energy, infrastructure, and green jobs. This resolution set the stage for subsequent policy proposals and legislative efforts aimed at integrating environmental sustainability with industrial and economic policy, and strongly influenced political preferences articulated across the left spectrum of the political landscape (Victor and Carlton 2023).

Following the Green New Deal's introduction, significant legislative efforts, including the Inflation Reduction Act (117th Congress 2022b), Infrastructure Investment and Jobs Act (117th Congress 2021), and executive orders focused on clean energy and environmental sustainability (Executive Office of the President 2021), have further solidified the U.S. commitment to green industrial policy. These efforts emphasize the government's role in fostering innovation, supporting sustainable industries, and ensuring the United States' competitiveness in the global transition to a green economy (see infra, Section 3.1.2).

The historical evolution of green industrial policy in the United States illustrates a gradual but significant shift towards recognizing and leveraging the synergies between environmental sustainability and economic growth. From early environmental regulations to contemporary

legislative and policy initiatives that focus on advancing clean technology manufacturing and renewable energy production, the rise of green industrial policy reflects a growing consensus on the political viability of policies that simultaneously advance economic resilience, social equity, and environmental stewardship objectives.

3.1.2 Central Features of U.S. Green Industrial Policy

The evolution of green industrial policy in the U.S. has been significantly influenced by the legislative landscape and executive leadership, which have both propelled and shaped the direction of policy development and implementation. Notable legislative efforts, such as the American Recovery and Reinvestment Act of 2009 (111th Congress 2009) marked early attempts to integrate green investments into broader economic recovery measures. However, the push towards a more cohesive green industrial policy gained momentum with recent initiatives that explicitly target climate change and environmental sustainability as central pillars of economic policy (Bistline, Mehrotra, and Wolfram 2023; Farber 2023).

Following the 2020 general election, the Biden Administration has played a decisive role in accelerating the U.S. pivot to green industrial policy. It has been, in turn, heavily influenced by the introduction of the Green New Deal resolution in Congress (Ocasio-Cortez 2019), which, although not enacted into law, framed the conversation on climate action within the broader context of social and economic reform, highlighting the interconnections between environmental sustainability, economic inequality, and social justice (Schreurs 2024; Victor and Carlton 2023). Guided by the recommendations of a 'Unity Task Force' that had been appointed by Senator Bernard Sanders and presidential candidate Joseph R. Biden Jr., key elements of this progressive agenda found their way into Biden's electoral campaign platform (Kerry et al. 2020).

Following the election, the green industrial policy dimension of this political platform evolved into the 'Build Back Better' agenda, which eventually culminated – albeit in a diminished form, due to multiple political compromises required for passage – in the Infrastructure Investment and Jobs Act and Inflation Reduction Act. These acts represent landmark investments in clean energy, climate resilience, and environmental justice, reflecting a holistic approach that encompasses economic revitalization, job creation, and addressing the disproportionate impact of climate change on vulnerable communities (White House 2023).

Chronologically the first of these legislative measures to pass in November 2021, the narrowly bipartisan Infrastructure Investment and Jobs Act (IIJA) earmarks $1.2 trillion towards revamping the United States' infrastructure, with a significant focus on sustainable and resilient systems (117th Congress 2021). Approximately $550 billion of new spending is allocated to various projects, including improvements to public transit, water infrastructure, and broadband access, as well as initiatives specifically aimed at bolstering the country's climate resilience and reducing greenhouse gas emissions. A notable aspect of the Act is its investment in electric vehicle (EV) infrastructure, aiming to create a nationwide network of EV chargers to facilitate the transition to electric transportation. Additionally, the Act invests in upgrading the electrical grid, addressing one of the most serious bottlenecks currently holding back more rapid deployment of renewable energy sources (Smead 2024).

Adopted the following year on a purely partisan vote, the CHIPS and Science Act of 2022 focuses on strengthening the United States' semiconductor industry and scientific research infrastructure, recognizing the critical role of technology and innovation in economic competitiveness and national security (117th Congress 2022a).[3] The Act authorizes approximately $280 billion in federal investments for semiconductor research, development, and manufacturing incentives, alongside substantial funding for science and technology research initiatives. While it primarily aims to bolster the U.S. position in the global technology race, it acknowledges the strategic importance of semiconductors in a range of industries, including clean energy technologies, where advanced materials and components are essential for innovation and efficiency improvements. Not only does it indirectly advance the broader goals of U.S. green industrial policy by investing in the semiconductor industry and scientific research, but it also directly appropriates up to $67 billion to fund research directly relevant to decarbonization, including research on advanced zero-emissions technologies such as improved energy storage, hydrogen, carbon capture and storage, and fusion, greenhouse gas management, climate science research, as well as disaster-resilience research (Meyer 2022; Sargent Jr., Singh, and Sutter 2023).

In August 2022, Congress narrowly passed the Inflation Reduction Act (IRA) on a partisan vote through the reconciliation process to avoid a potential filibuster in the U.S. Senate (117th Congress 2022b). Hailed as the "most important climate action in U.S. history" (Marcacci 2022), this measure seeks to enhance energy security and bolster green innovation through a range of public investments in the form of tax credits, grants, loans and other subsidies. Investment volumes dedicated to addressing climate change through mitigation and adaptation efforts, while difficult to estimate with precision, are significant, starting with the initial projection by the

3 CHIPS stands for 'Creating Helpful Incentives to Produce Semiconductors'.

Congressional Budget Office of $369 billion over ten years, which represents the lower end of estimates (Congressional Budget Office 2022). Further analyses suggest a higher uptake of tax credits, which are not capped in volume, potentially tripling the fiscal impact of this legislation to $1 trillion or more (Bistline, Mehrotra, and Wolfram 2023; Credit Suisse 2022). A considerable portion of the funds under the Inflation Reduction Act is specifically allocated to support the production of renewable energy and other low-carbon technologies, with several incentives tied to domestic content or assembly conditions that are designed to shift the manufacturing of these technologies to the United States.

More specifically, the Inflation Reduction Act deploys numerous initiatives aimed at stimulating private sector investments in low-carbon technologies and production, representing an combination of government policies and market incentives to address climate change. It allocates roughly $30 billion in production tax credits to strengthen domestic production of solar panels, wind turbines, batteries, and the processing of essential minerals. Additionally, it proposes a $10 billion investment tax credit for the construction of facilities dedicated to low-carbon technology manufacturing, alongside $20 billion in loans for establishing new clean vehicle production sites nationwide. It also includes a variety of grants and tax incentives aimed at minimizing industrial emissions, featuring nearly $6 billion for a new Advanced Industrial Facilities Deployment Program benefitting significant industrial emitters such as chemical, steel, and cement manufacturers, and more than $9 billion dedicated to the public procurement of low-carbon technologies to create a consistent demand signal (Marcu, Mehling, and Cosbey 2023). Furthermore, significant incentives aimed at low-carbon electricity and fuels are set to expedite the decarbonization of the energy sector, thereby reducing the indirect emissions attributed to U.S. manufacturers.

At the same time, the Inflation Reduction Act addresses the social dimensions of the green transition, allocating funds to disadvantaged communities and workers affected by the shift away from fossil fuels. This approach reflects the political strategy of ensuring that the benefits of the green economy are widely shared, promoting equity and environmental justice as central tenets of U.S. climate action, to secure broad public acceptance and political support (Farber 2023).

Beyond the foregoing legislative measures of the U.S. Congress, the administration has issued a number of executive orders that help advance the U.S. green industrial policy agenda, setting targets for reducing greenhouse gas emissions, promoting federal sustainability, and enhancing the resilience of critical infrastructure to climate change. Notably, the Executive Order on Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability outlines

significant efforts by the U.S. government to bolster environmental and energy efficiency across federal operations (Executive Office of the President 2021). It revokes previous orders, aiming for a more robust and comprehensive approach to sustainability within federal agencies by emphasizing the transition to carbon pollution-free electricity, sustainable acquisition and procurement, and adapting federal operations to climate change impacts. The order sets out several climate policy objectives, such as achieving a substantial percentage of zero-emission vehicle acquisitions by 2035 and a net-zero emissions building portfolio by 2045, and commits the administration to reducing emissions and supporting resilient supply chains through prioritized purchasing decisions favoring sustainable products and services. Importantly, these actions leverage the considerable purchasing power of the federal government to advance domestic policy objectives.

Finally, the regulatory environment and institutional support mechanisms are key components of the U.S. green industrial policy framework. The Environmental Protection Agency (EPA) and the Department of Energy (DoE) play critical roles in implementing and enforcing regulations that support the transition to clean energy and sustainable practices. The Department of Energy, for instance, recently announced an investment of $6 billion to accelerate innovation in clean energy technologies and foster partnerships between the government, private sector, and research institutions designed to reduce barriers to innovation and market entry. Specifically, 33 projects across more than 20 states will help decarbonize energy-intensive industries including aluminum and other metals, cement and concrete, chemicals and refining, as well as iron and steel, and are expected to reduce the equivalent of more than 14 million metric tons of carbon dioxide emissions each year (Department of Energy 2024).

3.1.3 Assessment

U.S. green industrial policy, as exemplified by the Inflation Reduction Act, Infrastructure Investment and Jobs Act, and CHIPS and Science Act, marks a significant pivot towards sustainable economic development and climate resilience. The cumulative impact of these policies is profound, setting the stage for a comprehensive transformation across various sectors of the economy. From bolstering clean energy technologies to modernizing infrastructure and enhancing the nation's scientific and technological capabilities, these legislative efforts embody a multifaceted approach to addressing the pressing challenges of climate change while ensuring economic growth and competitiveness. At the same time, the emphasis on sustainability and resilience in procurement practices, as guided by executive

orders and departmental strategies, underscores a commitment to embedding environmental considerations into the fabric of federal operations.

Estimates suggest that the recent legislative advances – once operationalized by federal agencies – will help substantially narrow the gap between projected emissions and the Nationally Determined Contribution (NDC) submitted by the United States under the Paris Agreement (Bistline et al. 2023; Jenkins et al. 2023), which requires emissions to decline by 50-52% below 2005 levels in 2030 (United States 2021). Impacts of the latest green industrial policy efforts are not only manifesting themselves in terms of anticipated emission reductions, however. Already, in the first year after its adoption, the Inflation Reduction Act and the generous incentives it sets out were seen as critical enablers for a 37% increase in new clean energy and technology investment across the U.S. economy, and a 125% year-on-year increase in clean technology manufacturing, particularly within electric vehicle and solar manufacturing (Bermel et al. 2013). Investment in clean energy production and industrial decarbonization also rose 15% year-on-year, and household and business retail investment in purchasing and installing clean technologies such as heat pumps and zero-emission vehicles (ZEVs) rose 32% year-on-year (Bermel et al. 2013).

Looking ahead, the trajectory of U.S. green industrial policy suggests an increasingly integrated approach to climate policy, economic strategy, and national security. The recognition of climate change as both a strategic challenge and an opportunity for innovation and growth informs a forward-looking perspective that is adaptive, inclusive, and politically resilient. Even if the upcoming federal elections prompt a change in leadership, it is likely that the incoming administration will continue the focus on technological innovation, workforce development, and broad access to the economic benefits of a green economy, not least since a majority of clean energy activities benefitting from investment under legislation such as the Inflation Reduction Act are located in Republican congressional districts (Kupfer 2024; Tamborrino and Siegel 2023).

At any rate, green industrial policy now represents a pivotal element of the U.S. strategy to combat climate change. Through a combination of legislative action, executive leadership, and strategic planning, the U.S. has laid the groundwork for a durable and – if early indicators have any predictive value – potentially very effective climate policy framework that both reflects and is tailored towards its unique resource endowment and political economy context. As this policy landscape continues to evolve, the focus on innovation, equity, and international cooperation will be crucial for maximizing the impact and efficacy of U.S. green industrial policy initiatives. Going forward, the role of international collaboration and diplomacy in advancing global climate goals will present an increasingly critical avenue for the U.S. to enhance its

impact and leadership. By aligning domestic policy objectives with international commitments and partnerships, the U.S. stands to leverage its economic and technological strengths to foster a collaborative approach to global climate challenges, setting a benchmark for ambitious, actionable climate policy (Schreurs 2024). Still, as critics of industrial policy have pointed out, the approach currently chosen by the U.S. is also costly and fraught with risk (Posen 2024). The path forward therefore also demands a commitment to continual assessment, adaptation, and engagement with a broad range of stakeholders to navigate the complexities of the green transition and realize the full potential of a sustainable economy.

3.2 Green Industrial Policy in the European Union

3.2.1 Background and Context

Europe's journey towards establishing a green industrial policy framework can be traced back to the early recognition of environmental protection as a foundational pillar of its collective policy agenda. Over the last three decades, EU climate policy has evidenced a consistent trend of international leadership and progressively rising ambition on climate change mitigation, with Brussels increasingly exercising its legislative powers and claiming an expanding institutional mandate, greater responsibilities, and new areas of integration (Bausch, Görlach, and Mehling 2017). European leadership in climate and energy policy is also an extension of broader trends in the process of European integration, with concerted action being perceived inside the EU as a unifying and urgent agenda, while simultaneously allowing it to enhance its international standing as a global actor. In response to its international commitments under the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), the EU adopted a European Climate Change Programme (ECCP) in 2000 (European Commission 2000), which was followed by a series of legislative measures aimed at reducing greenhouse gas emissions pollution and promoting sustainable practices across the Member States.

A landmark measure in this evolving policy landscape was the establishment of the EU Emissions Trading System (EU ETS) in 2005, the world's first major carbon market designed to cap and reduce greenhouse gas emissions from significant industrial emitters (European Union 2003). The EU ETS has represented a pioneering use of market-based mechanisms to drive environmental policy objectives, marking a dramatic pivot from earlier policy preferences of the EU, which had previously expressed skepticism about the instrument of emissions trading (van Asselt 2010; Hardy 2006; Wettestad 2005). It presently operates in 30 countries – all 27

EU Member States of the EU as well as Iceland, Liechtenstein and Norway – and covers around 10,000 emitters in the power, heavy industry and aviation sectors accounting for roughly 40% of EU GHG emissions. This makes the EU ETS a centerpiece of EU climate policy (Delbeke 2006). Over a dozen directives, regulations and decisions set out the legal framework of the EU ETS, linking it to international offsets, extending the market to new sectors and gases, establishing a common registry, and providing technical guidance and procedural details on design features such as auctioning and emissions monitoring, reporting, and verification (MRV) (Meadows et al. 2015).

After having championed the cause of market liberalization for the last several decades, the EU began to transition towards a more defined green industrial policy in recent years, as the European public – and, in particular, a growing force of environmental activists, such as the 'Fridays for Future' movement – articulated increasing concern about the climate crisis and the urgency of an ambitious policy response (Spaiser, Nisbett, and Stefan 2022; Noth and Tonzer 2022). The European response to this challenge was characterized by a strategic pivot towards leveraging industrial policy as a key instrument for promoting environmental sustainability and economic resilience. This shift was initially articulated through various policy documents and communications that emphasized the importance of supporting industries and technologies critical to the transition to a low-carbon economy. Most notable among these is the European Green Deal (EGD) announced in July 2019 by the incoming European Commission President Ursula von der Leyen during her campaign to secure political confirmation by the European Parliament (von der Leyen 2020). It sets out a policy roadmap to "transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050" (European Commission 2019).

Subsequent implementation measures include the European Climate Law, adopted as a regulation in June 2021, which enshrines in legally binding terms the aspiration to ensure a climate neutral European Union by 2050, and sets a near term objective of a 55% emissions reduction by 2030 (European Parliament and Council 2021). Additionally, a package of more than a dozen legislative and regulatory measures – the 'Fit for 55' package – was released in July 2021, with the individual measures gradually progressing towards passage through the legislative process between the European Parliament and the Council of the European Union (Schlacke et al. 2022).

This ambitious agenda laid the foundation for an expansive suite of policy initiatives aimed at integrating green industrial policy more explicitly into the broader European economic strategy. Central to this agenda was the recognition of the need to bolster the EU's industrial

base, secure supply chains for critical materials, and promote innovation in key sectors such as clean energy, digitalization, and circular economy practices. The subsequent evolution of the EU's green industrial policy has been significantly influenced by global challenges, including the COVID-19 pandemic, supply chain disruptions, and geopolitical tensions. These challenges underscored the critical importance of resilience and sustainability in the EU's industrial and economic strategy. In response, the EU has sought to expand its policy toolset to include mechanisms such as the Carbon Border Adjustment Mechanism (CBAM), the proposed Net Zero Industry Act, and the Critical Raw Materials Act (see infra, Section 3.2.2), aiming to mitigate carbon leakage, promote clean industrial development, and ensure secure and sustainable supply chains (Oberthür and von Homeyer 2023).

3.2.2 Central Features of EU Green Industrial Policy

The EU's green industrial policy is framed within a complex political and regulatory context, characterized by ambitious policy initiatives aimed at addressing the dual challenges of climate change and economic competitiveness. Central to this context is the European Green Deal, complemented by strategic legislative acts and regulations designed to promote a comprehensive and integrated approach to green industrial development. In terms of implementation, the European Green Deal is exceptionally broad and sets out goals that extend across all major sectors, including energy, industry, transport, buildings, and agriculture, accompanied by a roadmap with a timetable for the introduction of specific policies and measures in each thematic area. Specifically, it identifies a need for new policies to, inter alia: increase EU climate ambition for 2030 and 2050, through a review and revision of relevant climate policy instruments, including emissions trading and energy taxation, as well as adoption of a new European Climate Law; promote the supply of clean, affordable and secure energy, including prioritization of energy efficiency and development of a power sector based largely on renewable resources; mobilize industry for a clean and circular economy; and accelerate the shift to sustainable and smart mobility through increased adoption of sustainable and alternative fuels in road, maritime and air transport, strengthened emission standards for combustion-engine vehicles, and measures to encourage the adoption of low-emission vehicles (European Commission 2019).

Taken together, this detailed roadmap illustrates a scope that extends well beyond environmental objectives, targeting economic growth, social equity, and technological innovation as integral components of the European green transformation. In response to

evolving global challenges, such as supply chain disruptions and geopolitical tensions, the EU has sought to expand its climate policy toolset to include elements of industrial policy (McNamara 2023). EU green industrial policy is thus intricately linked to broader concerns regarding supply chain resilience and energy security. The COVID-19 pandemic and subsequent geopolitical tensions, notably the Russian invasion of Ukraine, have highlighted the vulnerabilities of global supply chains and the strategic importance of energy independence. In response, the EU has intensified its efforts to develop a robust and diversified supply base for critical raw materials and to accelerate the deployment of renewable energy sources, thereby enhancing the bloc's strategic autonomy and resilience in the face of global uncertainties (Paleari 2024; Tagliapietra and Veugelers 2023). This strategic expansion of EU climate policy to a more full-fledged green industrial policy is evident in the introduction of the Carbon Border Adjustment Mechanism (CBAM), the proposed Net Zero Industry Act, and the Critical Raw Materials Act. Each is described in greater detail below.

Proposed in July 2021 as part of the 'Fit for 55' package, the CBAM is a pioneering policy instrument designed to prevent carbon leakage by applying a carbon price on imports of certain carbon-intensive goods (European Union 2023). Its introduction will be accompanied by a successive reduction in freely allocated allowances under the EU ETS, which has served as the primary safeguard against emissions leakage to date. The CBAM counters emissions leakage by extending the price imposed on carbon by the EU ETS to emissions released during the production of imported goods from six sectors – cement, iron and steel, aluminum, fertilizer, electricity, and hydrogen. From October 2023, importers have been required to declare the emissions embedded in covered goods entering the customs territory of the EU using verified emissions data or default values for the carbon intensity of these imports (European Commission 2023d). From 2026 onward, importers will additionally be required to purchase and surrender certificates every year in an amount equal to the declared emissions during the previous year, with the price of these certificates set at the same level as the price of EU ETS allowances.

The proposed Net Zero Industry Act, meanwhile, is a legislative initiative aimed at accelerating the EU transition to a net-zero economy by bolstering the development and deployment of clean technologies across key industrial sectors (European Commission 2023c). This Act is part of the broader European Green Deal broader strategy to achieve climate neutrality by 2050, and operationalizes an earlier European Green Deal Industrial Plan focused on enhancing the EU's industrial competitiveness and innovation capacity in the green technology market (European Commission 2023a).

The Act outlines a framework for providing targeted support to industries critical to the green transition, including renewable energy, energy storage, and carbon capture and utilization technologies. It proposes a mix of financial incentives, regulatory reforms, and research and development initiatives designed to stimulate investment, reduce bureaucratic hurdles, and foster collaboration between the public and private sectors. The Act also emphasizes the importance of skills development and workforce transition programs to ensure that the workforce is equipped to thrive in the emerging green economy (Veugelers, Tagliapietra, and Trasi 2024). By focusing on the strategic development of clean industries, the Net Zero Industry Act aims to position the EU as a global leader in green technology, ensuring long-term economic growth and job creation while meeting its ambitious climate targets. The Act represents a critical step in aligning the EU's industrial policy with its environmental objectives, facilitating a just and inclusive transition to a sustainable future.

Finally, the proposed Critical Raw Materials Act is a legislative initiative designed to secure the European Union's supply of essential materials crucial for the green transition and digital economy (European Commission 2023b). Recognizing the strategic importance of critical raw materials (CRMs) such as rare earth elements, lithium, and cobalt, the Act aims to reduce European dependency on external sources and mitigate the risks associated with supply chain disruptions (Schreurs 2024). The Act proposes a comprehensive approach to enhancing European resilience with regard to these critical supply chains, including measures to boost domestic production, promote recycling and circular economy practices, and diversify supply chains through strategic partnerships with like-minded countries. It also emphasizes the need for sustainability and responsible sourcing in the extraction and processing of CRMs, addressing environmental and social concerns associated with CRM production. By ensuring a secure and sustainable supply of CRMs, the proposed Critical Raw Materials Act supports the EU's ambitions in clean energy, digitalization, and defense sectors, all of which rely heavily on these materials (Mertens et al. 2024).

The political and regulatory context of the European Union's green industrial policy underscores a comprehensive and strategic approach to weaving together environmental, economic, and industrial policy strands. Through initiatives like the European Green Deal and the integration of new policy instruments such as the CBAM, the EU is actively shaping a future that balances climate ambition with economic growth and resilience. This forward-looking policy framework not only aims to position the EU as a global leader in green industrial development but also serves as a model for integrating sustainability and competitiveness in the pursuit of a just and inclusive transition to a green economy.

3.2.3 Assessment

The EU's green industrial policy agenda has begun to reshape the industrial landscape in Europe, although they have yet to drive the desired investment in clean technology manufacturing. Because the main initiatives – the CBAM, Net Zero Industry Act, and Critical Raw Materials Act – have yet to be finalized or only recently entered into force, one can only speculate about their expected impacts. Still, the CBAM, for example, signals a bold move towards leveling the global playing field, encouraging producers both within and outside the EU to adopt cleaner production methods (Clausing and Wolfram 2023a). This not only aids in reducing global carbon emissions, but also protects EU industries from unfair competition, thereby supporting jobs and economic growth within the union. The proposed Net Zero Industry Act and Critical Raw Materials Act, moreover, aspire to substantiate the EU commitment to securing its industrial base and supply chains for essential materials (Oberthür and von Homeyer 2023; Schreurs 2024).

Looking ahead, it is already apparent that EU green industrial policy sets a strategic direction for sustainable growth and competitiveness on the global stage. The emphasis on clean technologies and the transition to a circular economy presents an opportunity for the EU to lead in the creation of new markets and industries. Moreover, by promoting high standards of environmental protection and labor rights, the EU is poised to define global norms and practices for sustainable development in a manifestation of the 'Brussels Effect' (Bradford 2020), a normative diffusion process that is already in evidence with the CBAM spurring adoption of carbon pricing in EU trade partners around the world (Delbeke and Vis 2023). The impact of these policies will likely extend far beyond the borders of the EU, setting standards and practices that could inspire similar ambitions worldwide. In doing so, the European Union not only stands to advance greater sustainability at home, but also has an opportunity to demonstrate that industrial decarbonization can go alongside economic prosperity and resilience – a message many observers around the world will draw on as a benchmark for the success or failure of green industrial policy.

However, the successful implementation of this ambitious policy framework will require navigating a rapidly evolving political landscape. As the EU heads into a pivotal election year, it must navigate complex global dynamics, including trade tensions and the geopolitical implications of the energy transition as well as a widespread trend towards protectionism and fragmented markets. Collaborative approaches, both within the EU and with international partners, will be crucial for advancing shared climate goals and ensuring a just transition for all stakeholders (Bown and Clausing 2023). By embracing a globally oriented perspectives and

continuously adapting its policy toolkit, the EU can navigate the complexities encountered on the way to a successful green industrial policy strategy. Building on its decade-long journey of increasingly ambitious climate policy, and the more recent, comprehensive thrust of the European Green Deal, the EU is well-equipped to balance the risks and benefits of an industrial policy strategy.

3.3 Comparing U.S. and European Approaches to Green Industrial Policy

The European Union and the United States stand at the forefront of a transformational process towards low-carbon industrial practices, each adopting distinct yet impactful green industrial policies. These strategies not only reflect their commitment to environmental stewardship, but also underscore the integral role of industrial policy in achieving long-term sustainability and economic resilience. By examining the EU's long-term and holistic framework alongside the U.S.'s more targeted incentives approach, we can glean insights into the dynamic interplay between policy, innovation, and market forces in driving the green transition.

The EU's green industrial policy, spearheaded by the European Green Deal, offers a systemic approach to sustainability, weaving climate objectives into economic, social, and industrial fabrics. Its many ambitious initiatives, such as the Carbon Border Adjustment Mechanism (CBAM) and the proposed Critical Raw Materials Act, demonstrate a commitment to reducing carbon emissions, securing supply chains, and fostering a circular economy without sacrificing its industrial base. This comprehensive strategy highlights the European vision of a carbon-neutral future, emphasizing regulatory measures and financial incentives to support a just and inclusive transition (Veugelers, Tagliapietra, and Trasi 2024).

By contrast, the U.S. has chosen to focus on fiscal incentives and other public investments in innovation and deployment to spur the growth of the clean energy sector and sustainable practices. The Inflation Reduction Act, alongside the Infrastructure Investment and Jobs Act and the CHIPS and Science Act, undoubtedly represents a generational investment in renewable energy, infrastructure modernization, and technological advancement, prioritizing economic stimulation and energy security, and leveraging federal support to catalyze industry-wide shifts towards sustainability (Bistline, Mehrotra, and Wolfram 2023).

As the urgent need for climate action further intensifies, yet multilateral cooperation is impeded by regional fragmentation and protectionist reflexes, both the EU and the U.S. offer valuable lessons for other jurisdictions looking to rely on green industrial policy to advance a combined environmental, social, and economic policy agenda. These broader lessons can be summarized with the following five signature takeaways:

- Integrating Sustainability Across Sectors: The EU method of embedding climate goals across all policy areas with the European Green Deal offers a blueprint for systemic change. Jurisdictions can learn from this approach by ensuring that sustainability is not siloed within environmental departments, but is a central and long-term tenet of economic, social, and industrial policy-making.

- Leveraging Fiscal Incentives for Rapid Innovation: The U.S. success in utilizing tax incentives to stimulate clean technology deployment illustrates the power of fiscal policy in accelerating innovation. Other jurisdictions might consider similar incentives to drive investment and adoption of sustainable technologies, particularly in nascent industries.

- Building Resilient and Diverse Supply Chains: Both the proposed Critical Raw Materials Act in the EU as well as the U.S. focus on semiconductor manufacturing under the CHIPS and Science Act as well as local content requirements in the Inflation Reduction Act underscore the importance of securing supply chains for essential materials and components. This is a critical lesson for ensuring the resilience of green industries against geopolitical and economic disruptions, yet also has to be balanced against the risks of economic fragmentation and decoupling, as well as protectionist reflexes.

- Fostering International Collaboration: The global nature of climate change and the interconnectedness of economies necessitate a collaborative approach to green industrial policy. Learning from EU efforts to project its normative aspirations internationally as well as U.S. initiatives to create partnerships with like-minded nations – for instance through free trade agreements that focus on critical raw materials – other jurisdictions should seek partnerships that advance shared goals for sustainability and economic development. In fairness, however, neither the EU nor the U.S. have fully succeeded in fleshing out a foreign policy extension of their domestic green industrial policy strategies, and fledgling initiatives such as the Group of 7 (G7) Climate Club have yet to demonstrate their ability to effect meaningful progress on collaborative industrial decarbonization.

- Ensuring Equity and Inclusivity: An essential lesson from both regions is the importance of integrating social equity into green industrial policy. Ensuring that the benefits of the green transition are widely shared, particularly among disadvantaged communities, is crucial for building public support and achieving just outcomes, and will become even more crucial as the global economy becomes more competitive, and domestic politics more encumbered by populist and nationalist movements.

The strategies employed by the EU and U.S. in advancing their green industrial policies offer useful insights for other jurisdictions. By balancing systemic reforms with targeted incentives, building resilient supply chains, fostering international collaboration, and ensuring equity and inclusivity, jurisdictions can navigate the complexities of the green transition more effectively. The path forward for global sustainability will require not only innovation and investment but also a shared commitment to an equitable and environmentally resilient future. Still, it is also clear that both the EU and the U.S. are still in early stages of their green industrial policy trajectory, with longer-term outcomes remaining uncertain for now. In particular, it remains unclear to what extent the potential risks and costs of heavy reliance on industrial policy – such as market distortions and freeriding, but also heightened geopolitical and trade tensions with partners around the world – will manifest themselves and offset some of the beneficial outcomes observed to date. A more robust international engagement strategy will invariably become a necessity to better harness the advantages of green industrial policy while limiting the possible downsides that might otherwise materialize.

4 Learning from Green Industrial Policy: Lessons for Japan

Building upon the analysis of EU and U.S. green industrial policies, this section now turns its focus to Japan – a country facing unique socio-economic and geopolitical challenges as it navigates its path toward a sustainable future. Japan's approach to green industrial policy is of particular interest due to its potential to leverage lessons from both the EU and U.S. as it seeks its own pathway towards an industrial strategy aligned with ambitious climate goals. Japan stands distinct from the EU and U.S. in several respects. Like the EU – but unlike the U.S. – it is highly dependent on energy imports, given its scarce natural resources, which has historically shaped its energy and industrial policies. Moreover, its economic landscape is marked by a strong emphasis on manufacturing and export-led growth, with a prominent role played by keiretsu – large conglomerates with interlocking business relationships and shareholdings. Politically, Japan's approach to policy-making often reflects a consensus-driven model, which,

while ensuring stability, can sometimes slow the pace of radical reforms.

Japan's approach to sustainability is framed by its economic structure, energy dependency, and the geopolitical landscape. Unlike the resource-rich U.S. or the politically and economically integrated EU with an internal market comprising 27 individual jurisdictions, Japan faces acute challenges due to its reliance on raw material imports and its dense manufacturing base. The aftermath of the Fukushima nuclear accident in 2011 has further complicated Japan's energy policy, amplifying debates around the role of nuclear energy in its energy mix and driving interest in renewable sources and energy efficiency. Moreover, Japan's geographic location in East Asia, with its close proximity to China – itself a country that has made extensive use of industrial policy strategies to advance its renewable energy and low-carbon technology sector – gives rise to additional geopolitical challenges, but also could provide unique opportunities.

That is not to say that Japan does not possess a number of significant advantages when it comes to harnessing industrial policy to advance economic, security, and environmental goals. It can draw on a wealth of experience in the deployment of industrial policies, having arguably championed their use to accelerate its economic recovery in the period after the Second World War (Vestal 1995). Additionally, it is supported by a competent bureaucracy at the Ministry of Economy, Trade and Industry (METI) and beyond, and benefits from strong access to financial markets, a robust industrial base, and a high level of technological advancement in various fields (Terzi 2023). At the same time, Japan – like the European Union – has tended to downgrade geopolitical or military priorities following the war, and instead opted to uphold and benefit from a rules-based and open international economic order that is now under threat by the very industrial policy strategies advanced by countries such as China and the U.S. Adjusting policymaking for a world of increasing geopolitical tensions will therefore represent a challenge for Japan, but one that it shares with the EU (Terzi 2023).

For that reason, the European Green Deal may provide a helpful blueprint for systemic transformation that could offer significant lessons for Japan. The European method of weaving sustainability into the fabric of all policy areas, coupled with mechanisms to safeguard industrial competitiveness such as the CBAM, illustrates a possible framework for achieving climate goals while maintaining the viability of domestic industry. Japan, with its strong industrial base and technological prowess, could adopt a similar holistic approach, integrating sustainability across all sectors and leveraging its leadership in technologies such as robotics and electronics to advance green manufacturing and energy efficiency. Moreover, the EU emphasis on circular economy principles and the more recent focus on strategic autonomy in critical raw materials could inform Japan's efforts to reduce its dependency on energy imports and enhance

supply chain resilience. Initiatives like the proposed Critical Raw Materials Act underscore the importance of securing supply chains for sustainable development – a lesson that Japan, with its significant import of rare earth metals and other materials that are essential for high-tech industries, could draw upon to bolster its own supply chain strategies.

By contrast, the U.S. has demonstrated the effectiveness of leveraging fiscal incentives and policy measures to stimulate innovation and scale up the clean energy sector. The Inflation Reduction Act, with its historic investment in clean energy and clean technology manufacturing, presents a model for how targeted financial mechanisms can accelerate the adoption of renewable energy and drive economic growth. Japan could consider similar fiscal incentives to catalyze investments in clean technologies, particularly in areas where it holds competitive advantages, such as battery storage and hydrogen fuel cells. Furthermore, the U.S. strategy of promoting public-private partnerships and engaging in international collaborations for technology development and deployment can offer a roadmap for Japan. By fostering an ecosystem that encourages innovation and scales up clean technologies, Japan can enhance its technological leadership while contributing to global sustainability efforts. Both the U.S. and the EU, moreover, highlight the importance of securing enabling conditions for a successful energy transition, such as adequate workforce training and legal reforms to enable expedited siting and permitting of large infrastructure projects and other activities that are critical for energy system and industrial decarbonization, such as expanded electricity transmission and distribution lines, or pipeline and storage networks for hydrogen and captured CO2.

For Japan, adapting lessons from the EU and U.S. entails a careful consideration of its own socioeconomic and geopolitical context. This includes leveraging its technological leadership to drive innovation in clean energy and efficiency, while also navigating the challenges of energy security and economic growth. Collaborating with international partners, especially in the Asia-Pacific region, could enable Japan to share best practices, develop regional supply chains for critical materials, and promote the adoption of green technologies. From a geopolitical perspective, such collaboration could also afford important regional opportunities. Aggressive deployment of industrial policies by the U.S., the EU and China poses significant challenges for developing countries in Southeast Asia, and risks exacerbating economic disparities while fostering political frictions (Walker and Palaon 2024). Japan is uniquely positioned to mitigate potential adverse impacts on these countries while also identifying opportunities for strategic alliances. A more nuanced approach than China's heavy-handed state intervention in relevant markets can offer an alternative model that promotes inclusive growth and sustainable development. By prioritizing collaboration over competition, Japan can help ensure that Southeast Asia's transition towards green technologies is both equitable and conducive to

regional stability. This strategy would not only align with Japan's economic interests but also bolsters its diplomatic posture within a rapidly evolving geopolitical landscape.

Finally, Japan's green industrial policy could benefit from an integrated approach that aligns with broader economic strategies, emphasizing sustainability, innovation, and equity. If recent experience in the U.S. and the EU is any indication, engaging a wide range of stakeholders, from industry to civil society, will be crucial in building consensus and ensuring that Japan's green transition is inclusive, resilient, and aligned with long-term sustainability goals. Overall, Japan's path toward a green industrial future presents both challenges and opportunities. By synthesizing the consistent, long-term vision of the EU and its comprehensive, cross-cutting strategy with the innovation-driven approach of the U.S., Japan has an opportunity to tailor its own green industrial policy strategy in a way that leverages its distinct strengths and addresses its specific challenges. As Japan embarks on this transition, it has the potential to not only transform its own economy but also to serve as a model for other nations, contributing to a sustainable and resilient global economy.

5 Conclusions

Based on this exploration of the green industrial policy strategies of the European Union and the United States, several central takeaways emerge that also affect the potential applicability of these strategies in the Japanese context. Each section of this paper has illuminated the varied approaches to integrating sustainability with economic and industrial strategies, underscoring the complexities and opportunities inherent in transitioning to a green economy.

The EU approach, characterized by a long-term, consistent vision and systemic integration across all policy domains, highlights the significance of a comprehensive framework. The European Green Deal, alongside mechanisms such as the Carbon Border Adjustment Mechanism (CBAM) and legislative proposals like the Net Zero Industry Act and the Critical Raw Materials Act, showcases the European ambition to embark on a low-carbon transformation. This strategy not only aims to mitigate climate change, but also to ensure economic growth and competitiveness on a global scale, emphasizing the importance of sustainable and resilient supply chains.

Conversely, the U.S. strategy focuses on leveraging fiscal incentives and innovation to stimulate the clean energy and clean technology manufacturing sector. The Inflation Reduction Act,

Infrastructure Investment and Jobs Act, and the CHIPS and Science Act exemplify how targeted incentives can catalyze significant advancements in clean technologies and infrastructure, and have positioned the U.S. as a leading destination for green investment and innovation in a very short period of time. This approach underscores the role of policy in accelerating the deployment of renewable energy solutions, enhancing energy security, and fostering economic resilience.

Application of these insights to the Japanese context has to contend with a unique political and economic landscape, shaped by dependency on energy imports, a strong manufacturing base, and consensus-driven policy-making approach. Drawing lessons from both the EU and U.S., Japan stands to benefit from adopting a hybrid strategy that combines the comprehensive integration of sustainability goals across all sectors seen in the EU with the U.S. focus on innovation and fiscal incentives. Such a strategy could advance Japan's technological leadership in clean energy, address its energy security concerns, and contribute to building resilient supply chains.

The comparative assessment of green industrial policy strategies in the EU and U.S., and their applicability to Japan, offers useful insights for navigating the transition to a green economy. Key takeaways include the importance of systemic integration of sustainability goals, the essential catalytic role of fiscal incentives and innovation policies, the importance of collaborative and inclusive processes, and the necessity of tailoring strategies to fit unique national contexts. For Japan, leveraging its technological capabilities and fostering international collaboration emerge as pivotal strategies for advancing its green industrial policy, enhancing energy and climate security, and ensuring the resilience of supply chains.

The journey towards a sustainable future is fraught with challenges, yet it also offers unparalleled opportunities for innovation, growth, and collaboration. As nations such as the EU, the U.S., and Japan chart their paths toward a wholesale green industrial transformation, their experiences will also provide valuable lessons for the broader global community. As an imperative of all economic activity, sustainability will define the resilience and prosperity of economies in the 21st century. Through shared insights and collective action, these countries and their partners around the world can navigate the complexities of the approaching transition, fostering a sustainable and resilient global economy for future generations.

Bibliography

111th Congress. 2009. American Recovery and Reinvestment Act of 2009. https://www.congress.gov/bill/111th-congress/house-bill/1/text.

117th Congress. 2021. An Act to Authorize Funds for Federal-Aid Highways, Highway Safety Programs, and Transit Programs, and for Other Purposes. https://www.govinfo.gov/content/pkg/PLAW-117publ58/pdf/PLAW-117publ58.pdf.

———. 2022a. Making Appropriations for Legislative Branch for the Fiscal Year Ending September 30, 2022, and for Other Purposes. https://www.govinfo.gov/content/pkg/PLAW-117publ169/pdf/PLAW-117publ169.pdf.

———. 2022b. To Provide for Reconciliation Pursuant to Title II of S. Con. Res. 14. https://www.govinfo.gov/content/pkg/PLAW-117publ169/pdf/PLAW-117publ169.pdf.

Agrawal, Ravi. 2023. "The White House's Case for Industrial Policy." Foreign Policy (blog). March 2, 2023. https://foreignpolicy.com/2023/03/02/live-industrial-policy-katherine-tai-trade-economy-chips-inflation.

Aklin, Michaël, and Matto Mildenberger. 2020. "Prisoners of the Wrong Dilemma: Why Distributive Conflict, Not Collective Action, Characterizes the Politics of Climate Change." Global Environmental Politics 20 (4): 4–27. https://doi.org/10.1162/glep_a_00578.

Aldy, Joseph E. 2013. "A Preliminary Assessment of the American Recovery and Reinvestment Act's Clean Energy Package." Review of Environmental Economics and Policy 7 (1): 136–55. https://doi.org/10.1093/reep/res014.

———. 2022. "Learning How to Build Back Better through Clean Energy Policy Evaluation." RWP22-010. HKS Working Paper. Cambridge, MA: Harvard University. https://www.hks.harvard.edu/publications/learning-how-build-back-better-through-clean-energy-policy-evaluation.

Andreoni, Manuela. 2024. "Climate Is on the Ballot Around the World." The New York Times, January 16, 2024, sec. Climate. https://www.nytimes.com/2024/01/16/climate/climate-is-on-the-ballot-around-the-world.html.

Asselt, Harro van. 2010. "Emissions Trading: The Enthusiastic Adoption of an 'Alien' Instrument?" In Climate Change Policy in the European Union: Confronting the Dilemmas of Mitigation and Adaptation?, edited by Andrew Jordan, Dave Huitema, Frans Berkhout, Harro van Asselt, and Tim Rayner, 125–44. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9781139042772.008.

Barbier, Edward B. 2010. A Global Green New Deal: Rethinking the Economic Recovery. Cambridge: Cambridge University Press. https://www.cambridge.org/core/books/global-green-new-deal/A46C5F39C7A8B8F87B7B4AC8E8855BC4#fndtn-contents.

Bausch, Camilla, Benjamin Görlach, and Michael Mehling. 2017. "Ambitious Climate Policy through Centralization? Evidence from the European Union." Climate Policy 17 (sup1): S32–50. https://doi.org/10.1080/14693062.2016.1259100.

Bermel, Lily, Jiale Chen, Brian Deese, Michael Delgado, Leandra Englisch, Yeric Garcia, Trevor Houser, et al. 2013. "The Clean Investment Monitor." Cambridge, MA: MIT Center for Energy and Environmental Policy Research (CEEPR). https://www.cleaninvestmentmonitor.org/reports/202309.

Bistline, John E.T., Geoffrey Blanford, Maxwell Brown, Dallas Burtraw, Maya Domeshek, Jamil Farbes, Allen Fawcett, et al. 2023. "Emissions and Energy Impacts of the Inflation Reduction Act." Science 380 (6652): 1324–27. https://doi.org/10.1126/science.adg3781.

Bistline, John E.T., Neil Mehrotra, and Catherine Wolfram. 2023. "Economic Implications of the Climate Provisions of the Inflation Reduction Act." Brookings Papers on Economic Activity. Washington, DC: Brookings. https://www.brookings.edu/wp-content/uploads/2023/03/BPEA_Spring2023_Bistline-et-al_unembargoedUpdated.pdf.

Bown, Chad P., and Kimberly A. Clausing. 2023. "How Trade Cooperation by the United States, the European Union, and China Can Fight Climate Change." WP 23-8. Working Paper Series. Washington, DC: Peterson Institute of International Economics (PIIE). https://www.piie.com/sites/default/files/2023-10/wp23-8.pdf.

Bradford, Anu. 2020. The Brussels Effect: How the European Union Rules the World. Oxford: Oxford University Press. https://academic.oup.com/book/36491.

Carley, Sanya, Sean Nicholson-Crotty, and Eric J. Fisher. 2015. "Capacity, Guidance, and the Implementation of the American Recovery and Reinvestment Act." Public Administration Review 75 (1): 113–25. https://doi.org/10.1111/puar.12294.

Cherif, Reda, and Fuad Hasanov. 2019. "The Return of the Policy That Shall Not Be Named: Principles of Industrial Policy." Working Paper 2019/074. Washington, DC: International Monetary Fund. https://www.imf.org/en/Publications/WP/Issues/2019/03/26/The-Return-of-the-Policy-That-Shall-Not-Be-Named-Principles-of-Industrial-Policy-46710.

Clausing, Kimberly A., and Catherine Wolfram. 2023a. "Carbon Border Adjustments, Climate Clubs, and Subsidy Races When Climate Policies Vary." Journal of Economic Perspectives 37 (3): 137–62. https://doi.org/10.1257/jep.37.3.137.

———. 2023b. "Putting Progress over Protectionism in Climate Policy." RealTime Economics (blog). December 19, 2023. https://www.piie.com/blogs/realtime-economics/putting-progress-over-protectionism-climate-policy.

Congressional Budget Office. 2022. "Estimated Budgetary Effects of Public Law 117-169, to Provide for Reconciliation Pursuant to Title II of S. Con. Res. 14." Washington, DC: Congressional Budget Office. https://www.cbo.gov/publication/58455suisse.

Cooper, Richard N. 1987. "Industrial Policy and Trade Distortion: A Policy Perspective." In Protection, Cooperation, Integration and Development: Essays in Honour of Professor Hiroshi Kitamura, edited by Ali M. El-Agraa, 37–69. London: Palgrave Macmillan UK. https://doi.org/10.1007/978-1-349-09370-0_3.

Credit Suisse. 2022. "US Inflation Reduction Act: A Tipping Point in Climate Action." ESG Report. Treeprint. Zürich: Credit Suisse. https://www.credit-suisse.com/treeprintusinflationreductionact.

Delbeke, Jos M. 2006. "The Emissions Trading Scheme (ETS): The Cornerstone of the EU's Implementation of the Kyoto Protocol." In EU Energy Law, Vol. IV: The EU Greenhouse Gas Emissions Trading Scheme, edited by Jos M. Delbeke, 1–13. EU Energy Law. Amsterdam: Claeys & Casteels.

Delbeke, Jos M., and Peter Vis. 2023. "How CBAM Can Become a Steppingstone towards Carbon Pricing Globally." Florence: European University Institute. https://doi.org/10.2870/603414.

Department of Energy. 2024. "Biden-Harris Administration Announces $6 Billion to Transform America's Industrial Sector, Strengthen Domestic Manufacturing, and Slash Planet-Warming Emissions." U.S. Government. https://www.energy.gov/articles/biden-harris-administration-announces-6-billion-transform-americas-industrial-sector.

Devarajan, Shantayanan. 2016. "Three Reasons Why Industrial Policy Fails." Commentary. Brookings (blog). January 14, 2016. https://www.brookings.edu/articles/three-reasons-why-industrial-policy-fails/.

European Commission. 2000. "Communication from the Commission to the Council and the European Parliament: EU Policies and Measures to Reduce Greenhouse Gas Emissions – Towards a European Climate Change Programme (ECCP), COM(2000)88 Final." European Commission. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2000:0088:FIN:EN:PDF.

———. 2019. "Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: The European Green Deal, COM(2019)640 Final." https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN.

———. 2023a. "Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: A Green Deal Industrial Plan for the Net-Zero Age, COM(2023) 62 Final." https://commission.europa.eu/system/files/2023-02/COM_2023_62_2_EN_ACT_A%20Green%20Deal%20Industrial%20Plan%20for%20the%20Net-Zero%20Age.pdf.

———. 2023b. "Proposal for a Regulation of the European Parliament and of the Council Establishing a Framework for Ensuring a Secure and Sustainable Supply of Critical Raw Materials (Critical Raw Materials Act), COM(2023) 160 Final." European Union. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023PC0160.

———. 2023c. "Proposal for a Regulation of the European Parliament and of the Council on Establishing a Framework of Measures for Strengthening Europe's Net-Zero Technology Products Manufacturing Ecosystem (Net Zero Industry Act), COM(2023) 161 Final." European Union. https://single-market-economy.ec.europa.eu/system/files/2023-03/COM_2023_161_1_EN_ACT_part1_v9.pdf.

———. 2023d. Commission Implementing Regulation (EU) 2023/1773 Laying down the Rules for the Application of Regulation (EU) 2023/956 of the European Parliament and of the Council as Regards Reporting Obligations for the Purposes of the Carbon Border Adjustment Mechanism during the Transitional Period. Vol. C/2023/5512. https://eur-lex.europa.eu/eli/reg_impl/2023/1773/oj.

European Parliament and Council. 2021. Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 Establishing the Framework for Achieving Climate Neutrality and Amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law'). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32021R1119.

European Union. 2003. "European Parliament and Council Directive 2003/87/EC of 13 October 2003 Establishing a Scheme for Greenhouse Gas Emission Allowance Trading Within the Community and Amending Council Directive 96/61/EC [2003] OJ L275/32." https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003L0087&from=EN.

———. 2023. Regulation (EU) 2023/956 of the European Parliament and of the Council of 10 May 2023 Establishing a Carbon Border Adjustment Mechanism. Vol. PE/7/2023/REV/1. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R0956.

Executive Office of the President. 2021. "Executive Order 14057: Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability." Federal Government. https://www.federalregister.gov/documents/2021/12/13/2021-27114/catalyzing-clean-energy-industries-and-jobs-through-federal-sustainability.

Farber, Daniel A. 2023. "Turning Point: Green Industrial Policy and the Future of U.S. Climate Action." SSRN Scholarly Paper. Rochester, NY. https://doi.org/10.2139/ssrn.4482489.

Gerarden, Todd D. 2023. "Demanding Innovation: The Impact of Consumer Subsidies on Solar Panel Production Costs." Management Science, February. https://doi.org/10.1287/mnsc.2022.4662.

Goldthau, Andreas, and Llewelyn Hughes. 2020. "Protect Global Supply Chains for Low-Carbon Technologies." Nature 585 (7823): 28–30.

Goldthau, Andreas, Llewelyn Hughes, and Jonas Nahm. 2022. "The Political Logic of Reshoring in Low Carbon Technologies: Economic Interdependence and Green Industrial Policy." SSRN Scholarly Paper. Rochester, NY. https://doi.org/10.2139/ssrn.4066047.

Hardy, Brettny. 2006. "How Positive Environmental Policies Affected Europe's Decision to Oppose and Then Adopt Emissions Trading." Duke Environmental Law & Policy Forum 17 (2): 297–318.

Helveston, John Paul, Gang He, and Michael R. Davidson. 2022. "Quantifying the Cost Savings of Global Solar Photovoltaic Supply Chains." Nature 612 (7938): 83–87. https://doi.org/10.1038/s41586-022-05316-6.

Jenkins, Jesse D., Erin Mayfield, Jamil Farbes, Greg Schivley, Neha Patankar, and Ryan Jones. 2023. "Climate Progress and the 117th Congress: The Impacts of the Inflation Reduction Act and Infrastructure Investment and Jobs Act." REPEAT Project. Princeton, NJ: Princeton University. https://doi.org/10.5281/zenodo.7826713.

Juhász, Réka, Nathan J Lane, and Dani Rodrik. 2023. "The New Economics of Industrial Policy." National Bureau of Economic Research Working Paper Series No. 31538. https://doi.org/10.3386/w31538.

Juhász, Réka, Nathan Lane, Emily Oehlsen, and Verónica C. Pérez. 2023. "The Who, What, When, and How of Industrial Policy: A Text-Based Approach." College PArk, MD: SocArXiv Papers. https://doi.org/10.31235/osf.io/uyxh9.

Kerry, John, Alexandria Ocasio-Cortez, Kathy Castor, Kerry Duggan, Catherine Flowers, Conor Lamb, Gina McCarthy, Donald McEachin, and Varshini Prakash. 2020. "Biden-Sanders Unity Task Force Recommendations: Combating the Climate Crisis and Pursuing Environmental Justice." Washington, DC. https://joebiden.com/wp-content/uploads/2020/08/UNITY-TASK-FORCE-RECOMMENDATIONS.pdf.

Krugman, Paul. 1983. "Targeted Industrial Policies: Theory and Evidence." Proceedings: Economic Policy Symposium - Jackson Hole, 123–76.

———. 2023. "How to Think About Green Industrial Policy." New York Times, May 9, 2023.

Kupfer, Jeffrey. 2024. "The Conservative Case for Keeping the Inflation Reduction Act." Text. The Hill (blog). March 18, 2024. https://thehill.com/opinion/energy-environment/4538435-the-conservative-case-for-keeping-the-inflation-reduction-act/.

Lamperti, Francesco, Mariana Mazzucato, Andrea Roventini, and Gregor Semieniuk. 2019. "The Green Transition: Public Policy, Finance, and the Role of the State." Vierteljahrshefte Zur Wirtschaftsforschung 88 (2): 73–88.

Lewis, Joanna I. 2014. "The Rise of Renewable Energy Protectionism: Emerging Trade Conflicts and Implications for Low Carbon Development." Global Environmental Politics 14 (4): 10–35. https://doi.org/10.1162/GLEP_a_00255.

———. 2024. “The Climate Risk of Green Industrial Policy.” Current History 123 (849): 14–19. https://doi.org/10.1525/curh.2024.123.849.14.

Leyen, Ursula von der. 2020. “Political Guidelines for the Next European Commission 2019-2024.” Luxembourg: Publications Office of the European Union. https://data.europa.eu/doi/10.2775/101756.

Lincicome, Scott, and Huan Zhu. 2021. “Questioning Industrial Policy: Why Government Manufacturing Plans Are Ineffective and Unnecessary.” White Paper. Washington, DC: Cato Institute. https://www.cato.org/sites/cato.org/files/2021-09/white-paper-questioning-industrial-policy-updated.pdf.

Marcacci, Silvio. 2022. “The Inflation Reduction Act Is The Most Important Climate Action In U.S. History.” Forbes, August. https://www.forbes.com/sites/energyinnovation/2022/08/02/the-inflation-reduction-act-is-the-most-important-climate-action-in-us-history.

Marcu, Andrei, Michael A. Mehling, and Aaron J. Cosbey. 2023. “CBAM in a Portfolio of Measures for Industrial Decarbonization.” Brussels: European Roundtable on Climate Change and Sustainable Transition (ERCST). https://ercst.org/cbam-in-a-portfolio-of-measures-for-industrial-decarbonization.

Mazzucato, Mariana. 2013. The Entrepreneurial State: Debunking Public vs. Private Sector Myths. London: Anthem Press.

———. 2022. “Financing the Green New Deal.” Nature Sustainability 5 (2): 93–94. https://doi.org/10.1038/s41893-021-00828-x.

McNamara, Kathleen R. 2023. “Transforming Europe? The EU’s Industrial Policy and Geopolitical Turn.” Journal of European Public Policy, July, 1–26. https://doi.org/10.1080/13501763.2023.2230247.

Meadows, Damien, Yvon Slingenberg, Peter Zapfel, Jos M. Delbeke, and Peter Vis. 2015. “EU ETS: Pricing Carbon to Drive Cost-Effective Reductions across Europe.” In EU Climate Policy Explained, 26–51. London: Routledge. https://www.taylorfrancis.com/books/e/9781317338123/chapters/10.4324/9789279482601-10.

Mehling, Michael A., David M. Driesen, and David C. Popp. 2024. “Industrial Policy, Populism, and the Political Economy of Climate Action.” Nature Climate Change Vol. 14.

Mertens, Jan, Jo Dewulf, Christian Breyer, Ronnie Belmans, Corinne Gendron, Patrice Geoffron, Luc Goossens, et al. 2024. “From Emissions to Resources: Mitigating the Critical Raw Materials Supply Chain Vulnerability of Renewable Energy Technologies.” Mineral Economics, February. https://doi.org/10.1007/s13563-024-00425-2.

Meyer, Robinson. 2022. “Congress Just Passed a Big Climate Bill. No, Not That One.” The Atlantic (blog). August 10, 2022. https://www.theatlantic.com/science/archive/2022/08/chips-act-climate-bill-biden/671095.

Nahm, Jonas. 2021. Collaborative Advantage: Forging Green Industries in the New Global Economy. Oxford: Oxford University Press. https://global.oup.com/academic/product/collaborative-advantage-9780197555361?cc=us&lang=en&.

National People’s Congress. 2021. “The 14th Five-Year Plan for National Economic and Social Development and the Long-Range Objectives Through the Year 2035.” Central People’s Government of the People’s Republic of China. http://www.gov.cn/xinwen/2021-03/13/content_5592657.htm.

Neely, Michelle Clark. 1993. “The Pitfalls of Industrial Policy.” The Regional Economist 1 (April): 10–11.

Noth, Felix, and Lena Tonzer. 2022. “Understanding Climate Activism: Who Participates in Climate Marches Such as ‘Fridays for Future’ and What Can We Learn from It?” Energy Research & Social Science 84 (February): 102360. https://doi.org/10.1016/j.erss.2021.102360.

Oberthür, Sebastian, and Ingmar von Homeyer. 2023. "From Emissions Trading to the European Green Deal: The Evolution of the Climate Policy Mix and Climate Policy Integration in the EU." Journal of European Public Policy 30 (3): 445–68. https://doi.org/10.1080/13501763.2022.2120528.

Ocasio-Cortez, Alexandria. 2019. Recognizing the Duty of the Federal Government to Create a Green New Deal, H.R. Res. 109. https://www.congress.gov/116/bills/hres109/BILLS-116hres109ih.pdf.

Paleari, Susanna. 2024. "The Role of Strategic Autonomy in the EU Green Transition." Sustainability 16 (6). https://doi.org/10.3390/su16062597.

Popp, David C. 2010. "Innovation and Climate Policy." Annual Review of Resource Economics 2 (1): 275–98. https://doi.org/10.1146/annurev.resource.012809.103929.

Posen, Adam. 2024. "America's Zero-Sum Economics Doesn't Add Up." Foreign Policy (blog). April 2, 2024. https://foreignpolicy.com/2023/03/24/economy-trade-united-states-china-industry-manufacturing-supply-chains-biden.

Rodrik, Dani. 2014. "Green Industrial Policy." Oxford Review of Economic Policy 30 (3): 469–91. https://doi.org/10.1093/oxrep/gru025.

Sargent Jr., John F., Manpreet Singh, and Karen M. Sutter. 2023. "Frequently Asked Questions: CHIPS Act of 2022 Provisions and Implementation." CRS Report R47523. Washington, DC: Congressional Research Service. https://crsreports.congress.gov/product/pdf/R/R47523.

Schlacke, Sabine, Helen Wentzien, Eva-Maria Thierjung, and Miriam Köster. 2022. "Implementing the EU Climate Law via the 'Fit for 55' Package." Oxford Open Energy 1 (January): oiab002. https://doi.org/10.1093/ooenergy/oiab002.

Schreurs, Miranda A. 2024. "Jockeying for Climate Leadership Amidst Rising Global Tensions: China, USA and the European Union." In Europe in an Era of US-China Strategic Rivalry: Challenges and Opportunities from an Outside-in Perspective, edited by Sebastian Biba, 243–64. Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-48117-8_12.

Smead, Richard G. 2024. "Infrastructure Permitting and Friction in the Energy Transition." Climate and Energy 40 (8): 27–32. https://doi.org/10.1002/gas.22394.

Spaiser, Viktoria, Nicole Nisbett, and Cristina G. Stefan. 2022. "'How Dare You?'—The Normative Challenge Posed by Fridays for Future." PLOS Climate 1 (10): e0000053. https://doi.org/10.1371/journal.pclm.0000053.

State Council. 2015. "Notice of the State Council on the Publication of 'Made in China 2025' (Unofficial Translation)." Central People's Government of the People's Republic of China. https://cset.georgetown.edu/wp-content/uploads/t0432_made_in_china_2025_EN.pdf.

Tagliapietra, Simone, and Reinhilde Veugelers. 2023. "Developing a Green Industrial Policy for the European Green Deal." In , 36–50. Cheltenham, UK: Edward Elgar Publishing. https://doi.org/10.4337/9781802200065.00010.

Tamborrino, Kelsey, and Josh Siegel. 2023. "Big Winners from Biden's Climate Law: Republicans Who Voted against It." POLITICO. January 23, 2023. https://www.politico.com/news/2023/01/23/red-states-are-winning-big-from-dems-climate-law-00078420.

Terzi, Alessio. 2023. "Industrial Policy Fit for the 21st Century." August 9, 2023. https://www.rieti.go.jp/en/special/p_a_w/198.html.

Thurow, Lester C. 1992. Head to Head: The Economic Battle Among Japan, Europe, and America. New York, NY: William Morrow & Co.

United States. 2021. "The United States' Nationally Determined Contribution. Reducing Greenhouse Gases in the United States: A 2030 Emissions Target." United States. https://unfccc.int/sites/default/files/NDC/2022-06/United%20States%20NDC%20April%2021%202021%20Final.pdf.

Vestal, James E. 1995. "Japanese Industrial Policy, Past and Future." In Planning for Change: Industrial Policy and Japanese Economic Development, 1945–1990, edited by James E. Vestal, 219–32. Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780198290278.003.0009.

Veugelers, Reinhilde, Simone Tagliapietra, and Cecilia Trasi. 2024. "Green Industrial Policy in Europe: Past, Present, and Prospects." Journal of Industry, Competition and Trade 24 (1): 4. https://doi.org/10.1007/s10842-024-00418-5.

Victor, David G, and Emily K Carlton. 2023. "Technology to Solve Global Problems: An Emerging Consensus for Green Industrial Policy?" Environmental Research Letters 18 (9): 091006. https://doi.org/10.1088/1748-9326/acf776.

Walker, Robert, and Hilman Palaon. 2024. "If Industrial Policy Is the New Candy House, Developing Countries Need to Gain More than Just the Bread Crumbs | Lowy Institute." April 3, 2024. https://www.lowyinstitute.org/the-interpreter/if-industrial-policy-new-candy-house-developing-countries-need-gain-more-just-bread.

Wettestad, Jørgen. 2005. "The Making of the 2003 EU Emissions Trading Directive: An Ultra-Quick Process Due to Entrepreneurial Proficiency?" Global Environmental Politics 5 (1): 1–23. https://doi.org/10.1162/1526380053243477.

White House. 2023. "Building a Clean Energy Economy: A Guidebook to the Inflation Reduction Act's Investments in Clean Energy and Climate Action." Executive Office of the President. https://www.whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf.

This research has been coordinated by the Climate and Energy Division of the Institute for Global Environmental Strategies, as part of the Asia Pacific Climate Security Project. For the details on the project, please visit:

https://www.iges.or.jp/en/projects/climate-security

Institute for Global Environmental Strategies (IGES)

2108-11 Kamiyamaguchi, Hayama, Kanagawa, Japan

https://www.iges.or.jp/en