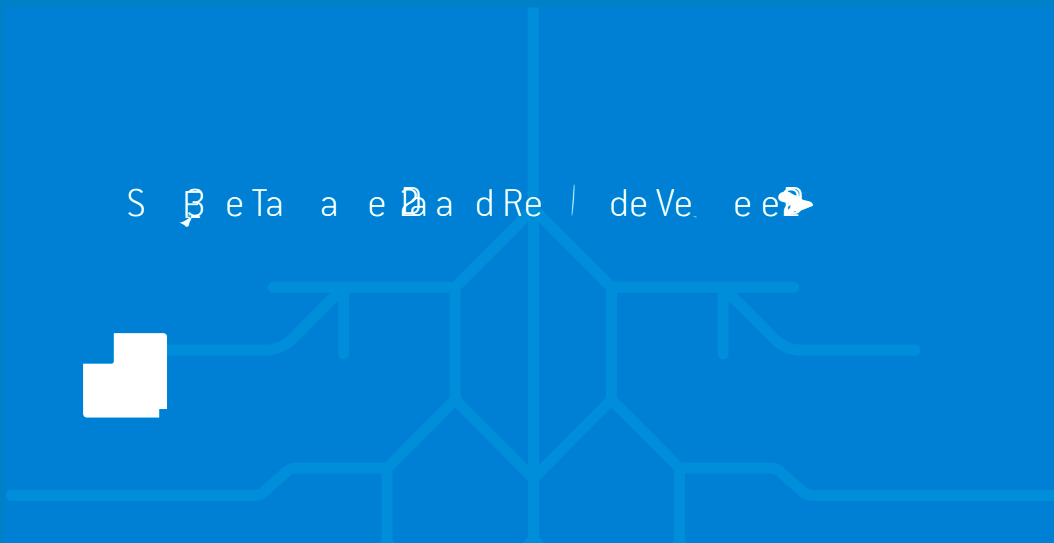
A GREEN INDUSTRIAL POLICY FOR EUROPE



A GREEN INDUSTRIAL POLICY FOR EUROPE

BRUEGEL BLUEPRINT SERIES
A e d a c a E e

S e Ta a e a d Re / de Ve e

Ed S e / e Ga l e
La a dc e de : H c Bade e

B e e 2020 A / e ed. S ec e , e ceed
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ISBN: 978-9-078910-50-3

Acknowledgements

e authors are grateful to André Sapir, Guntram Wol and Maria Demertzis for their extensive comments on preliminary drafts. ey would like to thank Enrico Bergamini for his excellent contribution in drafting the literature review underpinning chapters 1, 2 and 3 and the case studies in chapter 6. Tom Schraepen and Ben McWilliams provided excellent research assistance.

is Blueprint has been produced with the nancial support of the European Climate Foundation.

Contents

Foreword

e European Green Deal, the agship initiative of the European Commission under Ursula von der Leyen, aims at making Europe climate-neutral by 2050. e European Council has decided on the goal of reducing the European Union's emissions by 55 percent relative to their 1990 level by 2030. ese are ambitious goals and putting them into practice will be extremely challenging from political, distributional and technological perspectives. We are only at the beginning of a major endeavour. Europe cannot a ord to fail.

To succeed, decarbonisation has to accelerate in all industries and sectors across Europe. e European Green Deal must foster major shifts from fossil fuels to renewables. For example, the internal combustion engine in vehicles will need to be replaced by electricity or hydrogen. Industrial processes will need to reduce their dependence on coal and oil. Green energy production capacities must be increased.

Shifting the economy from brown to green represents one of the biggest socio-economic transformations ever seen in history. Not by coincidence, this challenge is often referred to as an industrial revolution against a deadline. Without signi cant technological advancements, the industrial revolution will become too expensive to be socially acceptable. And relying only on price signals may mean that technological change happens to late. Green industrial policy therefore needs to be a cornerstone of the European Green Deal.

But what is green industrial policy? What makes it di erent from general industrial policy? What are the market failures it should address? What are the main principles it should respond to and its

Executive summary

e European Green Deal aims to make Europe the rst climate-neutral continent by 2050. is is not going to be an easy journey. To be successful, the European Green Deal will have to foster major shifts in the European industrial structure, including transitions from fossil fuels to renewable energy and from combustion engine cars to electric cars. Shifting economies from brown to green would be a major, historic socio-economic transformation. Not by coincidence, this challenge is often referred to as an industrial revolution against a deadline. In this context of broad, paradigmatic, change for European industry, a 'green industrial policy' will be fundamental to Europe's climate change ambitions.

In March 2020, the European Commission published a *New Industrial Strategy for Europe* (COM (2020) 102 nal). Despite its focus on the twin green and digital transitions, the strategy failed to provide the coherent European Union green industrial policy framework that is required to turn the green transition into an industrial opportunity for Europe. In her September 2020 State of the Union speech, Commission President Ursula von der Leyen pledged to update the industrial strategy in the rst half of 2021. is Blueprint aims to contribute to this debate, by setting out a set of principles and guidelines for the development of a strong EU green industrial policy.

ese principle and guidelines have been developed on the basis of an in-depth analysis of the existing literature on industrial policy design and selected case studies. ere are limits to what the market and the state can each deliver. For a successful green industrial policy, mechanisms will be needed to make them work together e ciently.

e design of public-private partnerships will make or break green industrial policy e orts. e major transformative change demanded by climate change will also require the involvement of civil society more than in other areas of industrial policy. Green technologies, often still emerging, are complex and uncertain. Future uncertainty about climate and technology scenarios underlines the importance of industry-research collaboration.

is Blueprint is structured as follows:

- Chapter 1 introduces the concept of green industrial policy, distinguishing it from general industrial policy, and from climate policy.
- Chapter 2 then discusses the practice of industrial policy in Europe, from the protectionism of the early twentieth century to the current industrial policy revival because of both the climate crisis and COVID-19.
- Chapter 3 sets out the theory of industrial policy and the academic debate between state interventionists and free-marketers. Particular attention is devoted to the notions of market and government failures as a framework for discussing industrial policy.
- Chapter 4 describes the most recent developments in the academic debate on industrial policy, seeking to reconcile the two traditional schools of thought. It introduces a new perspective for industrial policy that takes a broader approach and focuses not only on policy tools, but also on the policy process, most notably the involvement and coordination of, and the sharing of information between, the government, private sector and civil society.
- Chapter 5 discusses the characteristics of green industrial policy, in the context of the urgency of the climate crisis, the broad spectrum

Strong governance will be essential

To develop a successful green industrial policy, the EU must work closely with the private sector. Public-private partnerships are not only about co- nancing of initiatives, but are also about ensuring access to skills, knowledge and information. But close public-private interaction involves risks, such as rent-seeking and political capture. To address risks, a clear set of targets and milestones and well-structured procedures of accountability and transparency are needed.

European Alliances should be further expanded

European Alliances – already established since 2017 for batteries and since 2020 for clean hydrogen – foster public-private collaboration and should be expanded, making them deeper and broader. First, these Alliances should focus on addressing mega-problems covering the whole value chain, and not only manufacturing. is is relevant where most of the economic growth and job-creation potential in a value chain lies in installation and maintenance, rather than in the manufacturing – as is the case for solar energy or residential energy e ciency, for example. Second, these Alliances should involve emerging and innovative industrial and other stakeholders alongside established industrial players. ird, state aid rules should be revisited to check whether they are suitable for broadening and deepening of Important Projects of Common European Interest, which are at the core of these Alliances.

The EU should be braver in fostering green disruptive innovation

Green industrial policy needs breakthrough innovation. is requires signi cant risk-taking by public institutions, and an acceptance that there will be failures. New support models that provide numerous but still-sizeable grants via relatively non-bureaucratic channels are crucial to stimulate frontier ideas. Policy should not lead to money being put only on safe bets that o er average returns. In this sense, the innovation component of EU green industrial policy should be viewed

as a portfolio, in which certain initiatives will inevitably fail. A portfolio with no failures entails no risks, and a portfolio with no risks is unlikely to provide breakthrough innovation. More new policy initiatives designed and monitored as experiments should be tried.

EU investment is important for financing green industrial policy initiatives

EU green investment will play an important role in realising the green transition, including by mobilising funds from national budgets and the private sector. e decision to devote 30 percent of the EU 2021-2027 budget and 37 percent of Next Generation EU funding to climate action is good news. However, the European Commission should develop a solid methodology for monitoring climate spending to avoid risks of greenwashing. e European Investment Bank (EIB) should be allowed to truly become Europe's climate bank, notably via a capital increase that will increase its repower. e EIB should also further develop its role as nancier of the green transition, including by playing the important role of connecting, as an intermediary, the relevant public and private stakeholders and supporting their interactions.

Finally, the EU should seize the current opportunity to become a global standard-setter for green bonds, given that it is the biggest player on this rapidly growing market.

EU green industrial policy should go beyond Europe's borders

Europe produces less than 10 percent of global greenhouse gas emissions. To really make a di erence in terms of climate protection, the European Green Deal has to go beyond Europe's borders. It is of paramount importance for Europe to ll the current global leadership vacuum in climate terms, and to initiate and build global partnerships with other countries. In its relations with developing countries, we recommend that the EU should focus its external development policy more on supporting green projects nancially and with capacity-building activities. Such an approach would provide a triple bene t. First,

it would help meet the EU's climate nance obligations and thus help to achieve the conditional emission-reduction commitments made by most developing countries under the Paris Agreement. Second, it would help EU industry to enter into new, rapidly growing markets. And third, it would help economic development in the EU's partner countries, providing an invaluable foreign policy dividend for the EU.

1 Defining green industrial policy

In December 2019, the then-newly appointed President of the European Commission, Ursula von der Leyen, published amid great fanfare a proposal for a European Green Deal, which has the fundamental aim of making Europe the rst climate-neutral continent by 2050. In September 2020, it was followed up with a proposal to achieve net-zero emissions, centred on the acceleration of the European Union decarbonisation process over the next ten years, with a steeper EU emissions reduction target for 2030 of at least 55 percent relative to 1990 (compared to a 40% reduction target currently). e plan also addresses the economic and industrial transformation this necessarily implies, and aims to make the overall process socially inclusive.

It will not be an easy ride. A successful European Green Deal will have to foster major shifts in the European economic structure, including transitions from fossil fuels to renewable energy and from diesel to electric cars. is will be a broad, paradigmatic, change to our economies and a historic major socio-economic transformation. For good reason, this challenge is often referred to as an industrial revolution against a deadline.

As in any major transformation, there will be winners and losers, particularly in the short-run. With the European Green Deal,un. Wp (on,2.)]TJ8 355.y

meet such a vast challenge, creating more winners than losers. e European Green Deal seeks to facilitate this challenging broader process by providing a clear sense of direction to investors and citizens and by putting in place mechanisms to ensure that the most vulnerable segments of society are supported and not left behind.

It is often said that the European Green Deal must turn decarbonisation into an opportunity to revitalise the European economy, and thus to ensure long-term economic growth and jobs. at is, while heading towards climate neutrality by 2050, the European economy has to remain highly competitive at global level, in the context of increasing competition from other major economies. is puts green industrial policy in the spotlight, in the context of a debate about it that has gathered fresh momentum in recent years (see Lane, 2019; Rodrik, 2014; Rodrik and Sabel, 2019; Aiginger and Rodrik, 2020; and Cherif and Hasanov, 2019, among many others).

A rst challenge when entering into this debate is to de ne what green industrial policy is about. It is already a challenge to de ne industrial policy. Any government policy will have some impact on the economic structure of a country. To naD 435 >impact on

Furthermore, green industrial policy will operate alongside climate policy and industrial policy more generally and therefore raises the issue of coordination of the various policies, particularly when they are overseen by di erent institutions or departments. Climate policy and industrial policy each have their own instruments. Is coordination of the already existing climate change and industrial policy instruments su cient to establish a green industrial policy? Does green industrial policy need its own policy instruments? If so, how should they be coordinated with existing instruments?

Green industrial policy, like any policy, is a public intervention aimed at correcting problems. Industrial policy addresses problems including nancial market imperfections that lead to constraints on access to nance, research externalities[2] that cause constraints on access to knowledge, labour market imperfections that limit access to skills and network externalities that hinder partnerships[3]. ese constraints may lead to markets failing to grow, while preventing new markets from emerging and developing.

In addition to tackling market failures, which is the core of classic industrial policy, green industrial policy must also address market failures associated with climate change. e main market failure in climate terms is that greenhouse gas emissions are a side-e ect of economically valuable activities, but those responsible for the emissions do not pay the costs. e adverse e ects of greenhouse gases are therefore 'external' to the market, which means there is usually only an

2 Research and development (R&D) activities are widely considered to have positive e ects beyond those enjoyed by the funders of R&D (normally, the companies that pay for the research). is is because R&D adds to the general body of knowledge, contributing to other discoveries and developments. However, the returns to a rm selling products based on its own R&D typically do not include the returns to others who bene ted indirectly.

3 Network externalities are the phenomenon by which the value or utility a user derives from a good or service depends on the number of users of compatible products. Network externalities are typically positive, resulting in a given user deriving more value from a product as other users join the same network.

ethical – rather than an economic – incentive for businesses and consumers to reduce their emissions. Consequently, the market fails by over-producing greenhouse gases. Economists have long argued that the first-best policy to correct this market failure is to apply a cost to greenhouse gas emissions in order to encourage reductions. Without a high enough carbon price, policymakers must fall back on second-best policy interventions, including regulation. Being generalised and technology-neutral, carbon pricing represents a superior policy tool, also because it avoids the risk that more targeted policies might bring of selecting wrongly (eg subsidising certain industries that ultimately go bankrupt).

The combination of classic market failure externalities and the greenhouse-gas externality represents a significant challenge for green industrial policy. It implies that green industrial policy requires the deployment of specific instruments that go beyond typical general industrial policy measures. These instruments do not need to be new instruments, but should at least be tailored to fit into a green industrial policy. A green industrial policy mix should in any case be developed in coordination with the policy instruments used for climate policy and industrial policy. Carbon pricing, for example, is an important part of the green industrial policy mix because if the price of carbon remains too low to drive low-carbon technology innovation in industry and other sectors of the economy, green industrial policy will have to fall-back on second-best options.

This Blueprint set out green industrial policy design guidelines, based on an in-depth review of the academic literature and a critical assessment of past policy experiences

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to modernise. e European Economic Community (EEC), established after the ECSC, progressively reduced tari s in European markets. e

e climate crisis together with COVID-19 have made clear that for resilient growth after the pandemic, not only will state intervention be needed, a di erent way of doing things will also be needed. Bowles and Carlin (2020) argued that: "*No combination of government at and market incentives, however cleverly designed, will produce solutions to problems like the pandemic*," stressing the role of civil society in the gap between the state and the market. A very similar argument can be made for the climate crisis.

Future industrial policy also faces other challenges. Haskel and Westlake (2018) showeTm[(and C)10 n6ndeetoBDC BT10 0hal9.5

3 Classic arguments for industrial policy

powerful. Compared to entrants, incumbent rms may be better able to exploit the synergies between new and existing intangible assets, giving them a major advantage over entrants, especially for more incremental innovative investments. e emerging role of big data in rms' business models illustrates this. Incumbents are able to expand their databases, run algorithms, draw conclusions and improve their

uncertainty. For new activities, entrepreneurs may simply not know what is pro table and what is not. In the presence of informational externalities, a free-rider problem arises between initial and subsequent investors. Early investors cannot recover their sunk costs when

4 New industrial policy

Critiques of the traditional, vertical-style industrial policies that prevailed during the 1960s and 1970s can be grouped into two larger clusters of arguments: on the capacity of bureaucrats and administrators to allocate public resources correctly to the market (by picking winners and subsidising them), and on the probability of rent seeking and 'capture'.

In terms of the first of these, the review of arguments for industrial policy in chapter 3 shows the enormous difficulties involved in implementing industrial policies. Policymakers would have to master an extraordinary range and depth of information and knowledge to implement policies successfully. Policymakers would have to be knowledgeable about firms and industries that generate knowledge spillovers, the relative amount of learning by individual firms from others and from their own experiences, the precise path of such learning over time and the magnitude of cost disadvantages at each stage in the learning process, and the extent to which early entrants generate benefits for future entrants. The breadth of knowledge and skills needed to implement an optimal policy would exceed that possessed by almost any institution, including the best consulting firms.

In addition, distortions could arise from lobbying efforts through which vested interests try to capture rents arising from public finances. Where accountability and transparency are lacking, pervasive lobbying efforts and corruption have resulted in inefficient and socially suboptimal allocation of rents. Altenburg *et al* (2015) give the examples of

the German Renewable Energies Act[6] and of the EU emissions trading system[7] in this regard.

If the role of industrial policy is the creation of 'arti cial' rents, the risks of capture, corruption and distortion are extremely tangible.

is is a well-known issue, especially for countries with low institutional quality. Chang (2019) noted that the risk of political capture can also be the indirect product of di erent lobbying e orts, which can hinder the implementation of industrial policies. He cited the cases of Brazil, South Africa and other developing countries, where competing interests and lobbying groups (for example, the nancial lobby pitted against the manufacturing lobby) have contributed to premature deindustrialisation. Because of greater pressure from the nancial lobby, high interest rates in countries such as Brazil and South Africa undermined the competitiveness of the manufacturing sector. High (real) interest rates discourage investment in general, but impacts

6 e Renewable Energies Act established the principle of providing feed-in tari s (over a 20-year period) for renewable sources of electricity generation (see the case study in section 6). e costs originating from guaranteed prices above market rates are translated into an electricity price surcharge borne by all electricity consumers, domestic and commercial. e result is thus a deliberate policy-induced rise in electricity costs. However, the law also foresees exemptions for particular types of companies. is is exactly where political capture kicks in. Such exemptions were initially con ned to high energy-intensity manufacturers (electricity cost of at least 14 percent of production value) that were subject to international competition, such as steel and chemical companies. However, exemptions have proliferated and cover a broad range of diverse industries not foreseen under the provisions of the law. As a result, the sum total of exemptions grew from 7 percent of Germany's electricity consumption in 2004, to 20 percent in 2014. Initially well-de ned and justi ed exemptions thus became the object of aggressive lobbying, leading to a level of political capture that erodes the credibility of the incentive. In late 2013, the European Commission opened an investigation into the compatibility of the

are particularly negative for investment in the manufacturing sector, where the requirement for borrowing is greater because of higher capital needs than in other sectors. ese negative impacts of high interest rates on the manufacturing sector have clearly unfolded in Brazil and South Africa in the last two decades, with real interest rates frequently around 10-12 percent. As a consequence, few rms are able to borrow to invest (Andreoni and Chang, 2020).

Rent-seeking is likely to become increasingly challenging as rms rely more on intangible assets. Defending the ownership of, and appropriating the value from, intangible assets is much more complex than for tangible assets. Copyrights and patents are, in general, more subject to challenge than the ownership of, for instance, a production plant. All this may encourage rms to spend money on lobbying to protect their claims on intangible assets. Furthermore, the gains from such lobbying are typically greater for larger, incumbent rms because of the scalability of intangible assets. e resulting captured regulations may then discourage smaller rms from investing in intangible assets in the rst place.

Even if optimal rst-best policies were not possible because of the information and capture constraint, policy could still be e cient and e ective. e e ectiveness of industrial policy ultimately has to be evaluated on the basis of its realised outcomes compared to no intervention. In terms of realised outcomes, the history of industrial policy in Europe provides many examples of failures, such as the loss to the United States of the race to develop computers in 1960s and 1970s (when France implemented the *Plan Calcul*[8]), the loss to Japan of the

8 e *P a Ca c* was a 1960s programme to promote a national or European computer industry, in response to concerns about French dependence on the US computer industry. Under it, an agency, a manufacturing company and a research institute were created, but it did not succeed in developing a French computer industry, and as of 1971, US rm IBM had a more than 50 percent market share in almost every European country. Under President Giscard d'Estaing, the *P a Ca c* was progressively dismissed between 1975 and 1978, and ultimately deemed a failure.

race to develop semiconductors in the 1980s and 1990s, and the failure of Concorde, the British-French project to develop the rst supersonic passenger aircraft[9]. Various failed programmes built the case for a laissez-faire approach to industrial policy. At a more systematic level, larger-scale evaluation studies most often have looked at the impact of trade protection, R&D subsidies and tax credits, and general subsidies. Also in these studies one can nd cases – such as subsidies for speci c industries or public procurement programmes – which have distorted the market, resulted in the picking of the wrong rms and have burdened the taxpayer with disappointing returns[10]. e big problem with evaluation studies is to identify the causal impact of industrial policy on outcomes, as proper counterfactuals to compare with are often lacking, and one has to take into account that policy interventions are not randomng (en-GB2 (-2 (er co)4 s a0)/MCID 1 n()6.6650 0 10/MCnd h-GB)/MCID

in market failures, and the implementation di culties (government failures). It addresses the information capacity of bureaucrats and political-capture arguments. What needs to be solved by industrial policy from this point of view (and what markets do when they function properly) is how to mobilise resources.

e new industrial policy perspective moves the debate away from the view of industrial policy as a set of tools to allocate resources, towards understanding it as a process. Rodrik (2014) argued for new industrial policy to be a "*process of institutionalised collaboration and dialogue rather than a top-down approach*" in which the government picks sectors or rms and transfers money to them. e private sector has to be one of the three fundamental stakeholders in this collaboration, in which the other two elements are the government and civil society.

Industrial policy should be designed in a way that makes it easier for the state to build policies based on the knowledge that resides in the private sector, while being legitimate from the point of view of civil society. e state's role should be to identify constraints and opportunities, in order to develop solutions that bring together private and public capacities and information, with aligned public and private motives, in a very pragmatic way. A modern framework should address the issues of rent-seeking and political capture, and all the ine ciencies and risks that lie at the intersection between the public and the private sectors, by e ectively combining incentives and regulatory constraints, and building in accountability and transparency.

Rodrik (2014) posits three pillars for this theoretical framework: i) embeddedness; ii) discipline; iii) accountability[11].

e concept of embeddedness (or embedded autonomy) dates

do not know in advance where market failures will occur. erefore, government agencies have to be embedded with the private sector and have access to their information in order to leverage it to design policies. Embeddedness thus requires a high degree of collaboration between the public and private sectors, which would work closely to discover solutions. e design of public-private partnerships can take di erent forms. Deliberation councils, investment advisory councils, round tables, public-private venture funds and development banks are all examples through which governments can implement the embeddedness principle.

In the Rodrik interpretation, new industrial policies by de nition assume that trust and competences can be developed over time. Embeddedness relies on a continuous, fair and open dialogue between the di erent stakeholders, something that could be de ned as policy-learning. But while embedded, government agencies should not be 'in bed' with the private sector. e implementation of embeddedness must take into account informational asymmetries between di erent partners and how asymmetries change over time.

To avoid the risk of moving too slow or staying inactive in the face of the high uncertainties and high risks of failure, experimentation is crucial. Policies designed as learning experiments can help to reduce

industrial policy approach would therefore be a portfolio approach, with some initiatives within the initial portfolio failing along the way. A portfolio with no failures entails no risks.

While embeddedness and collaboration could represent a way to solve the information problem, they clearly entail the risk of capture and of provision of distorted information. To deal with the political-capture risk, industrial policy should include monitoring and transparency mechanisms, as well as mechanisms to align private and public incentives. To activate private agents and prevent 'cheating,' proper incentives and accountability need to be in place.

Transparency on incentives and accountability mechanisms should be facilitated by roadmaps and clear government communication (Kemp and Never, 2017). A process of open policy dialogue should ensure a high degree of accountability. Accountability will be critical to the success or failure of industrial policy exercises.

(companies, policymakers, administrators). Embedded autonomy worked well in safeguarding processes against lobbying. The success of those programmes relied on clear systems of incentives, in which performance indicators were clearly stated, as well as transparency requirements and serious evaluations conducted ex post for the firms targeted by the industrial policy programmes.

Competition as a feature for taming the government failure risk is reminiscent of Aghion *et al* (2011), who recommended competition and state-aid policy to foster the level-playing field within sectors. Any intervention should target those sectors with the greatest degree of within-sector competitiveness. A focus on competitiveness should be engrained in the public-private partnership mechanisms. Aghion *et al* (2015) found empirical evidence, for China, that industrial policy that subsidises firms can enhance productivity growth if the targeted firms within sectors are sufficiently competitive and innovative. The conclusions of Aghion *et al* (2011) were broadly endorsed by Altomonte and Veugelers (2019), who recommended a combination of horizontal measures ensuring competition and an innovation-friendly environment, with vertical measures that are careful about the choice of targeted firms and sectors, representing a portfolio approach to industrial

with the objective of reaching the goals. Broad acceptance of the missions would be rooted in citizen engagement, via multi-stakeholder consultations.

is system also implies setting concrete but ambitious milestones during the process. e United Nations' Sustainable Development Goals would be examples of missions, according to Mazzucato (2018). Meeting them requires a new toolkit that goes beyond xing failures in existing markets. Strategic public investment in many di erent sectors should open up new industrial opportunities, to be developed further by the private sector. Mazzucato and Penna (2016) proposed a revived role for development banks as channels for entrepreneurial states. e public sector should help shape the industry by providing basic research innovations as bases for follow-up private investments. Examples are transistors and the internet. Gruber (2017) gave as an example IMEC (Interuniversity Microelectronics Centre), set up in Leuven, Belgium in 1982 by the Flemish government working with Flemish universities to strengthen the microelectronics industry in Flanders. IMEC is currently one of the most advanced research centres for nano-electronics, working in areas including sustainable energy.

Fernandez-Arias *et al* (2020) studied smart development banks[12] in more detail as facilitators of new activities within a new industrial policy perspective. Well-designed development banks can help governments discover where problems and failures lie. ey should engage in the search for nascent economic activities that face obstacles from market or government failures. is requires intelligence gathering and dissemination of lessons learned rather than simply providing

12 Development banks are 'smart' when they "*ide if a e fai e h gh hei a - cee i ga d e di gac i ie g ide hei e ai a d ide c i ica i f he de ig f d c ie de e e icie . i i e ige ce e f de e e ba i i ia he e ha de he ie f a cia i e e- dia i a ig ba a i i i ihac a aei ead a agei d ci g a d ce i gi f ai .H e e, hie ia eba f c if ai ia e e , de e e ba d e ia d ce a d ga i ei f - a i ab cia e* " (Fernandez-Arias *et al*, 2020).

credit. Development banks should transmit information on market and government failures to the relevant agencies. Fernandez-Arias *et al* (2020), in a survey of development banks, concluded that current practice is very far from what they propose. Nevertheless, they believe that development banks can be reoriented to exploit the complementarities between their lending and intelligence gathering.

achieve competitiveness, but a necessity to guarantee the continuation of society. For green industrial policy, more than for other areas of industrial policy, the lack of action and risk-taking can be particularly problematic in the long run, as scenarios of doing too little too late are extremely concerning. A green industrial policy portfolio with risks entails accepting failures. is puts the experimentation principle at the core of green industrial policy, going beyond the principle of only intervening if there is a clear case for intervention.

5.1.1 Public-private partnerships and civil society involvement

e huge transformative change of decarbonisation will require the involvement of the private sector and civil society more than in other areas of industrial policy. It will also require private-sector involvement. Public-private partnerships will be central to green industrial policy, much more than for climate policy, and will cover more private-sector activities than industrial policy.

5.1.2 Addressing green market failures: environmental externalities

innovation and its increased complexity and uncertainty in the green context, this market failure is particularly concerning, given the danger

instruments (such as public procurement) and technology-push instruments (such as tari s or subsidies), to make policy as e ective as possible. is points to a role for policy coordination and coherence in the green industrial policy mix.

5.3 A global green industrial policy: avoiding the tragedy of the commons

Climate change is a global commons problem. As stated by Edenhofer *et al* (2013), *"the atmosphere is a global common-pool resource in its function as a sink for greenhouse gases, and it is openly accessible and appropriated by everyone free of charge in most regions of the world"*.

e geographical origin of greenhouse gas emissions into the atmosphere has no e ect on their impacts. Any jurisdiction taking action to limit emissions thus incurs the costs of its actions, while the bene ts are distributed globally. erefore, as noted by Aldy and Stavins (2011),

policy champion. But when the price of silicon unexpectedly fell, and Solyndra could no longer compete with Chinese rms (it went bankrupt in 2011), the Obama Administration's intervention was criticised.

Another governance challenge is high uncertainty and the need for a long time horizon for green policymaking, con icting with politicians' needs to nd short-term successes. e di erence in time horizons between policy planning and political cycles makes achieving coherent and sustained green industrial policy e orts extremely challenging. Green industrial policies thus need to be protected as much as possible from this problem of uncertainty and time inconsistency. A long-term vision of paths and objectives combined with milestones is important. Lütkenhorst *et al* (2014) highlighted the need for a social agreement on long-term roadmaps in order to prevent policies from becoming subject to political capture and the economy from being locked-in to unsustainable pathways. Measures could include investment guarantees and provision of long-term capital loans. Lütkenhorst *et al* (2014) also underlined the need to ensure exibility under these di erent forward-looking settings. One example is feed-in tari s that are guaranteed for 15 to 20 years: long-term prices are guaranteed, but the auctioning mechanism works in batches, in order to adapt to technology cost changes.

Viewing the climate change challenge as a societal transition to a new sustainable growth path, further increases the need for the broad involvement of stakeholders, including citizens. A broader set of stakeholders may exacerbate the rent-seeking challenge, but will also o set one another's rent-seeking incentives. To get citizens on board, Kemp and Never (2017) stressed the importance of communicating well the policies and their design. Altenburg *et al* (2017) quoted di erent examples of energy policy reforms undermined by a combination of *"strong opposition from interest groups"* and lack of broad societal consensus, especially in cases of strongly disruptive energy policies, such as the scrapping of fossil-fuel subsidies.

Kemp and Never (2017) also underlined the concept of *"embedded*

autonomy" from the new industrial policy literature. When looking at Germany's national platform for electric mobility, for instance, they found the continuous involvement of di erent stakeholders (automobile producers, city planners, technology companies and environmental groups) was a key success factor. is transition also had a broad political support: it was backed by the Chancellor, and co-led by ministries. Kemp and Never (2017) concluded that broad political backing and the taking of responsibility gave more stability to the industrial policy programme. *"Embedded autonomy"* should also be associated with transparency, accountability and independence, in order to avoid political capture.

5.5 Summary: lessons for green industrial policy

Green industrial policy should have much bigger and broader objectives than typical industrial policy. Green industrial policy should address the meta-problems associated with the transformative change climate change brings, rather than seeking to boost the competitiveness of targeted sectors and rms. Its broadness is also di erent from climate change policy, which is more narrowly de ned in terms of climate change targets. Longer-term broad objectives involving the whole of society should focus on building win-win coalitions, compared to the short-term competitiveness objectives of selected sectors and rms. is broader public interest is the foundation for the legitimacy of the policy. Objectives should be clearly identi ed and transparently, broadly and repeatedly communicated. Goals should be translated into clear, measurable targets and milestones, which are the basis of monitoring and evaluation.

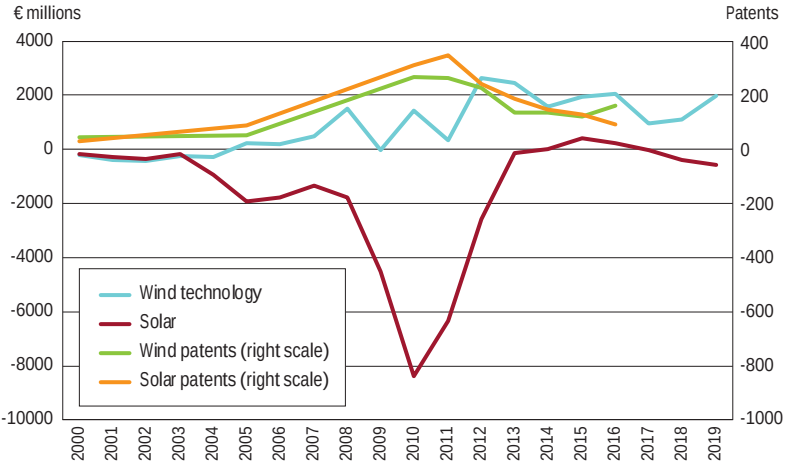
Green industrial policy should activate and coordinate a broad set of stakeholders. From the private sector, various sectors and technologies and di erent parts of the value chain should be engaged in public-private partnerships. Future uncertainty about climate and technological scenarios underlines the importance of self-discovery on the market and industry-research-policy collaboration via forums,

the many di erent types of stakeholders, policy governance areas, instruments and projects, and to coordinate across di erent geographical layers. is requires competent, empowered governance bodies, which should be su ciently politically independent or detached from political pressures, yet accountable for their achievements, with a set of clear, realistic milestones.

6

innovation, job creation and climate-change mitigation. On competitiveness, Germany's strong position in wind turbine manufacturing rather than solar panel manufacturing clearly shows up in export data (Figure 3). In terms of innovation, Germany ranked third in terms of the absolute number of green patents from 1990 to 2010, behind the United States and Japan. Figure 3 shows that there was little di erence in the number of solar and wind patents and trends. Yet, between 1990 and 2010, Germany accounted for 21 percent of global wind technology patents, while for solar photovoltaic technology it only represented 12 percent. In terms of jobs, in 2012, solar and wind energy created 54 percent and 23 percent respectively of a total of 380,000 jobs attributed to renewable energies.

Figure 3: German net exports (€ millions) and numbers of wind/solar patents



Source: Bruegel based on Patstat and Comtrade databases.

e solar panel industry's weaker overall performance is mainly due to strong Chinese competition and the lack of an accommodating industrial policy. Feed-in tari s provided an important boost in demand for solar panels in Germany. e government guaranteed

added lays in this industry. End users of solar panels bene tted from the feed-in tari s, as did suppliers and workers, as the industry is characterised by a high density of installation and maintenance jobs. To the extent that FIT made this part of the solar panels value chain more attractive, an overall positive social welfare outcome was realised, even without explicit strong domestic solar panel manufacturers or support for explicit policy intervention in favour of manufacturing.

Surprisingly, the rapid deployment of renewables in Germany did not lead to lower total greenhouse gas emissions but rather to stagnation. Electricity prices fell considerably as a result of oversupply, resulting from unexpectedly high generation from renewable sources. Low input prices and the low carbon price in the EU emissions trading system exacerbated the situation. erefore, at times, only the cheapest energy sources remained competitive: hard coal and, in particular, lignite in the case of Germany (Lütkenhorst *et al*, 2014).

e *buildings energy e ciency* part of Germany's energy transition programme, meanwhile, was based on three pillars: regulation, scal incentives and a high level of transparency to stakeholders and markets (Kemp and Never, 2017). e policy was gradually introduced by raising buildings energy e ciency standards, to overcome the various imperfections in the real estate and construction markets. Market failures included unequal access to information, split incentives between tenants and owners in terms of energy e ciency and mispricing of future energy costs at the time of construction (Kemp and Never, 2017). As we have discussed, these situations call for collaboration and sys5276 232et

full time jobs". El-Shagi *et al* (2014) concluded that regulation had a strong indirect impact on innovation. Key success factors are identi ed in the process of continuous revision of regulation and incentives, in the combination of di erent types of measures, in the collaboration between di erent participants and in the promotion of complementary measures, such as the use of renewable energy in buildings.

e *Energiewende* case makes it clear that climate change policy instruments, such as feed-in tari s, although important for supporting renewable energy, may not be su cient from the perspective of green

conditions to boost the development of the sector, through economic incentives and favourable ownership restrictions" (Mendonça and Lacey, 2009).

Mendonça and Lacey (2009) linked this structure to the idea of "*innovative democracies*", which is de ned by Hvelplund (2005) as "*the active collaboration of a number of actors, including politicians, new small private rms, the energy companies and the grassroots energy movement*". Clearly, this model presents some of the features of the theoretical framework for green industrial policy (section 5). is approach is characterised by a combined bottom-up and top-down approach that includes the private and public sectors, civil society, activists and NGOs. is spread of involved parties has helped counterbalance lobbying e orts by fossil-fuel companies.

Two sets of government policies further contributed to wind industry developments in Denmark. e Danish government implemented several programmes of feed-in tari s, which stayed relatively stable from the 1980s to the beginning of the 2000s. In addition, R&D and investment subsidies had a positive impact on the production and deployment of wind turbines, as shown by Klaassen *et al* (2005). is highlights the importance of a balanced mix of policy instruments, particularly the interplay between demand-pull and technology-push green industrial policy tools. More recent work by Cook and Lin Lawell (2020) has con rmed empirically the success of feed-in tari schemes, as well as another Danish government programme: the replacement certi cate programme, which provided incentives for the replacement of old turbines.

In institutional and political economy terms, an important part of the success of the Danish model has been its persistency (Mendonça and Lacey, 2009). We can think of the Danish model as a clear way to address the market failures linked to uncertain time horizons. Continuous involvement of NGOs, academics and citizens in the policy process, in the innovative democracy model (as also referred to by Schwarz, 2020), ensures that the risk of doing too little is mitigated

by the involvement of stakeholders who keep the pressure to act constant.

6.4 United States

the successful wind industry. Public-private partnerships have enjoyed similar success in Germany.

Another lesson is the importance of policy stability, commitment and predictability over a longer term horizon. e development of the Danish wind industry was supported strongly by stable and sensible policies. Conversely, literature has noted that policy inconsistency in the Netherlands, arising from energy market liberalisation programmes, reduced the e ectiveness of transition-management programmes. Yet, in view of high levels of uncertainty, long-term commitment needs to go hand in hand with exibility. ough built on a stable platform, policies are gradually adapted and strengthened over time. E ective stakeholder engagement allows this to be done in an informed manner. e German experience of progressively adapted targets for energy e ciency in buildings is a good example.

Measures should mix demand-pull and technology-push, general, horizontal instruments, and speci c, targeted instruments. On selecting targets, the US experience with Solyndra shows that public administrations should refrain from placing any one industry or organisation on a pedestal, and should instead reinforce the message that a successful industrial policy is characterised by risk taking involving winners but also losers. Political communication must reinforce this message.

A nal observation from the German experience of feed-in-tari s is the importance of clearly de ning and understanding the relative importance of 'green' and 'industrial policy'. e German FIT arguably catalysed the global market for solar panel, yet German players have a relatively low share of the market. From a purely industrial policy perspective, the conclusion might be that this was a failure. But from a green perspective, the policy was successful. Even from an industrial policy perspective it was a success, at least when taking a broader view, including the bene ts of value added and jobs created in the servicing of solar panels. e Danish wind deployment programme was successful from both the sectoral and broader perspectives.

7 Green industrial policy in the

Table 1: Europe's green industrial policy landscape

	Innovation and technology	Investments and deployment	Framework conditions
EU level	Framework programmes (Horizon Europe);European Innovation Council; Missions; EU Innovation Fund (section 7.3.4)	EU budget and Next Generation EU; European Investment Bank (section 7.3.5); Single market rules (eg green public procurement) (section 7.3.7)	Coordination of national green industrial policies (eg European Semester; RIS3; IPCEIs) (sections 7.3.1 and 7.3.3);Competition policy; Environmental standards; Climate policy (eg carbon price, renewable and energy e ciency targets, clean standards; section 7.3.6); Development policy (7.3.8); Monetary policy
National level	Public R&D spending; Intellectual property protection law (at EU level)	Government investment programmes, incentives, subsidies, public procurement, clean energy standards	Consistency of macroeconomic policies with industrial strategy; Climate targets; Environmental standards; Environmental taxation
Regional level	Implementation of public-private partnership in place-based setups (eg university-industry collaborations)	Smart specialisation strategies; Regional Investment budgets; Implementation of EU Cohesion policies	Regulations (such as bu 8 1nvestment

strategy actually never uses the expression ‘green industrial policy’ but a set of green goals is speci ed: i) securing the supply of clean energy and raw materials; ii) stepping up investment in green research, innovation, deployment and up-to-date infrastructure; and iii) creating lead markets in clean technologies through regulatory policies, public procurement and competition policy.

e strategy outlines a set of green policy action areas: i) support for zero-carbon steelmaking; ii) launch of a chemicals strategy for sustainability; iii) launch of an energy e ciency ‘renovation wave’;

7.3 The EU's main green industrial policy tools

7.3.1 Coordination of national green industrial policies: the European Semester and smart specialisation programmes

ere is a real need for better coordination of EU countries' respective national green industrial policies, in order to prevent distortions of the EU single market and to enable synergies and economies of scale. Strong EU coordination in the eld is thus of paramount importance, particularly if Europe wants to establish itself at the frontier of green technology and green technology value added creation.

To coordinate the various green industrial policy initiatives under

dependence on the EU's competitors.

In practice, these alliances are networks of the main industrial and innovation players (including SMEs), regional authorities, national authorities, the European Commission and the European Investment Bank. Importantly, projects developed in this context can receive state aid from EU countries (see section 7.3.3 on the Important Projects of Common European Interest) and are therefore channels through which the EU level can support national or regional green industrial policy.

Box 1: The European Battery Alliance

Launched in 2017, [illegible]

4. De e a d e a ed e a e a- ec a . T c de d ade a e , a d , a d a E ea ac e d-ca e e e fie d;
5. S e a ab EU ba e ce a ac d e e e a b e. T e a e e- e a e a d a ab e ba e d c E e;
6. E c e c e b ade EU e a a d e ab e- (c d e c ea e e e a d b ac a e , a d ade c).

I Dece be 2019, e E ea C a ed de EU a e a d e a I a P ec C E ea I e fied b Be , F a d, F ce, Ge a , I a , P a d a d S ede a ac e e e E ea Ba e A a ce. T b c d a a a e 3.2 b , c e ec ed c a add a 5 b a e e . T e c - e e ec ed b b c d a ed 2031 (E ea C , 2019a).

Box 2: The European Clean Hydrogen Alliance

La c ed 2020 a e 'Ne d a a e E e', e E ea C ea H d e A a ce a e de e d - e ec b 2030, b e e e ab e a d -ca d e d c , de a d d , b a d e ec , a d d e a a d d b . W a e, e EU ee bec e a ba eade ce d a .

T e A a ce a e a d 500 c a 2020 1000 c - a 2024. I a a e a e e 6 a a (GW) c ea d - e b 2024, a d e 40 GW (EU) a d 40 GW (-EU) c ea d e b 2030 (E ea C , 2020c). T ce , a d e a I a P ec C E ea I e a e e be a ed a e .

7.3.3 Important Projects of Common European Interest

Competition policy possibly represents the most potent green industrial policy tool the EU has at its disposal, as it regulates interventions in the market by EU countries. Unsurprisingly, competition policy was at the centre of the pan-European discussions in 2019 around the need for a new green and digital industrial policy for Europe.

A revisiting of EU competition rules should indeed be an important part of developing an EU green industrial policy, as long as the application of competition rules is not just aimed at a 'negative coordination', in which all countries are permitted to intervene in the market as they prefer. Instead there should be a 'positive coordination', in which countries can jointly act in certain green technologies, internalising externalities and exploiting synergies.

An example of 'positive coordination' is the Important Projects

the European Institute of Innovation and Technology.

Of Horizon Europe's budget of close to €100 billion, 35 percent has been allocated to actions aimed at tackling climate change. More generally there is a commitment to use the overall programme to help achieving the United Nations Sustainable Development Goals and to boost EU competitiveness and growth (European Commission, 2019b). Missions and the European Innovation Council are two novel elements in Horizon Europe.

ree out of the ve Missions relate to climate change (Box 3 on the next page). ese can be considered green industrial policy tools, while also responding to the need to create institutionalised processes of collaboration between institutions, civil society and the private sector.

e European Innovation Council (EIC) was created in 2017 as a pilot initiative within Horizon 2020 to fund the most talented radical innovators and help their companies scale up and expand beyond European borders. It was given a budget of around €3 billion for the period 2018-2020, and will be fully implemented from 2021 under Horizon Europe. e EIC could become an important green innovation tool, with a strong mandate in the areas of clean energy, clean mobility and smart buildings.

Box 3: Horizon Europe Missions

I d b eA 11 a a e H E e M a ac e e ba c a e , ce a e a d b d e . T e E ea C c e e de , a d a e e e M . F e e e b a e e defi e c e ca ce c a e ada a , ea c ea a d ea , c a e- e a c e a d ea (e b a- , ee ://ec.e a.e / / - e e/ - - e e). I Se e be 2020, e b a ed e fi e ec fica - -defi ed M .

1. C β eØ Ca ceØM ββ P β be. A eda Øe e β Øe a 3 - β Øe a Øe dea b 2030.
2. AC aeRe e E Ø e. A eda Øe aØ E Ø e β Øc aed Ø β a dacceeØa e Øa β Ø a β β ac aeØ e a d E Ø eb 2030.
3. M ββ S aØ 2030: Re β Øe β Øcea a d Wa e . A eda cea aØ ea d Ø a e , Ø β Ø de Øded ec β e a d ab a a d deca Ø β e b eec β β b 2030.
4. 100 C a e-Ne Øa C e b 2030, b a d Ø ec e . A eda - Ø , Ø β a d β ca 100 E Ø ea c e e β e c Øa Ø a β β c aee e Øa b 2030, a d Ø e ec e β β a β b .
5. CaØ Ø Sβ Ca Ø Ø L e. A eda Ø β Ø d Øac ce β a e a ea 75 e Øe β a β ea Ø Ø d, e β e, a Øea dc aeb 2030.

Se ec ed ββ β a Ø β be e e ed 2021 a aØ β H Ø β E Ø e.

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e EIC is split into two branches: the EIC Accelerator and the EIC Path nder. e Path nder supports breakthrough research projects with grants of up to €4 million. e Accelerator supports SMEs that have new ideas and the potential to scale up. is instrument has a fund of up to €15 million in grants and equity. e EIC Accelerator includes more than 5,500 rms[17]. Of these 922 (17 percent) are in energy and 424 in transportation (8 percent). In 2020, the rst call for projects was opened by the Accelerator programme with a focus on green objectives. e European Commission has identi ed 38 projects

17 is portfolio includes projects that received funding previously under the EU's SME Instrument. Approximately 71 percent of projects in the portfolio received a €50,000 grant under the SME Instrument scheme.

through this call (European Commission, 2020d), which will receive both a grant and equity investment. e Path nder branch at time of writing covers 431 funded projects. Of these, 15 percent are in the areas of energy and environment (Deep Tech Europe, 2020).

e EU Innovation Fund (IF), established under the EU ETS for the period 2021-2030, will support the demonstration of low-carbon technologies and processes in energy-intensive industries, carbon capture and utilisation and storage of carbon dioxide, innovative renewable energy and energy storage technologies. e IF has been endowed with at least 450 million carbon allowances, with a value at carbon price levels at time of writing of about €11 billion. One approach to further scale-up the IF would be to rapidly reduce the number of allowances allocated for free under the ETS, and to use the resulting revenues for the IF.

e European Institute of Innovation and Technology (EIT) is an independent body created by the EU in 2008 to strengthen Europe's ability to innovate. e EIT is an integral part of the EU's Framework Programme for Research and Innovation. e Institute seeks to promote innovation across Europe by helping business, education and research organisations collaborate and work on pressing global challenges. In particular, the EIT supports the development of pan-European partnerships among companies, research labs and universities – so-called EIT Innovation Communities (Knowledge and Innovation Communities, KICs). Each KIC is dedicated to nding solutions to a speci c global challenge. Of the eight KICs at time of writing, at least ve are strongly relevant in the context of green industrial policy: EIT Climate-KIC: Innovation for climate action; EIT InnoEnergy; EIT Manufacturing; EIT Raw Materials; and EIT Urban Mobility. e additional KICs are: EIT Digital; EIT Food; and EIT Health.

7.3.5 Investment

Investment is a key part of a green industrial policy. e EU has at its disposal two main green investment vehicles: its budget

(the Multiannual Financial Framework, MFF) and the European Investment Bank (EIB).

e MFF covers spending areas from agriculture to cohesion, from research and innovation to environment, from single market to security and defence. EU leaders agreed in July 2020 to equip the EU with a budget of €1074.3 billion for the period 2021-2027. ey also agreed on a post-COVID-19 recovery fund, known as Next Generation EU (NGEU), amounting to €750 billion for the period 2021-2024[18]. EU leaders agreed an overall target for 30 percent of the total amount of expenditure from the MFF and NGEU to be climate-related spending.

solutions. It should be noted that the 30 percent climate spending target should be handled carefully and could be overstated. Not all the expenditures considered to qualify for this target will truly be green investment, or even green spending, as a very diverse range of activities will be covered, ranging from agriculture subsidies to research and innovation funding. is likely overstatement is also a result of the lack of a clear methodology for accounting for climate-related expenditures, a point reiterated by the European Court of Auditors (2020).

e development of a strong methodology and reporting system for monitoring climate spending is thus necessary to ensure that climate spending targets are translated into reality.

e EIB is the EU bank, and works, in cooperation with other EU institutions, to promote the development of the EU and to support EU policies within Europe and globally. In 2019, the EIB prioritised climate action, with the aim of becoming Europe's 'climate bank'. It adopted a new energy lending policy and sustainability strategy based on three pillars: i) end of nancing for fossil fuel projects from the end of 2021; ii) future nancing focused on clean energy innovation, energy e ciency and renewables; iii) €1 trillion of climate action and environmentally-sustainable investment up to 2030 (EIB, 2019). It should be noted that the volume of new lending disbursed by the EIB has declined every year since 2015, and its total amount of outstanding loans has fallen as well. e EIB has a margin of manoeuvre to act more forcefully: its capital ratio has gone up in recent years and its leverage has been dropping since 2012. Also, according to its statutes (Article 16.5), it can lend as much as two and a half times its level of subscribed capital (plus reserves and pro ts), which means its portfo-

as collateral and imposing lower capital charges on green assets held by banks. European Central Bank (ECB) president Christine Lagarde has approved use of the ECB's large asset purchase scheme to pursue green objectives. She notably stated that the ECB *"has to look at all the business lines and the operations in which it is engaged in order to tackle climate change, because at the end of the day, money talks"* (*Financial Times*, 2020). In an important speech in July 2020, ECB board member Isabel Schnabel further developed this vision, identifying three major avenues through which the ECB, and central banks more generally, can contribute: i) through the ECB's involvement in de ning rules and standards, and in promoting research for a better understanding of the implications of climate change for nancial markets and monetary policy; ii) by ensuring that the ECB is itself an environmentally mindful and responsible investor, for instance when it comes to its pension fund investments and other non-monetary policy portfolios; iii) by taking climate considerations into account when designing and implementing monetary policy operations. ese issues are at the centre of a vivid debate in monetary policy circles, with some taking the view that central banks must keep market neutrality as their benchmark in purchasing corporate bonds, and others taking the view that central banks should respond to market failures and take into account in their actions the risks that climate change poses to price stability. e outcome of this debate and any eventual decision taken in this eld by the ECB will impact green investment signi cantly in Europe and beyond.

Finally, the EU can become a standard-setter in the green bond market. e global green, social and sustainability-related bond market reached €270 billion in 2019, though the segment remains a niche, representing about 5 percent of the total bond market. However, it is rapidly expanding. Between 2018 and 2019, it grew by 50 percent, and is expected to reach €338 billion in 2020. e EU is the biggest

jump between 2018 and 2019. According to a 2019 survey (Climate Bonds, 2019), 67 percent of respondents said there was a shortage of supply of green bonds. Moreover, respondents specified that regulation is the most effective way to scale-up the green bond market, with the development of a clear taxonomy of what counts as green being a key priority.

7.3.6 EU climate policy

All but one of the EU's member countries have endorsed the objective of EU-wide climate neutrality in 2050. This political commitment has not yet been translated into an operational strategy.

EU climate policy is based on a framework that includes bloc-wide targets and policy objectives for the period from 2021 to 2030. This framework, which also represents the EU contribution to the Paris Agreement, requires a 40 percent greenhouse gas emissions reduction target by 2030 (compared to 1990 levels), as along with renewable energy and energy efficiency targets.

However, the European Commission in September 2020 issued a plan to tighten the emissions reduction target to at least 55 percent by 2030 compared to 1990. The December 2020 European Council approved this target. The EU will now have to revise its climate and energy legislation to accommodate it.

One of the main EU policy tools is the emissions trading system (ETS), which covers emissions from the power sector, industry and intra-EU flights (overall amounting to about 40 percent of total EU emissions). Non-ETS sectors including transport, buildings and agriculture are dealt by the Effort Sharing Regulation (ESR, Regulation (EU) 2018/842), which requires EU countries to pay fines if they fail to reduce emissions by stated amounts.

Increasing the EU carbon price can be achieved by reducing the number of allowances put on the market by member states. This should result in increased revenues for EU countries because the price effect should largely exceed the volume effect. An increase in the

"failing to coordinate would hamper the full exploitation of the size of the EU market and the related economies of scale" (Altomonte and Veugelers, 2019).

e second, more speci c, tool is public procurement. In the EU, this is estimated to amount to about 16 percent of GDP (European Commission, 2018). Given its scale, public procurement represents a unique tool to foster innovation. For example, with the revised Clean Vehicles Directive ((EU) 2019/1161), the EU introduced national targets for public procurement of electric and low-emission buses and other vehicles. Such measures are important in boosting demand and promoting further deployment of low- and zero-emission vehicles. According to OpenTender data, in 2018 European countries procured transport equipment (including passenger cars, vans, buses and trains) for a total value of almost €19 billion. Assuming that most of this public procurement is devoted to motor vehicles, it is interesting to compare this gure with EU's electric car market, estimated in the same year at €13 billion[19]. is illustrates the order of magnitude of the role EU public procurement could play in creating a lead market for clean vehicles. Requiring clean mobility solutions in public procurement tenders can also support the transformation of the European automotive industry and could be a case of EU green industrial policy working.

Similar provisions could be introduced in the construction sector, which stands out as a sector in which European governments are important buyers, with about €100 billion in purchases per year. Such measures would contribute to the refurbishment and improvement of the building stock in the EU, which plays a central role in decarbonisation strategies, as the building sector is one of the largest energy

19

consumers in Europe, responsible for more than one third of the EU's emissions. Furthermore, such measures could represent a major opportunity to create jobs and boost the construction sector, which is largely dominated by local businesses, while strengthening Europe's industrial competitiveness.

ese two complementary tools – common environmental standards and green public procurement – can foster the emergence of the necessary ecosystem that will enable innovative green European companies to grow in a receptive single market.

7.3.8 Development policy

e EU produces less than 10 percent of global greenhouse gas emissions. is implies that to have an impact on global temperature levels, the EU needs to push its green objectives beyond its borders – also to achieve green industrial policy objectives. An important step in this direction was the European Commission's proposal in 2018 for a Neighbourhood, Development and International Cooperation Instrument (NDICI, COM (2018) 460). Starting in 2021, NDICI will bring together EU funding for its external policies in a single instrument. A quarter of the NDICI budget would be earmarked for climate action. With this tool the EU can increase its visibility and leverage in developing countries, notably in the promotion of green projects. Another important step would be to further consolidate and streamline EU development nance and climate activities outside Europe, which are today divided between the European Commission, the EIB, the European Bank for Reconstruction and Development and EU countries.

8 Conclusions and policy recommendations

the process to promote more risk taking. ird, exible policy design is required to cope with the uncertainties of new green technologies, with clear intermediate targets and milestones that can be monitored in order to strengthen policy measures over time. Fourth, it is key to ensure accountability, with incentives and penalties where needed.

Implementing all this requires strong governance, which should be based on three principles: competence, ownership and political independence. is could be provided through a governance body

instruments, such as Green Missions and IPCEIs. is czar would be able to select a dedicated EU green industrial policy unit and advisory board, with external experts from industry, academia and civil society.

e czar leader should be given clear and realistic targets, and milestones, for which (s)he can be held accountable, and which also allow for risk-taking and failures.

e advantages of this approach include the ability to nd new creative solutions, go outside formal channels, and an ability to involve multiple di erent players in big-issue decision-making. ese advantages would suit very well the governance challenge presented by EU green industrial policy.

8.2 Tackling geographical fragmentation

European green industrial policies remain highly fragmented, with a vast number of initiatives being undertaken at EU, national and regional levels with little to no coordination. Signi cantly di erent green industrial policies in di erent countries could undermine the level playing eld in Europe – and thereby fragment the EU single market. us strong EU coordination is needed. Strong coordination at EU level also is of paramount importance to bene t from synergies from various local policy initiatives. Fragmentation exists in local industrial policy initiatives to support green technologies, and in local climate-change policy initiatives related to, for example, environmental standards or energy taxation. A fragmented EU single market for clean technologies and markets holds back innovative European cleantech companies from scaling up in the way that their US and Chinese competitors do on their domestic markets. It is vital to develop a solid regulatory framework, ensuring access to a truly single, competitive EU market with common environmental standards. e current fragmentation ultimately hampers the full exploitation of the size of the EU market and the related economies of scale.

e EU level can tackle geographical fragmentation of green industrial policy in three ways: through state aid control, the European

of ETS allowances given out for free (a concern for industry), how to deal with transport (inclusion in the ETS versus national taxation), how to use ETS revenues (EU own resources versus national green investments and mitigation of the distributional e ects of climate policy), and how to design a functional carbon border adjustment mechanism. EU legislation on renewable energy and energy e ciency will also need a substantial upgrade. EU 2030 targets for renewable energy and energy e ciency at time of writing (respectively, a 32 percent share of nal energy consumption, and a 32.5 percent improvement against a baseline) will only deliver greenhouse gas emissions reductions of 45 percent by 2030. e EU must nd ways for its countries to deliver on higher targets in the absence of nationally binding commitments, and for private investment to be really mobilised (one example is simpli cation of permitting procedures for renewables). Other important areas of EU legislation, including transport and agriculture, will have to be revised to push the decarbonisation of these sectors.

Delivery of this legislative framework will be critical for the development of a strong EU green industrial policy. It should be noted that the di erence in time horizons between policy planning and political cycles makes achieving coherent and sustained green industrial policy e orts extremely challenging. In this sense, clear climate targets – particularly if enshrined into law – also protect green industrial policy from signi cant uncertainty.

8.4 Development of sound public-private partnerships

To develop a successful green industrial policy, the EU has to be embedded with the private sector. Public-private partnerships are not only about activating co-funding, but are also ways to access skills, knowledge and information. is requires a high degree of interaction between the public and private sectors, and collaboration should be iterative since the solutions are not assumed as known, but only as discoverable. e literature and case studies show that the design of

public-private partnerships can take di erent forms. Deliberation councils, investment advisory councils, round tables, public-private venture funds and smart development banks are all examples of ways in which governments can make operational the principles described above.

Our recommendations on EU green industrial policy governance include a strong element of private embeddedness. In parallel, we recommend expanding the use of the European Alliances format, which has already been employed since 2017 for batteries and since 2020 for clean hydrogen. ese Alliances are important public-private collaborations at EU level and should become key tools for EU green industrial policy. Important Projects of Common European Interest (IPCEI) are a core element of European Alliances. A further broader and deeper application of IPCEI should be considered, to make the best of this tool.

e principles for a new green industrial policy should serve as guidelines when selecting and governing new alliances. Alliances should focus on addressing mega-problems covering the whole value chains of all relevant clean markets, rather than solving more discrete problems. e Hydrogen Alliance is already broader than the quite narrow Battery Alliance. EU green industrial policy should also employ a balanced mix of alliances involving already-connected value chains that need to be scaled-up and very early-stage emerging value chains with still-to-be-connected stakeholders, even if the latter are higher risk choices that will result in higher failure rates.

To ensure a competitive environment in which innovation is stimulated in the new clean markets created and supported by the EU's green industrial policy, and to avoid rent seeking, the EU should use its competition policy toolbox, while ensuring that the competition policy arm of the Commission has su cient dedicated expertise on clean technologies and markets.

8.5 Stimulating EU green investment

EU green investment will be important to realise the green transition, including by mobilising funds from the national budgets of EU countries and from the private sector. e EU decision to devote 30 percent of its budget for 2021-2027 to climate action is good news. But this goal should be handled carefully. First, it will be important to ensure that the remaining spending does not go against the green targets, requiring a mainstream green monitoring of the EU budget and of Next Generation EU funding. Second, with current EU accounting rules, there is a risk the climate-related spending will be overstated. Not all these expenditures can be considered green investment, or even green spending, as they are very diverse, ranging from agricultural subsidies to research and innovation funding. For all these reasons, the EU should develop a solid methodology for monitoring climate spending, and to report on it annually (Claeys and Tagliapietra, 2020). is will be important to ensure that the 30 percent target is realistically re ected in spending choices – and thus contributes to the scaling-up of the investment component of EU green industrial policy.

e EIB should be allowed to do more on climate action. e EIB currently bene ts from very favourable rates for borrowing from capital markets and it would be a shame not to use this opportunity to nance worthwhile projects that can contribute to the ght against climate change. If EU countries are (unduly) worried about the EIB's rating, a capital increase should be carried out. e European Council of July 2020 invited the EIB Board of Governors to review exactly this issue. is represents an important opportunity to take a step towards making the EIB into Europe's true 'climate bank'. e EIB should also be supported in further developing its role as intermediary to address network and information imperfections, in order to become a true 'smart climate development bank'.

e European Central Bank can help unleash the nances required for the green transition by using its operations – such as its large asset purchase scheme – to pursue green objectives.

8.6 Stimulating EU green science and innovation

e EU needs to invest more in green innovation. It currently invests less in climate-related R&D than the United States and China. To truly develop a green industrial policy, the EU must leverage its public resources and toolkit to scale-up national and regional public resources that go into climate innovation, but especially private investment in climate innovation. e decision to earmark 35 percent of the Horizon Europe budget to climate innovation is welcome, but, as in the case of green budget spending, it will be necessary to ensure that the remaining 65 percent does not end up working against green targets.

It should be emphasised that fostering green innovation is not only about availability of public nance resources. It is also about allocating public nance to the best areas and projects, meaning those with the largest socio-economic and climate returns that could not have been reached without public support. In this respect, particular emphasis should be placed on high-risk, early stage technologies with potential for general-purpose breakthroughs. Green innovation requires a signi cant dose of risk-taking by public institutions, and an acceptance that there will be failures. New support models that provide numerous and still sizeable grants in a relatively non-bureaucratic way are crucial to unleash frontier ideas. Green industrial policymaking should avoid deploying money only to safe bets with only average returns. In this sense, a new green industrial policy should be a portfolio, with some initiatives within the portfolio failing along the way. A portfolio with

Within Horizon Europe, new climate change missions should be considered beyond the current three (box 3 in chapter 7). e Horizon

A European Climate and Sustainable Development Bank could indeed become an important tool for exporting the European Green Deal, and thus a key tool of EU green industrial policy. Such an approach would first help meet the EU's climate finance obligations and thus achieve the conditional emission-reduction commitments proposed by most developing countries under the Paris Agreement. Second, it would enable EU industry to enter new, rapidly growing markets, a win for EU green industrial policy. Third, it would help economic development in the EU's partner countries, providing an invaluable foreign policy dividend for the EU.

A second-best, and perhaps more realistic, solution would be to establish a one-stop-shop through which all EU (and eventually also national) funding for development is channelled or at least described in a consistent manner. It would be a platform to make it easier for third parties to access these European development funds, and to provide a clear overview about who is doing what in Europe in the field.

8.8 Communicate transparently

Green industrial policy, like any form of industrial policy, brings with it the risk of political capture, and all the risks that generally lie at the intersection of the public and the private sectors. Transparency is critical throughout the whole process of green industrial policy development, and should include roadmaps and clear government communication. A process of open policy dialogue on the part of the EU should ensure a high degree of accountability, which is critical to the success or failure of green industrial policy. Getting citizens on board through transparent communication will provide more involvement, legitimacy stability to green industrial policy initiatives.

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